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Managing new and emerging risks in the context of ISO 45001 standard

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Abstract

In the last years the world economy is characterized of important changes that have effects at macro economic level as well as at organization's level. These effects include the increasing of previous known risks and the rising of new risks due to new technologies, advances in scientific research and changes in social or public perceptions. In many cases, enterprises are not prepared to deal with new and emerging risks and this issue represents a main challenge for the employer and the organization management system. It is well known that failure of OHS management system can have serious consequences on the quality management system and also on the environmental management systems. The new standard ISO 45001 "Occupational health and safety management systems – Requirements with guidance for use" (planned for first release in 2016, now in draft version) could be an important instrument for employer to deal with new and emerging risks. The aim of the paper is to present how the requirements of the ISO 45001 standard could be used to design processes that allow the organization to prevent or reduce the undesired effects of new and emerging risks. The positive effects of controlling these risks address not only the OHS issues but also the quality and environmental requirements of the organization.

Keywords: new and emerging risks; occupational health and safety; risk assessment; management system; quality management system; environmental management system

1. Introduction

In the last years, the image and the perception of risk in the occupational health and safety (OHS) domain has considerably changed due to the influence of several technological, scientific or social factors. These changes have effects at macro economic level as well as at organization's level, including the increasing of previous known risks and the rising of new risks. An emerging OHS risk is defined as any occupational risk that is both new and increasing (Cioca and Moraru, 2010; Houtman et al. 2016). According to the definition, a risk is new if:

- "the risk was previously unknown and is caused by new processes, new technologies, new types of workplaces or social or organizational changes, or
- a long standing issue is newly considered to be a risk due to changes in social or public perceptions; or
- new scientific knowledge allows a long standing issue to be identified as a risk".

Also, the risk is increasing if:

- "the number of hazards leading to the risk is growing; or
- the likelihood of exposure to the hazard leading to the risk is increasing, or
- the effect of the hazard on the worker's health is getting worse (seriousness of health effects and/or the number of people affected)".

For example, ageing of population is one of the main issues of the social changes. The population across the EU has been ageing significantly over the last decades and this evolution will continue and intensify in the next decades. The

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EU average age was 33 years in 1960, will be 44 years in 2020 and 46 years in 2060 (EU-OSHA, 2015). As a consequence, employers have to hire older workers and the people have to work longer. Thus, the risk of musculoskeletal disorders, cardiovascular or respiratory diseases increases. In the same time, the employer has to take in consideration the natural alteration of functional capacities of the worker and the necessity to adapt the workplace to these changes.

Another example is engineered nanomaterials, characterized by the size of particles between 1 and 1000 nanometers. Due to specific size, nanomaterials have unique properties that improve the performance of many products and generate applications in many industrial sectors such as medicine, automotive, chemicals or construction. The new risk of nanomaterials is generated by their property to enter the body by the digestive system, respiratory system or the skin, to locate far from the entry point, crossing cells membranes and representing a toxicity factor by its accumulation.

An important characteristic of the new and emerging risks is that their potential consequences are not fully known, in contrast to the “classic” risks which are well assessed and efficient prevention measures are available for implementation.

The importance of controlling new and emerging risks is recognized at European level. Thus, the European Agency for Safety and Health at Work (EU-OSHA) establishes in its Multi-annual Strategic Programme 2014-2020 the strategic objective 1 “The provision of credible and good quality data on new and emerging risks that meet the needs of policy-makers and researchers and allow them to take timely and effective action”. The reason of this strategic objective is sustained by the fact that in many cases, enterprises are not prepared to deal with new and emerging risks and this issue represents a main challenge for the employer and the organization management system. Also, the enterprises are equally exposed to new and emerging risks, regardless their size.

The lack of control of the new and emerging risks generates failure of OHS management system that can have serious consequences, due to “domino effect”, on the quality management system and also on the environmental management systems, affecting the image of the enterprise, their position relative to competitors, financial performance and the interests of stakeholders. To avoid such a situation, the employer could use the new standard ISO 45001 “Occupational health and safety management systems – Requirements with guidance for use” (planned for first release in 2016, now in draft version) as an important instrument to deal with new and emerging risks.

2. ISO 45001 – an important instrument to manage new and emerging risks

Following the OHSAS 18001, the new standard ISO 45001 “Occupational health and safety management systems – Requirements with guidance for use” represent an important reference, together with ISO 9001 and ISO 14001, to build an integrated quality-environmental-health and safety (QEHS) management system at organization level (Fig.1).

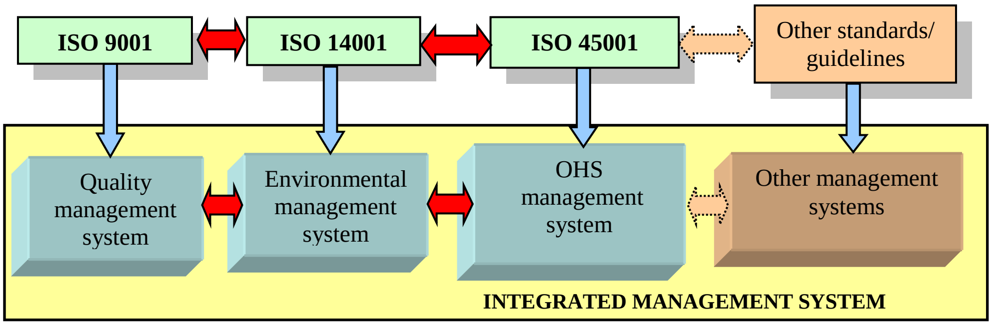

Fig.1. QEHS integrated management system

In an integrated QEHS management system, the components (quality, environment and OHS) are interrelated, any failure in one components could produce significantly negative effects on others components. For example, a lack of operational control on trucks fleet of a chemicals transport company could lead to a traffic accident and generate in the same time an OHS problem (a work accident), an environmental problem (by spilling the chemicals) and a quality problem (an unsatisfied client). In this example, the potential cause of the accident could be related to the age of the driver (e.g. health problems, alteration of the functional capacities), to the psychosocial issues (e.g. stress) or organizational aspects (routes planning, shorter deadlines, increasing competition etc.). All these potential causes of the accident represent examples of new and emerging risks that could efficiently be controlled in an integrated management system.

2.1. Context of the organization

As a part of plan process, ISO 45001 require the organization to "determine external and internal issues that are relevant to its purpose and that affect its ability to achieve the intended outcomes of its OHS management system" (ISO 45001, 2016). Organization should include among the external issues elements generating new and emerging risks such as globalization, increasing competition, demographic changes, migration or ageing of the population. Internal issues in relation with new and emerging risks that organization should address are introduction of new technologies, changes in organizational structure, working time arrangements or the form and extent of contractual relationships, including for example outsourced activities.

In the same time, the organization should understand "the need and expectations of workers and other interested parties". The need and expectation of workers depends on many factors such as: age, education level, organizational culture, social and economic local context etc.

Other interested parties to an OHS management system can include: authorities, parent organizations, suppliers, contractors, workers' organizations (trade unions), employers' organizations, owners, stakeholders etc. (ISO 45001, 2016). The need and expectations of these interested parties could change rapidly and significantly as an adaptation to technological, social and economic changes which are relevant to the organization.

2.2. Participation and consultation

ISO 45001 provide that "the organization shall establish, implement and maintain processes for participation (including consultation) in the development, planning, implementation, evaluations and actions for improvement of the OHS management system by workers at all applicable levels and functions, and where they exist, workers' representatives". In this context, the organization should focus on the participation of non-managerial workers in:

- hazard identification and risk assessment;
- actions to control hazards and risks;
- determining control measures and their effective use.

The role of participation and consultation of the non-managerial workers in management of the new and emerging risks is very important, because these workers could provide essential information about their perception on the issues such as musculoskeletal hazards, psychosocial risks or sensibility to certain work conditions. Also, by participation and consultation, employer could receive information from workers related to their extra-professional issues (health, personal or social aspects) that could affect the professional life. As some of these issues could represent confidential information (e.g. nature of ill, drugs or alcohol dependence), the role of the medical services and psychologist is very important in order to provide the employer with anonymous but still relevant data. One of the most valuable instrument to collect information in the process of participation and consultation regarding risk exposure is the checklist. For example, a checklist for identification of psychosocial hazards could be structured on the issues represented in Table 1 (EU-OSHA, 2012).

Table 1. Psychosocial hazards

Issue	Psychosocial hazards
Job content	Lack of variety or short work cycles, fragmented or meaningless work, under-use of skills, high uncertainty, continuous exposure to difficult clients, patients, pupils etc.
Workload and work pace	Work overload or too little work, machine pacing, high levels of time pressure, continually subject to deadlines
Work schedule	Shift work, night shifts, inflexible work schedules, unpredictable hours, long or unsociable hours
Control	Low participation in decision-making, lack of control over workload, pacing, shift working etc.
Environment and equipment	Inadequate equipment availability, suitability or maintenance, poor environmental conditions such as lack of space, poor lighting, excessive noise
Organizational culture and function	Poor communication, low levels of support for problem solving and personal development, lack of definition of, or agreement on, organizational objectives
Interpersonal relationship at work	Social or physical isolation, poor relationships with superiors, interpersonal conflict, lack of social support, harassment, bullying, third-party violence
Role in organization	Role ambiguity, role conflict and responsibility for people
Career development	Career stagnation and uncertainty, under-promotion or over-promotion, poor pay, job insecurity, low social value of work
Home-work interface	Conflicting demands of work and home, low support at home, problems relating to both partners being in the labour force (dual career)

2.3. Hazard identification and assessment of OHS risks

ISO 45001 require the organization to “establish, implement and maintain a process for the on-going proactive identification of hazard arising”. The OHS risks should be assessed taking into account “applicable legal requirements and other requirements and the effectiveness of existing controls”.

Also, the organization’s methodology and criteria for assessing the OHS risk should take in consideration new and emerging risks. For example, an older worker has statistically a lower probability to suffer a work accident than a younger worker, but the consequences could be more serious comparative with a younger worker. In the same time, the OHS risk level for an older worker is affected by the natural changes of functional capacities.

Another relevant aspect is that the “classic” risk assessment methodology could not be suitable for assessing some of the new and emerging risks. For example, assessing the psychosocial risks requires specific instruments and requires the contribution of a psychologist and a medical doctor.

2.4. Operational planning and control

Operational planning and control have an important role in managing the identified risks, including the new and emerging risks, and to prevent the situations of failure not only for OHS management system, but also for quality and environmental management system.

2.5. Management of change

ISO 45001 require the organization to “establish a process for the implementation and control of planned changes that impact OHS performances”. A special attention should be paid to issues that could generate new and emerging risks, such as new products, processes, services or technology.

3. Conclusion

The important changes produced at the organization level as the effect of new and emerging risks, in many cases, find enterprises not prepared to deal with this new situation and this issue represents a main challenge for the employer and the organization management system. The difficulty of managing new and emerging risks is generated by the fact that their potential consequences are not fully known.

In this context, ISO 45001 standard is a valuable instrument that could be used to design processes that allow the organization to prevent or reduce the undesired effects of new and emerging risks. The positive effects of controlling these risks address not only the OHS issues but also the quality and environmental requirements of the organization.

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Increasing of the occupational safety and health performances, according to ISO 45001, with respect of the Regulation (EC) no 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

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Abstract

This paper aims to presenting issues related to the increasing of the occupational safety and health (OSH) performances, according to ISO 45001, of the organizations manufacturing or importing chemicals, with respect of the Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), amounts between 1 and 100 tonnes per year. Specific chemical risks assessment methods are presented in order to ensure workers protection through suitable protective and preventive measures.

Keywords: occupational safety and health management, REACH registration, evaluation, authorisation of chemicals, social responsibility, sustainable development

1. Introduction

This paper aims to presenting issues related to the increasing of the occupational safety and health (OSH) performances, according to ISO 45001 and in compliance with the sustainable development principles according to Directive 2014/95/EU, of the organizations manufacturing or importing chemicals, with respect of the Regulation (EC) No 1907/2006 on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), amounts between 1 and 100 tonnes per year. Specific chemical risks assessment methods are presented in order to ensure workers protection through suitable protective and preventive measures.

2. Presentation

According to the European Agency of Safety and Health at Work, every year 142,400 people die in EU because of occupational diseases and 8,900 of work accidents (EU-OSHA, 2014), many of them related to the chemicals. According to the latest Eurostat data (Eurostat, 2014), in 2012, there were just under 2.5 million non-fatal accidents that resulted in at least four calendar days of absence from work and 3,515 fatal accidents in the European Union. These figures marked a substantial reduction in relation to 2009, when there had been approximately 313 thousand more non-fatal accidents and 310 more fatal accidents.

A performing management system allows the business to develop efficiently and profitably, providing the means to organize people, resources and processes to meet every designed objective. Once the integrated management system of quality, environment and safety and health at work is in place excellence can be achieved (Manuc et al, 2015). The new standard ISO 45001 currently developed by a committee of occupational health and safety experts, and following the

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other generic management system approaches such as ISO 14001 and ISO 9001 will provide to the organisations an internationally recognised occupational health and safety standard to follow.

This new standard will provide the specification for formal, systematic analysis and management of risk, management of regulatory compliance, promotion of safer work practices, and evaluation of occupational health and safety performance, in order to facilitate a decrease in the number of incidents. Occupational safety and health performances integrates also into the sustainable development concept and represents a new challenge for companies within the publication of the Directive 2014/95/EU modifying Directive 2013/34/EU.

The Directive states that large undertakings which are public-interest entities exceeding on their balance sheet dates the criterion of the average number of 500 employees during the financial year shall include in the management report a non-financial statement containing information to the extent necessary for an understanding of the undertaking's development, performance, position and impact of its activity, relating to, as a minimum, environmental, social and employee matters, respect for human rights, anti-corruption and bribery matters (Directive 2014/95/EU).

The Commission shall consult relevant stakeholders and shall prepare non-binding guidelines on methodology for reporting non-financial information, including non-financial key performance indicators, general and sectorial, with a view to facilitating relevant, useful and comparable disclosure of non-financial information by undertakings, by 6th December 2016. Member States will apply the provisions of this Directive to all undertakings for the financial year starting on 1st January 2017 or during the calendar year 2017.

A Ministerial Order is preparing by the Public Finance Ministry in order to implement the provisions of the Directive 2014/95/EU reflecting the non-financial statement included by the large undertakings in the management report. This order will be applied starting 1st January 2017 (Ministerial order project, august 2016).

According to REACH Regulation, if a company manufacture or import chemical substances from outside the EU above one tonne per year, it have registration obligations under REACH. Additionally, if a company manufacture or import a product (mixture, article), it may contain substances that need to be registered individually. The REACH registration deadline is 31 May 2018 for pre-registered substances manufacture or import from outside the EU above one tonne but not more than 100 tonnes per year. The late pre-registration deadline is 31 May 2017 for the substances not yet pre-registered.

Regarding this new approaches on occupational safety and health management, chemical risks assessment, social responsibility, and sustainable development it is interesting to mention that The National Research&Development Institute on Occupational Safety – INCDPM 'Alexandru Darabont' Bucharest participated in international projects as Phare-RO Twinning Project, France, 2004-2006 – Planning and Implementing a National Occupational Risk Assurance System; Topic Centre Enlargement Action, 2005, European Agency for Safety and Health at Work - observer status; Topic Centre New Member States, 2004-2005 European Agency for Safety and Health at Work - observer status; Phare OSHA - Topic Centre on Good Practices for Candidate Countries, 2003-2004 – Task Leader for Dangerous Substances.

Experts from the institute has also developed projects and articles on social responsibility starting 2007, before the release of *ISO 26000 Guidelines on social responsibility*. Social responsibility and improving health and safety performances in the healthcare sector issues were developed by our institute in National Research Programme and Structural Programme, between 2008-2014.

In the same time, two experts of INCDPM 'Alexandru Darabont' are members of the National Commission on Occupational Health&Safety for hazardous chemical agents (on occupational exposure limit values) according to MS/MMFPS Order no. 1297/2096/2011) and one expert is co-opted member of Committee for Risk Assessment (RAC) of the European Chemicals Agency (ECHA) since 2015.

3. Methods and results

The preparing of a registration dossier for the chemical substance involves the assessment of the hazards and risks of the chemicals. It is necessary to collect all available information, compare them with the legal requirements, identify any potential data gaps and demonstrate the safe use of the substance.

Regarding the relevant physicochemical, toxicological and ecotoxicological information, there are five main types of information needed:

- the substance identity information
- physical and chemical properties of the substance
- environmental properties of the substance
- human health properties of the substance
- uses and conditions of use of the substance from manufacture to waste (ECHA Newsletter, 2016).

These information can be collect from a variety of sources, as company, databases, sources in literature or on the internet. The relevant information for the registration depend on the volume of the substance manufacture or import.

For low tonnage (1 to 10 tonnes per year) data on up to 22 properties applicable to the substance are necessary. For the 10 to 100 tonnes per year, additional information on up to 13 properties are needed. Testing for specific information can be avoided if it is technically not possible to conduct the study due to the properties of the substance (for example, very volatile or highly reactive substance).

The hazard data and classifications should be recorded in the registration dossier. In some cases, different classifications are possible for the same substance because of different impurities influencing the classification. For the manufacture or import more than 10 tonnes per year, a chemical safety assessment (CSA) and a chemical safety report (CSR) is needed.

In order to help the companies to undertake the chemical safety assessment (CSA) and to provide relevant data to demonstrate the safe use of the substance, some exposure models and tools were developed by different organisations. Information regarding these models are presented in this paper.

One of them is CHEmical **S**afety **A**ssessment and **R**eporting tool (Chesar), developed by the European Chemicals Agency (ECHA) to help companies to carry out their chemical safety assessments (CSAs) and to prepare their chemical safety reports (CSRs) and exposure scenarios (ESs) for communication in the supply chain (ECHA/Chesar, www.echa.eu).

The chemical safety report (CSR) documents the chemical safety assessment (CSA) undertaken as part of the REACH registration process, and is the key source from which the registrant provides information to all users of chemicals through the exposure scenarios. It also forms a basis for other REACH processes including substance evaluation, authorisation and restriction.

The chemical safety assessment is carried out to demonstrate that the risks from the exposure to a substance, during its manufacture and use, are controlled when specific operational conditions and risk management measures are applied. These conditions of use of a substance constitute the exposure scenario, which is an essential component of the chemical safety report. The chemical safety report should be understandable and it should include all the relevant information for the chemical safety assessment. The principles applied in the hazard and exposure assessments, the assumptions made and the conclusions drawn should be transparent and well documented. The key data should be easily identifiable without the need to revert to the underlying substance datasets (IUCLID substance dataset).

The elements to be included in the chemical safety report are presented in Annex I, section 7 of REACH regulation.

An exposure scenario is a set of conditions that describe how a substance is manufactured or used, and the measures necessary to control exposure to humans and releases to the environment. The final exposure scenario defines the operational conditions and risk management measures required to ensure the safe use of the substance for each exposed population during all the lifecycle stages of the substance, including the waste stage and the article service life, where applicable. It is achieved through refinement of the operational conditions and risk management measures until the risks for humans and the environment are shown to be controlled.

The final exposure scenario should be documented in a standard way to accurately describe the conditions of use to promote adequate and achievable risk management measures. The relevant exposure scenarios will be communicated to downstream users via the extended safety data sheets.

For substances registered at and above ten tonnes per year, which meet the classification criteria, each identified use of a substance should have an exposure scenario that will document all the relevant routes of exposures and releases associated with that use.

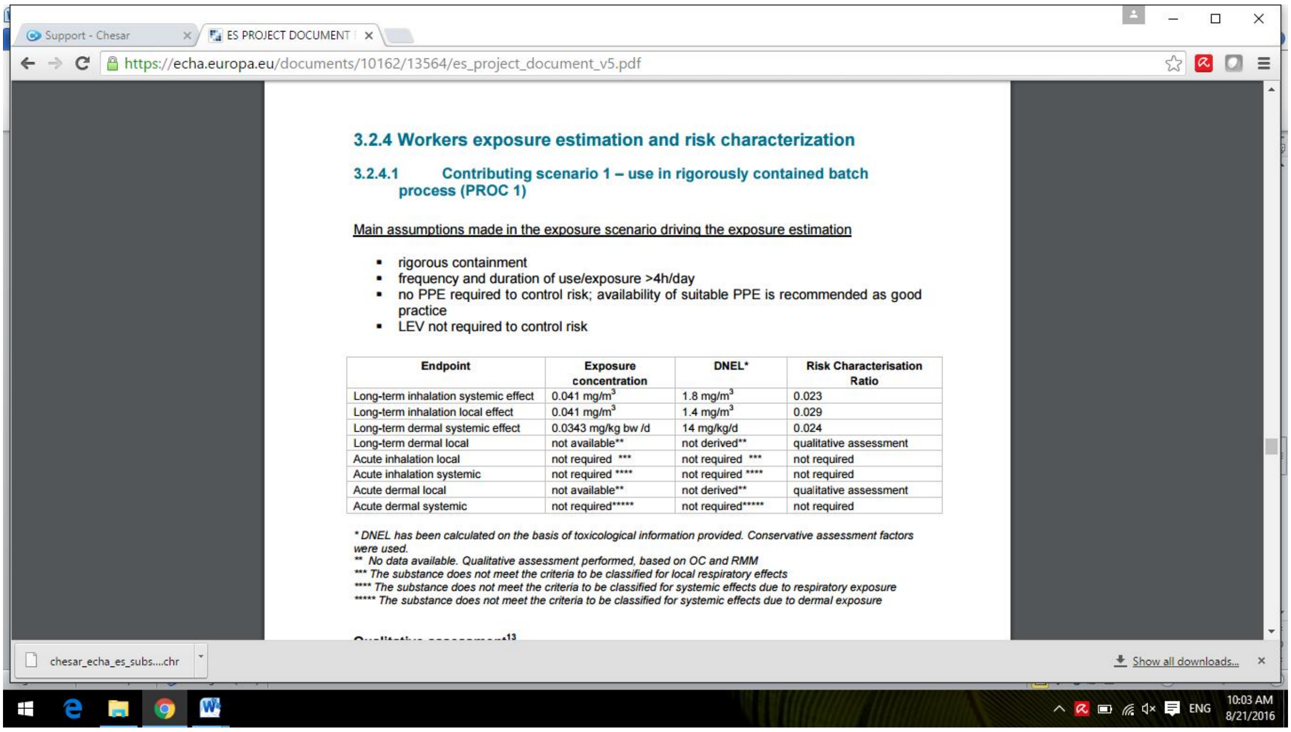
Chesar application help registrants to carry out their safety assessments in a structured, harmonised, transparent and efficient way. The substance-related data are imported directly from IUCLID data-base, describing the uses of the substance, carrying out exposure assessment including identifying conditions of safe use, related exposure estimates and demonstrating control of risks. Based on this, Chesar automatically generates the CSR and exposure scenarios for communication as a text document, and export information on use and exposure to IUCLID. Chesar also facilitates the re-use (or update) of assessment elements generated or imported from external sources. To use Chesar, we need to have sufficient information available on the properties of the substance, the uses of the substance, the related tonnages and the conditions under which the uses take place. Based on these inputs, it will be defines the conditions of safe use, calculates (and/or reports) the corresponding exposure estimates and compares the estimated exposure to the predicted no-effect concentrations for environment (PNECs) and the derived no-effect levels human health (DNELs).

Workers and consumers exposure estimations provided by Chesar are calculated using the ECETOC TRA tool (available on http://www.ecetoc.org/tra).

Environmental exposure estimates provided by Chesar are based on the EUSES 2.1 model. The release estimates can be based on Environmental Release Categories (ERCs), release factors or Specific Environmental Release Categories (SpERCs).

Chesar also supports the assessments based on other exposure estimation tools or measured data. Chesar can be used for qualitative assessments when predicted no-effect-levels are unavailable for certain hazards.

The most recent version of Chesar is Chesar 3, which supports assessment of complex cases such as substances that transforms, multiconstituent, where groups of constituents behave differently or substances available in several forms/compositions with different hazard profile.



3.2.4 Workers exposure estimation and risk characterization

3.2.4.1 Contributing scenario 1 – use in rigorously contained batch process (PROC 1)

Main assumptions made in the exposure scenario driving the exposure estimation

- rigorous containment
- frequency and duration of use/exposure >4h/day
- no PPE required to control risk; availability of suitable PPE is recommended as good practice
- LEV not required to control risk

Endpoint	Exposure concentration	DNEL*	Risk Characterisation Ratio
Long-term inhalation systemic effect	0.041 mg/m^3	1.8 mg/m^3	0.023
Long-term inhalation local effect	0.041 mg/m^3	1.4 mg/m^3	0.029
Long-term dermal systemic effect	0.0343 mg/kg bw /d	14 mg/kg/d	0.024
Long-term dermal local	not available**	not derived**	qualitative assessment
Acute inhalation local	not required ***	not required ***	not required
Acute inhalation systemic	not required ****	not required ****	not required
Acute dermal local	not available**	not derived**	qualitative assessment
Acute dermal systemic	not required*****	not required*****	not required

** DNEL has been calculated on the basis of toxicological information provided. Conservative assessment factors were used.*
*** No data available. Qualitative assessment performed, based on OC and RMM*
**** The substance does not meet the criteria to be classified for local respiratory effects*
***** The substance does not meet the criteria to be classified for systemic effects due to respiratory exposure*
****** The substance does not meet the criteria to be classified for systemic effects due to dermal exposure*

Fig. 1. Example of an exposure scenario generated using Chesar (Source: echa.europa.eu/web/guest/support/practical-examples-of-exposure-scenarios)

The consumer exposure models can be categorized into various tiers. In general models with an higher tier are more complex and realistic models. The exposure models evaluating exposure assessment under REACH are the ECETOC TRA, MEASE, EMKG-Expo-Tool and Stoffenmanager. The ECETOC tiered risk assessment (TRA) tool is, within the REACH guidance, the tiered (step by step) approach for calculating the exposure to and risks from chemicals that might reasonably be expected in defined circumstances of use. The ECETOC TRA Consumer Tool is a first (lower) tier tool that allows calculation of consumer exposures to substances that are present in preparations and articles used by consumers (www.ecetoc.org/tra). The ECETOC TRA is also the basis for the worker and consumer exposure estimates used within the European Chemicals Agency's (ECHA) CHESAR (Chemical Safety Assessment and Reporting tool).

The ECETOC Targeted Risk Assessment (TRA) tool was launched in 2004. The TRA consists of 3 separate models for estimating exposures to workers, consumers and the environment during a series of events ('exposure scenarios'), according to Chapters R12-R16 of the ECHA Technical Guidance on Information Requirements and Chemicals Safety Assessment (IRCSA).

The new version 3 of the TRA incorporates a number of enhancements in each of the worker, consumer and environmental sections of the tool. Version 3 of the TRA is available in two forms: as an integrated exposure risk assessment tool covering worker, consumer and environmental exposures; and as a standalone consumer exposure estimation tool. An improvement of the ECETOC TRA consumer exposure tool has recently been published by the European Solvent Industry Group (ESIG) (http://www.esig.org/en/regulatory-information/reach/ges-library/consumer-gess).

Another model used for the exposure assessment of the substances is the Advanced REACH Tool (ART) version 1.5, developed in a consortium made by HSE, TNO, BAUA, IOM, Forskning, and IRAS which incorporates a mechanistic model of inhalation exposure and a statistical facility to update the estimates with measurements selected from an in-built exposure database or the user's own data. This combination of model estimates and data produces more refined estimates of exposure and reduced uncertainty.

The ART project has been conducted in close collaboration with a range of stakeholders from industry and member states. The use of ART for workers exposure assessment under REACH is described in ECHA's updated Guidance on Information Requirements and chemical safety assessment. ART is currently calibrated to assess exposure to inhalable dust, vapours, and mists. ART model cannot be used for the assessment of fumes, fibres, gases, and dust resulting from emissions during hot metallurgical processes.

Implementing the new referential ISO 45001 DIS will allow the companies working under REACH regulation compliance with legal provisions and a correct reporting of the key performance indicators regarding business (Directive 2014/95/EU).

The new concepts as context of the organisation, leadership and documented information are generally thought to be the more significant new concepts. ISO/CD 45001 includes some enhanced requirements. ISO/CD 45001 places more emphasis on risk management and ongoing assessment of risks and opportunities to prevent, or reduce, undesired effects. In combination these measures will ensure that an organization's reputation as a safe place to work will be promoted, and can have more direct benefits, such as :

- improving its ability to respond to regulatory compliance issues
- reducing the overall costs of incidents
- reducing downtime and the costs of disruption to operations
- reducing the cost of insurance premiums
- reducing absenteeism and employee turnover rates
- recognition for having achieved an international benchmark (which may in turn influence customers who are concerned about their social responsibilities) (Manuc et al., 2015).

The organization shall continually improve the suitability, adequacy, and effectiveness of the quality management system. Identification of risks and actions to address these risks is a requirement, but a risk management system is not(Nisipeanu et al., 2014).

ISO 45001 will give to the organisations an internationally recognised occupational health and safety standard to follow. This standard provides the specification for formal, systematic analysis and management of risk, management of regulatory compliance, promotion of safer work practices, and evaluation of occupational health and safety performance.

4. Conclusions

The new EU framework program for research and innovation during the period of 2014-2020 will provide financing opportunities to approach the social challenges in the areas of health, demographic changes and wellbeing.

This paper presents the importance of the workers and environmental exposure assessment related to hazardous substances, according to the principles of the new ISO 45001 standard and the Directive 2014/95/EU. It demonstrates that a managerial approach of occupational safety and health is essential, if considering the management system of occupational safety and health a tool that combines policies, persons and means with a view to continuously improve the organization performance and keeps risks under control. Thus, it is important that the approach is made taking into account the referential that promotes a system of quality management for occupational safety and health and reflecting the principles of social responsibility.

Some exposure models and tools were developed by different organizations, in order to help the companies to undertake the chemical safety assessment (CSA) and to provide relevant data to demonstrate the safe use of the substance for compliance with REACH regulation.

The new standard, ISO 45001 *Occupational health and safety management systems - Requirements, developed by ISO,* will help organizations reduce the burden of social costs by providing a framework to improve employee safety, reduce workplace risks and create better, safer working conditions, all over the world. A performing management system allows the business to develop efficiently and profitably, providing the means to organize people, resources and processes to meet every designed objective. Once the integrated management system of quality, environment and safety and health at work is in place excellence can be achieved.

The Directive 2014/95 / EU stipulates the obligation of the "enterprises of public interest" to publish information on at least environmental, social and human capital issues, setting 6th December 2016 as deadline of its transposition into the national legislation.

The new requirements should lead to a better integration of OHS management in the business processes and ensure that OSH issues are considered at a strategic level, including planning on long term.

Approaching an OSH management system provides an organization with better OSH performance on long term by: preventing or reducing at a minimum the risk of incidents resulting in physical or psychical injuries, or health problems for those affected by the organization activities; providing assistance in ensuring, meeting or conforming with legal or other requirements, ensuring that the changes (in OSH management, processes, products, materials, organization structure, etc.) are managed so that no new or OSH risks occur; promoting new safe work practices; developing financial and operational benefits that can result from the improvement of the OSH performance.

INCDPM 'Alexandru Darabont' has expertise in training and consultancy on chemical risks assessment, on implementing occupational health and safety management system and on social responsibility - implementing the provisions of Directive 2014/95/2014, in compliance with the further development strategy of our institute.

The success of the OSH management system depends on the commitment of every level and position in the organization, complementary with social responsibility and sustainable development issues, with special emphasis on the top management.

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Irrigation of energy dedicated crops as a method to utilize the post-fermentation effluent

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Abstract

Non – oxygenic fermentation of biological mater is a process that allows biogas production. As biogas main component is methane it is considered a highly desirable energetic resource. Additionally biogas production enables utilization of biological wastes – byproducts of such industries as: agriculture, meat production, dairy production, grocery production. However this technology as environmentally friendly as it seems produces a waste in a form of post fermentation effluent. This liquid waste I a water solution of mineral byproducts and leftover organic material. Because of its characteristic it contains variable amounts of nitrogen phosphorus, and other macro – elements, therefore it utilization presents a problem. One of ideas for effluent utilization is using it during irrigation of energy dedicated crops. To make this concept environmentally acceptable investigation concerning macronutrients absorption by the crops need to be carried out. For experiment tall wheatgrass (Elymus elongatum Host) was used, and was irrigated whit variable doses of post fermentation effluent obtained from fermentation of whey. The nitrogen concentration in water passing through the soil on which the crop was planted, and obtained harvest were investigated.

Keywords: energy dedicated crops; post fermentation effluent; nitrogen content.

1. Introduction

Energy production is a factor that determines every other aspect of industrial production. Commonly used energy sources are fossil fuels. Extended use of coal, oil, gas and radioactive elements causes their inevitable expenditure and generates considerable amounts of wastes (Gawlik et al 2007). Renewable energy sources are ways of energy production which does not require consumption of minerals with long time of geological creation processes and leaves small or no amounts of hazardous wastes (*Kyoto protocol* 1977). Renewable energy sources are: hot underwater springs (geothermal energy), solar radiation, water and air currents, biomass. Biomass is a material that is created from absorption of CO_2 by plants and used to build their organic matter, as well as animal biomass obtained from consumption and digestion of plants (McKendry 2002). Biomass can be used in energy production in two ways. One is direct incineration in furnaces which causes heat generation, second is obtaining high calorific value biofuels through fermentation processes. First approach can be performed only on plant biomass. Second approach can be applied for both kinds of biomass (Khan and Dwivedi 2013). One of fermentation types is non oxygenic oxidation that leads to production of biogas which contains up to 90% of methane gas (Mao et al. 2015) After purification methane can be used as a effective fuel. During the fermentation process one of byproducts is a liquid effluent, which is a aqueous solution of inorganic compounds which contains high amounts of nitrogen, phosphorus, and in case of animal biomass sulfur salts. The effluent utilization is a major problem in increasing popularity of biogas production compounds. One of a possible ways of dealing with that problem is using it for irrigation of energy dedicated crops.

Energy dedicated crops are plants which are specially harvested for combustion and/or fermentation purposes. These kind of plants have high calorific value, short growth time and large harvest amounts. Because of those qualities they require high amounts of macro elements. This makes energy dedicated crops interesting tool for utilization of high content of macro elements liquid wastes. Additionally harvested plants can be used for production of energy (Wilson et al. 2014).

The energy dedicated crop for the experiment was tall wheatgrass (Elymus elongatum Host). This plant is a modified grass, that grows naturally in dry climates on sandy soils. This is one of the reasons why it ca be used, because it can be harvested on low class soils, which cannot be used for food agriculture purposes. It has high calorific value, and can be harvested even three times a year (Martyniak et al. 2011).

2. Experiment

Twenty four pots with bottom drainage velves were filled with sandy soil obtained from experimental farming site at Tomaszkowo near Olsztyn. The pots were placed in vegetation hall of University of Warmia and Mazury. In twelve pots seeds of tall wheatgrass were placed. Pots were divided into three groups depending on amount of added post fermentation effluent. Every group of pots has four pots with plants, and four pots without plants. The amount of added effluent was based on its general nitrogen content. First group was irrigated with water only, second group was irrigated with water and effluent amount containing 100 mg of general nitrogen, and in the third group irrigation water was mixed with effluent amount of 200 mg of nitrogen. Post fermentation effluent used in the experiment was obtained from a reactor working at Chair of Environmental Engineering University of Warmia and Mazury. Concentration of general nitrogen in effluent ranged between 470 – 500 mg/l measured in samples stored at 4^{o}C. Samples were irrigated since March to September. The plants were watered according to group scheme for twelve weeks, and only with water for the rest of the six month period. At the end of September the plants were harvested dried weighed and a general amount of nitrogen was determined with Kjeldahl method. During the six month period water from the bottom of every pot was taken its volume was measured and nitrogen content was determined using Nessler method. The experiment was conducted in 2013 and 2014. The scheme of the experiment is given in Table 1.

Table 1. Scheme of the experiment

Pot number	Amount of nitrogen in single irrigation [mg]	Use of plant seeds
1	0	no
2	0	no
3	0	no
4	0	no
5	100	no
6	100	no
7	100	no
8	100	no
9	200	no
10	200	no
11	200	no
12	200	no
13	0	yes
14	0	yes
15	0	yes
16	0	yes
17	100	yes
18	100	yes
19	100	yes
20	100	yes
21	200	yes
22	200	yes
23	200	yes
24	200	yes

3. Results and discussion

3.1. Plants

I cases of almost all plants second year of experiment gave dry mass amounts then the first year. This result is expected and is in accordance with data found in the literature. Exception are plants grown in pots 15, 16 and 21 due to those plants being infected by fungus during 2014, and curing processes have inhibited their growth. The values of dry mass were between 10,2 g and 82,4 g in 2013 and 19,1 g to 118,1 in 2014.

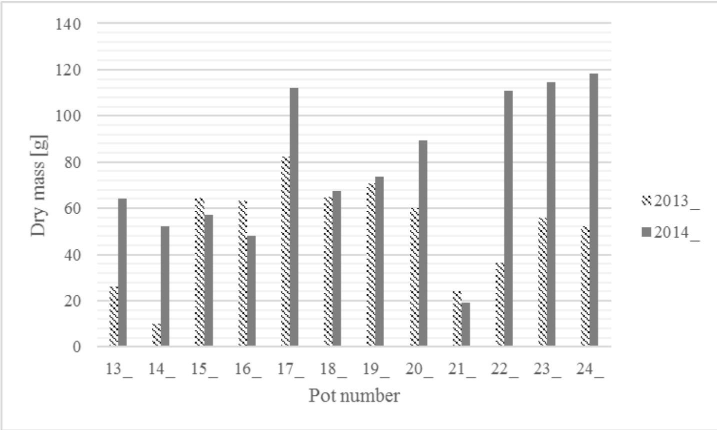

Fig 1. Dry mass amounts for plants of each pots in 2013 and 2014

After calculation of average value and standard deviation of dry mass of irrigation groups it can be concluded that in general dry mass in second year of the experiment increased. Additionally in first year plants in second irrigation group (with 100 mg of effluent nitrogen added to water) had the largest growth, but in the second year plants that were receiving the larger amount of effluent in water had higher dry mass values, see Fig. 2.

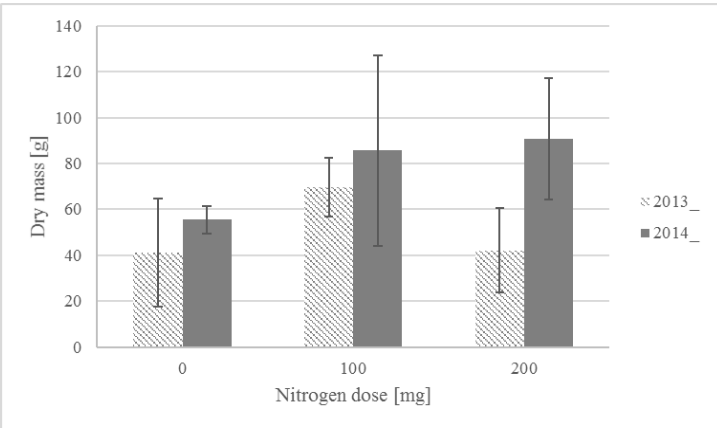

Fig. 2. Average dry mass values for irrigation groups in 2013 and 2014

Another plant parameter that was investigated for plants was nitrogen content. Because supplied amounts of nitrogen were the same during both years of experiment, and amount of dry mass in second year was larger the nitrogen content in second year was lower. The only exception from this is plant grown in pot number 13. The values of nitrogen content in the first year are between 6,4 mg/g and 19,2 mg/g. In second year nitrogen content values were between 7,9 and 13 mg/g, see Fig. 2.

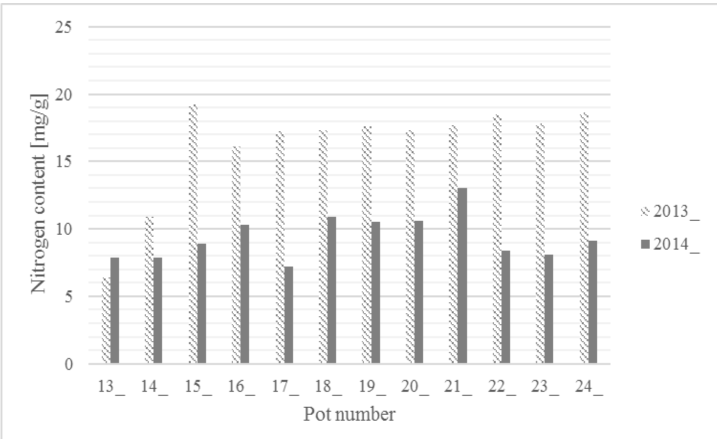

Fig. 3. Nitrogen content in plants of different pots

Comparison of average values and standard deviations for irrigation groups showed that nitrogen contents of plants supplied with effluent almost did not very in experimental years. Slightly higher content values were observed in the first year for second irrigation group, and in the third year were slightly higher in third irrigation group, see Fig. 4.

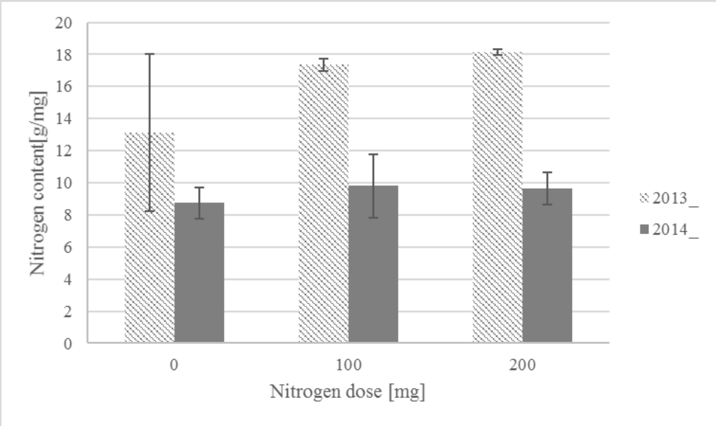

Fig. 4. Average nitrogen content for irrigation groups in 2013 and 2014

3.1. Drainage water

Water was obtained from all of the pots including ones without plants. The first parameter that was investigated is amount of drainage water from the pots. The less water can be obtained from a pot the more beneficial in environmental engineering it is, because the water does not reach the deeper parts of soil and lesser is the probability of water pollution with excess macro elements amounts. Volumes of drain water from pots without plants did not differ very much between first year and second year values. In case of pots with plants the amounts in second year were smaller, see Fig. 5.

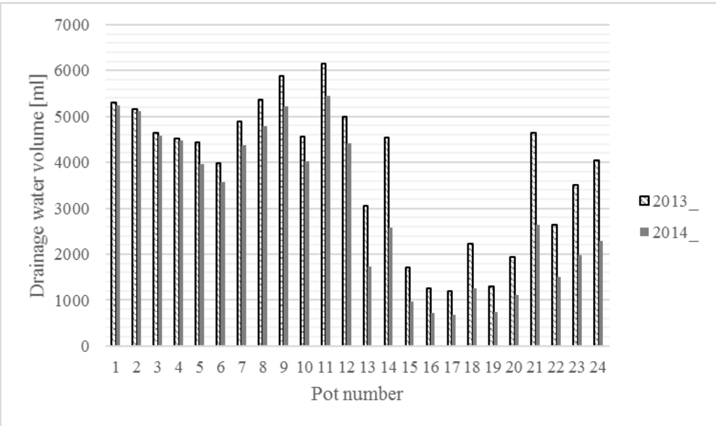

Fig. 5. Drainage water volume obtained from all pots

Investigation of average water volumes on pots with plants showed, that second group plants retained water better inside the plant soil system. In both years second group pots gave lowest amounts of water from lower drain, see Fig. 6.

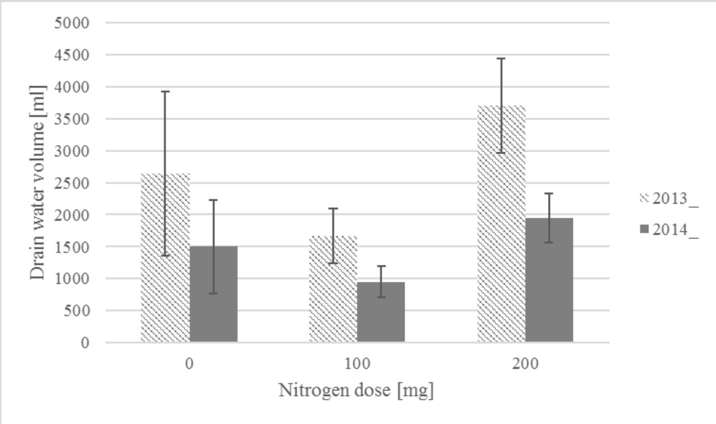

Fig. 6. Average water values for plants in irrigation groups in 2013 and 2014.

Second parameter investigated for drainage water is summary nitrogen amount in drainage water. In water from every pot amounts of nitrogen were lower in second year than in the first, this means that plants retained nitrogen to a greater degree during the second year of growth, see Fig. 7.

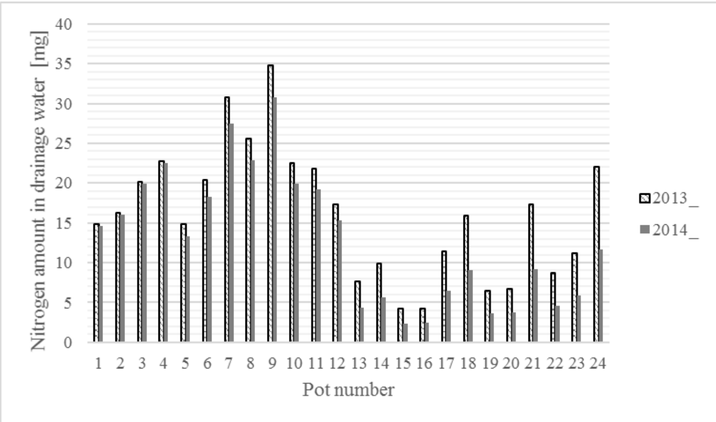

Fig. 7. Nitrogen amounts in drainage water in all pots

Average values of nitrogen for irrigation groups in both years were the lowest for control group and highest in the third group, see Fig. 8.

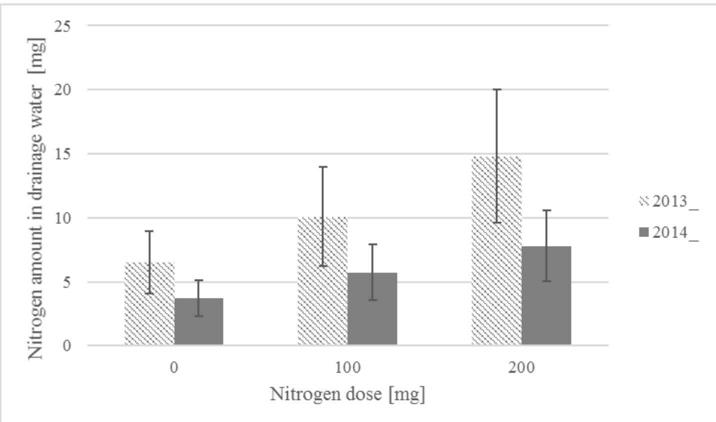

Fig. 8. Average values of nitrogen amount in irrigation groups.

4. Conclusions

Effluent treatment of tall wheatgrass did not stop the growth of plants in the experiment. Parameters responsible for effluent utilization such as water retention and nitrogen retention increased in second year of the plant growth. Further experiments with increased dosages should be carried out.

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7th International Multidisciplinary Symposium

„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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General principles and framework of machinery risk management

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Abstract

The machinery manufacturing industry is one of the largest and most competitive European industrial sectors and, therefore, avoiding and/or reducing the risks associated with their use is one of the major challenges of the European Union policy in the field of safety and health at work. Safety of machinery has been a constant concern of the European and national regulatory authorities, which has resulted in the emergence of a complex, broad legal and regulatory framework, characterized by multiple interconnections and interdependencies. Based on these considerations, the paper aims to achieve a critical-comparative analysis of the requirements governing the integration of safety into the machinery design and construction, resulting in the establishment of the general principles and framework of risk management in all predictable duration phases of their life.

Keywords: machinery; risk; safety; management;

1. Introduction

Establishing a harmonized regulatory framework for the design and construction of safe machinery for users has a vital economic importance for the European and national machinery manufacturing industry. National legislation on safety of machinery is made up of government decisions (G.D.) harmonized with European legislation:

- G.D. no. 1029/2008 as amended and supplemented (Romanian Government, 2008), containing conditions for the placing on the market and free movement of machinery, including essential health and safety requirements applicable to them; it is harmonized with Directive 2006/42/EC - with subsequent amendments;
- G.D. no. 1146/2006 regarding the use of work equipment at working place (Romanian Government, 2006); this applies because the term "work equipment" includes machines (and any apparatus, tool or installation used at work) and includes minimum requirements for features that must met by such products to ensure adequate protection and continuous health of workers; it is harmonized with Directive 2009/104/EC which is the consolidated version of Directive 89/655/EEC and its successive amendments.

To demonstrate compliance with G.D. no. 1029/2008 there are used the Romanian standards that adopt harmonized European standards on machinery, of which the most representative is type - A standard SR EN ISO 12100: 2011 Safety of machinery. General principles for design. Risk assessment and risk reduction (ASRO, 2011).

The constituent elements of the general framework of risk management associated with the use of machines, including risk assessment and reduction strategy, are contained in G.D. no. 1029/2008 and SR EN ISO 12100: 2011.

2. The iterative risk assessment and reduction process

The Essential Health and Safety Requirements (EHSR) set out in Annex 1 of G.D. no. 1029/2008 are introduced through four general principles. First, dealing with risk assessment, explains a fundamental requirement of Annex 1 consisting in hazard identification and assessment of risks related to the machine, in order to identify and apply the applicable EHSR. It should be noted that G.D. no. 1029/2008 uses the term "evaluation" but, according to SR EN ISO 12100: 2011, the correct term is "assessment" (Băbuţ et al., 2015).

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According to the second general principle, EHSR are applicable only when the corresponding hazard exists for the concerned machinery. In order to identify these hazards, taking into account all stages of foreseeable life cycle of the machine, the manufacturer or his authorized representative must ensure that risk assessment is achieved in accordance with the iterative process described in the first general principle.

The machine must be designed and manufactured taking into account the results of the risk assessment. Risk assessment is described as an iterative process because each risk reduction measure intended to treat a particular hazard must be evaluated to see whether it is appropriate and does not generate new hazards. Otherwise, the process must be restarted from the beginning. This implies that the risk assessment must be conducted in parallel with the design process of each machine. Risk reduction measures for the treatment of identified hazards must be taken in order of priority according to the principles of safety integration.

In accordance with the requirements of SR EN ISO 12100: 2011, the risk assessment consists of a series of logical steps allowing analyze and assess systematically the risk associated with the machine. Risk assessment is followed, whenever necessary, by the risk reduction. Repeating this procedure may be necessary to eliminate the risks as much as possible and reduce risks by implementing appropriate prevention measures. It is recognized that hazard is present when the machine will cause sooner or later harm if not implemented any preventive measure.

Critical and comparative analysis of the provisions of G.D. no. 1029/2008 and SR EN ISO 12100: 2011 highlights that there are no significant differences between these documents regarding the iterative stages of assessment and risk reduction process, the only notable difference being represented by the assignment of responsibility for his conduct, to the manufacturer or his authorized representative, in G.D. no. 1029/2008, respectively to the designer, in SR EN ISO 12100: 2011.

To illustrate the similarities and differences between the provisions of the two documents, in Table 1 are presented in parallel, the procedures for risk assessment and reduction contained therein (Băbuţ and Popescu-Stelea, 2016).

Table 1. The iterativ process of risk assessment and reduction

G.D. no. 1029/2008	SR EN ISO 12100: 2011
By the iterative process of risk assessment and risk reduction, the manufacturer or his authorized representative shall:	To implement risk assessment and risk reduction the designer shall take the following actions, in the order given (Figure 1):
a. determine the limits of the machinery, which include the intended use and any reasonably foreseeable misuse thereof;	a. determine the limits of the machinery, which include the intended use and any reasonably foreseeable misuse thereof;
b. identify the hazards that can be generated by the machinery and the associated hazardous situations;	b. identify the hazards and associated hazardous situations;
c. estimate the risks, taking into account the severity of the possible injury or damage to health and the probability of its occurrence;	c. estimate the risk for each identified hazard and hazardous situation;
d. evaluate the risks, with a view to determining whether risk reduction is required;	d. evaluate the risk and take decisions about the need for risk reduction;
e. eliminate the hazards or reduce the risks associated with these hazards by application of protective measures, in the order of priority established through the principles of safety integration.	e. eliminate the hazard or reduce the risk associated with the hazard by means of protective measures. Actions a) to d) are related to risk assessment and e) to risk reduction.

The risk assessment process is facilitated by the application of harmonized standards, as type-C Standards for machinery identifies significant hazards that are generally associated with that category of machines and specify protective measures to deal with them. However, application of harmonized standards does not exempt the machine's manufacturer from the obligation to perform risk assessment.

3. Principles of safety integration in machinery design and construction

The principles for integrating health and safety requirements in designing and building machines are set out in Annex 1 of G.D. no. 1029/2008 that constituting the concept sometimes called "safety by design". In order to point out these principles, in this work there were used information taken and adapted from the Guide to application of the Machinery Directive 2006/42/EC, 2nd Edition (European Commission, 2010).

The basic methodology for designing and manufacturing safe machines proposed in Annex 1 of G.D. no. 1029/2008 is fundamental to addressing the safety of machinery in terms of this legal act. The second general principle set out in Annex 1 of G.D. no. 1029/2008 states that this EHSR is applicable to all machinery. When applying other EHSR, the principles of safety integration should be followed.

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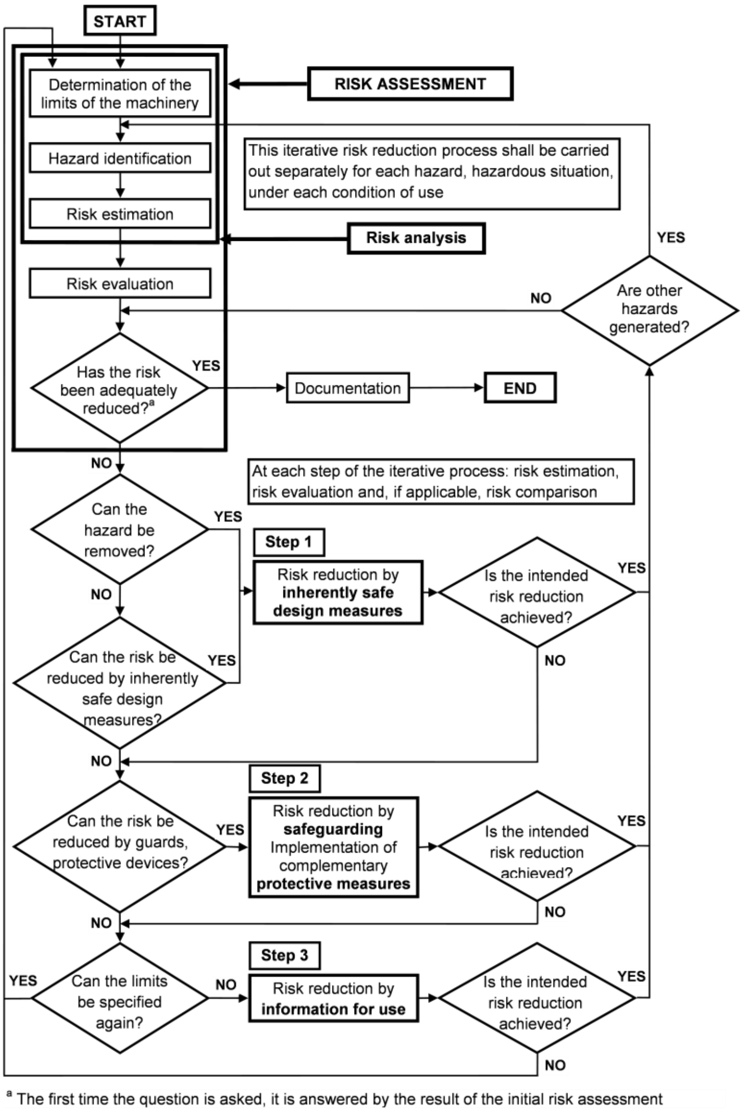

Fig. 1. Schematic representation of risk reduction process including iterative three-step method (after SR EN ISO 12100: 2011)

The principles of safety integration in the design and manufacturing of machinery are the following:

a. Machinery must be designed and constructed so that it is fitted for its function, and can be operated, adjusted and maintained without putting persons at risk when these operations are carried out under the conditions foreseen by the manufacturer, but also taking into account any reasonably foreseeable misuse thereof. The aim of measures taken must be to eliminate any risk throughout the foreseeable lifetime of the machinery including the phases of transport, assembly, dismantling, disabling and scrapping.

G.D. no. 1029/2008 aims, firstly, safety and contains no requirements on machine performance. Generally, it is considered that the performance of a machine is a matter to be left to the market and users will select machinery with performance characteristics appropriate to their needs. However, the ability of the machinery to fulfill its function properly affect safety in so far as inadequate functioning of the machine can lead to dangerous situations or may induce abnormal use.

The overall objective is to design and build a machine so that it can be operated, adjusted and maintained without exposing people at risk. The term "person" covers both operators and any other exposed persons. In order to achieve this goal, the manufacturer must take into account the normal conditions of use and any reasonably foreseeable misuse of the machine.

The objective of preventing risks throughout the foreseeable lifetime of the machine, including the phases of transport, assembly, disassembly, dismantling and scrapping, is the elimination of any risk. On the one hand, this requirement means that all components and assemblies having a safety role must be sufficiently strong and reliable and that the instructions must give proper maintenance and necessary replacements for components subject to fatigue and wear. On the other hand, this requirement imposes the manufacturer to address not only the risks generated in operation, starting from installation and maintenance of the machine, but also those possible during other phases of its life-cycle.

In accordance with SR EN ISO 12100: 2011 prevention measures are a combination of measures implemented by the designer and the user (Figure 2).

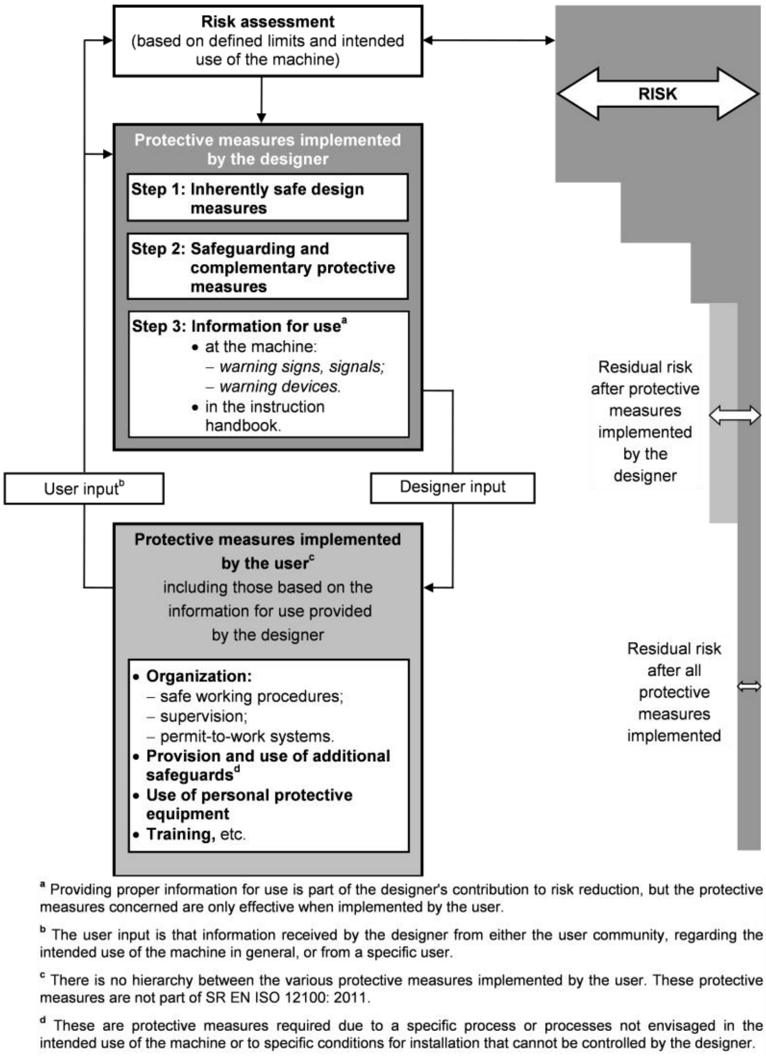

Fig. 2. Risk reduction process from point of view of designer (after SR EN ISO 12100: 2011)

Measures that can be incorporated into the design phase are preferable to those implemented by the user and prove usually more effective. The aim is to achieve the highest possible reduction of risk, taking into account four factors in the following order of preference:

- the safety of the machine during all the phases of its life cycle;
- the ability of the machine to perform its function;
- the usability of the machine;
- the manufacturing, operational and dismantling costs of the machine.

For the safe operation of the machine to be sustainable, it is needed that adopted protective measures to allow it to be easily operated and does not prevent the intended use. Ignoring this principle could lead to the situation that these safeguards be neutralized in order to exploit at maximum the machine’s capacity.

b. In selecting the most appropriate methods, the manufacturer or his authorized representative must apply the following principles, in the given order:

- eliminate or reduce risks as far as possible (inherently safe machinery design and construction);
- take the necessary protective measures in relation to risks that cannot be eliminated;
- inform users of the residual risks due to any shortcomings of the protective measures adopted, indicate whether any particular training is required and specify any need to provide personal protective equipment (PPE).

G.D. no. 1029/2008 proposes the use of the three-step method to establish measures to be taken for addressing the risks identified and evaluated through risk assessment. This method consists of three steps in a successive rank order of priority:

- step 1 = first priority - inherently safe design measures;
- step 2 = second priority - technical protective measures;

- step 3 = third priority - information for users.

This order of priority must be applied when selecting measures for treating a given risk in order to achieve appropriate EHSR. Consequently, the manufacturer must exhaust all possible security measures inherent in design before resorting to technical protection measures. Similarly, he must exhaust all possible technical protection measures before resorting to warnings and instructions for operators. Also, the method of the three stages must take into account the state of the art in technical engineering.

First priority is given to measures of intrinsic safety by design, because they are more efficient than technical protection measures or information to users. In the category of intrinsic safety measures by design are included, for example: full elimination of hazard; control system design and control devices design to ensure safe operation; inherent stability of the machine guaranteed through its shape and weight distribution; ensuring that accessible parts of the machine have no sharp edges or rough surfaces; a sufficient distance between fixed and moving machine parts to avoid the risk of crushing; reduce emissions at source for noise, vibration, radiation or hazardous substances; location of hazardous items out of reach of the machine; locations of adjustment and maintenance points outside the danger zones.

When it is not possible to eliminate the hazard or sufficiently reduce risk through intrinsic safety measures by design, the second priority is given to technical protection measures to prevent human exposure to hazards. This category of technical protection measures includes, for example: protectors; protection devices; isolation of electrical parts under tension; isolation of noise sources; vibration damping; retention or discharge of hazardous substances; devices to compensate for the lack of direct visibility; structures for protection against the risk of tipping or tilting or risk of falling objects.

Finally, for the residual risks that cannot be reduced adequately by measures of intrinsic safety by design or technical protection measures must be provided information both people to exposed in the form of warnings, signs and information on the machine and to the users in the form of instructions, so users must exercise caution and to take any measures necessary. Providing warnings and instructions is considered as an integral part of the design and construction of a machine. However, the fact that this third stage is the last in the order of priority shall have the effect that warnings and instructions must not be a substitute for measures of intrinsic safety through design and technical protection measures when these are possible, taking into consideration the technical and engineering state of the art.

In accordance with the requirements of SR EN ISO 12100: 2011, the procedure to reduce the risk in terms of the designer (Figure 2) is also based on the three-step iterative method:

- step 1: inherently safe design measures;
- step 2: safeguarding and complementary protective measures;
- step 3: information for use.

The procedure itself is iterative and can take several successive applications to reduce risk by using best available techniques.

c. When designing and constructing machinery and when drafting the instructions, the manufacturer or his authorized representative must envisage not only the intended use of the machinery but also any reasonably foreseeable misuse thereof.

The machinery must be designed and constructed in such a way as to prevent abnormal use if such use would engender a risk. Where appropriate, the instructions must draw the user's attention to ways - which experience has shown might occur - in which the machinery should not be used.

The principle contained in paragraph (c) logically follows from (a). Since the machine manufacturer must consider both the normal use of the machine, and reasonably foreseeable abnormal use, measures must be taken to prevent abnormal use that would pose a risk. These measures must be chosen in accordance with the priority established by the principle stated in (b). As a result, the manufacturer shall, to the possible extent, to prevent reasonably foreseeable abnormal use by technical means. Examples of such provisions are: installation of means to restrict access to machine controls; designing the machine so as to prevent assembly errors; installation of devices to prevent movement of mobile machine when the driver is not at the control panel; installing devices to prevent overcharging of lifting machines. When there is a residual risk of foreseeable misuse that cannot be fully prevented by such technical means, there must be displayed on the machine adequate warnings and provided instructions.

d. Machinery must be designed and constructed to take account of the constraints to which the operator is subject as a result of the necessary or foreseeable use of personal protective equipment (PPE).

This principle addresses a particular aspect of normal use of the machines. Machine operators may be required to dress or wear PPE to face the residual dangers generated by the machine itself such as, for example, hearing protectors to protect against noise emissions or eye protection to protect against the risk of ejecting substances or dangerous objects. Also, they may be required to use PPE to protect against hazards which are not generated by the machine but are present in the environment where the machine is operated. For example, machine operators may be required to wear gloves, protective clothing or footwear if the machine is used in cold or hot atmospheres or in adverse weather conditions. The design and construction of the machine and, especially, the design, positioning and dimensions of actuators must take into account the constraints to which the operator could be subject through the use of PPE.

e. Machinery must be supplied with all the special equipment and accessories essential to enable it to be adjusted, maintained and used safely.

This principle does not require machine manufacturers to provide standard tools and equipment necessary for the adjustment and maintenance operations that can be used with different types of machines. However, if adjustment, maintenance or use of the machine in full safety requires the use of equipment or accessories that are specific to machinery concerned, such equipment or accessories must be provided by the machine manufacturer with the machine. Such special equipment may include, for example, devices for removing the parts of the machine for cleaning or devices for filling or loading and unloading of work pieces to be processed.

4. Conclusions

Machinery as part of work equipment, represents the working system's element that holds the largest share of accidents at work, given their complexity, the temporal change in the of their safety quality, the various interventions of workers throughout their lifetime, and especially due to the presence of high kinetic and potential energies and the possibilities of workers to operate them directly or indirectly.

As a result, European and national regulators have developed a legislative and regulatory framework in which obligations were set on compliance with requirements for health and safety of both machine manufacturers and their users. Vastness and complexity of the legal framework have created difficulties of knowledge, understanding and its application to all parties involved in the machinery safety.

In this context, in this paper was performed a critical-comparative analysis of the legislative and regulations requirements regarding safety of machinery, which enabled the formulation of conceptual and methodological clarification of the iterative process of assessing and reducing the risks associated with their use, such as defining and explaining the principles governing the integration of safety into the design and manufacturing. Addressing from a holistic and integrated perspective the issues mentioned above allowed the identification and systematization of the components of general risk management framework associated with the use of machinery.

The scientific approach was grounded on general principles of risk management contained in the series of standards ISO 31000 (Moraru and Băbuţ, 2010), because risk management associated with the use of machinery is an integral part of the global system of management of occupational risks in a working system.

Through the information provided, the paper aims to contribute to reducing the social cost of accidents at work and occupational diseases caused directly by the use of machinery, by integrating the principles of risk management in all foreseeable stages duration of their life cycle.

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Some problems for assessment of fire in road tunnels

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Abstract

In recent years, a number of fire accidents have occurred in several road tunnels over the world. Many of these fires grew rapid to catastrophic size. Smoke as well as toxic gases from burnt materials are very dangerous to tunnel users. Based on the above, vitally important to forecast the ability of the amount of combustion products identified for different fire scenarios in underground. It is obvious that the development of fires mostly depends on the goods that are burned, although ventilation has a major effect. Ventilation on the one hand gives the oxygen to the fire areas and on the other hand neutralizes combustion products by reducing their concentrations. By means of mathematic modelling we investigated processes of the fires with different magnitude. Solution of the issue is topical to the operational staff of tunnels and emergency services for planning and implementation of the adequate measures for tunnel fire safety and asset protection. These studies aim to clarify two issues: 1.What is the impact on the spread of smoke during natural and mechanical ventilation of tunnel and how the speed of flow that is result of modelling, corresponds to similar facts of real fires that have occurred in the tunnels and which are available? 2. How to facilitate the operational staff of tunnel in rapid actions and what instruments we would suggest them for the estimation and the management of emergency situations in case of accident? In this work there were performed various mathematical models for the case of fire of easily flammable materials.

Keywords: computational modeling; fire in road tunnels; high temperature; toxic gases; smoke.

1. Introduction

With FDS-method computational modelling have been researched a dynamic developing damage factors of fire such as temperature, concentrations of toxic gases, visibility (or concentration of smoke). In this case we have considered the very well flammable fuel that quickly takes maximal value of HRR (heat release rate).

Recommendations of Economic Commission for Europe have been provided in the study (UN, 2001, 2002). In particular: the magnitude of modelling fires was up to 30 MW; pressure difference between portals was equal to 0-100 Pa; in all of the models cross-section area of tunnel was 56 m^2; burning surface area of liquid fuel - 15 m^2; slope of tunnel was varied in the range 0-6 ppm.

The subject of the study of the numerical simulation was determining of the propagation velocity of the smoke, because it is directly related to issues of allocation of toxic impurities and their zoning. We believe that almost at the same rate there would be distributed other toxic products of combustion. The results of modeling are in good agreement to the analogous available data of real fires for tunnels. In particular, when a pressure difference between the portals was 0 kPa, air velocity was 2.8 m/s and when a pressure drop between the portals was 100 Pa - 15.2 m/s. In both cases, the magnitude of fire was 15 MW. It should be noted that according to the data Beard and Carvel (2012), in similar situations, the air velocity varied between 2.20-1.15 m/s in first case and was near to 13.5 m/s in second case.

2. Results and discussion

To assess the influence of fire, depending on its development along the length of the tunnel, it takes necessity to divide the tunnel into virtual spatial zones. Establishing the boundaries of each zone, or the definition of its spatial scale

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is carried out by taking into account the effect of injurious factors, taken into account their importance and intensity. From our point of view during fires, among other factors, the key factors are both the spatial distributions of temperatures and of toxic products of combustion processes. At the same time we believe that the spread of smoke is an exact analogy to the distribution of other toxic products of combustion, and they are characterized with the same indicators. Thus the dynamics of these processes - release and dispersion of heat, smoke and toxic products is result of development of the combustion processes in time.

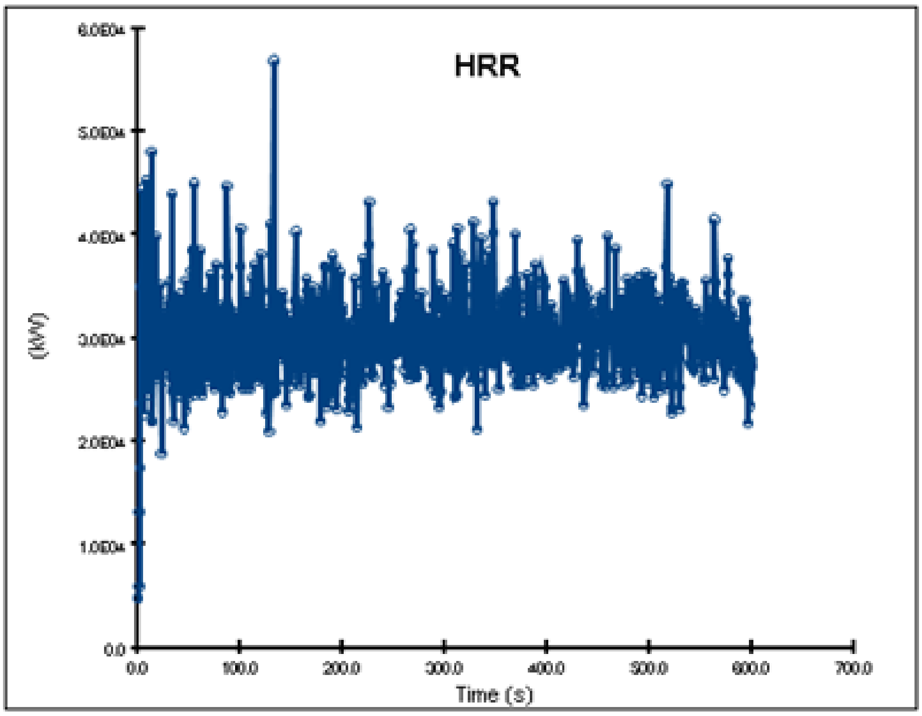

Fig. 1. The dynamics of heat release rate (HRR) in the situ of fire..

It is clear that during the dividing into zones the determinative should be the quality of state of person's health and for the assessing could be use the recognized rankings - 5-tiered rate, which is presented in Table 1. These results should be consistent with adequate scenarios of fire in tunnels according to outcome of natural experiments or computational modelling.

Table 1. Dividing of emergencies of space and time zones with consideration of damage

No	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
The spatial scale of each area, m	Linear length of the zone - L_1	Linear length of the zone - L_2	Linear length of the zone - L_3	Linear length of the zone - L_4	Linear length of the zone - L_5
The time scale, min.	$T_1<T_{max}$	$T_1<T_2<T_{max}$	$T_2<T_3<T_{max}$	$T_3<T_4<T_{max}$	$T_4<T_5<T_{max}$
The extent of damage	Hardest	Heavy	Average	Weak	Negligible

Table 1 gives the following values: The linear dimensions of the fire from the tunnel line in both directions: L_1; L_2; L_3; L_4; L_5; The determination the time of occurrence of the harm - the time scale: T_1; T_2; T_3; T_4; T_5; T_{max}; Damage assessment: The hardest - the result is lethal; Heavy - health is not fully restored; Average - health restored as a result of treatment; Weak - health restored as a result of short-term treatment; Negligible - with the help of primary health will be restored. There is possibility to make similar tables for other damage factors such are, as: toxic products, smoke and other results of combustion process.

We believe that based on the averaged experimental results and with computer simulation by means of FDS mathematic models can be getting spatial and temporal criterion for evaluation. These criteria may be rooted on the quantitative assessment of destructive factors. During fires in the tunnels the damaging factors of health are: abnormal temperatures, thermal radiation, dust of soot, toxic gases, such as CO, NO_x, HC, SO_x and others. Due to the fact that carbon monoxide is decisive in terms of the dilution of toxic concentrations of other gases in products of burning, we take carbon monoxide as decisive gas for the assessment of toxicity extracted gases during fire. The damaging effect of the abnormal temperature is not in doubt. Therefore, we believe that it is appropriate to take into account only two damaging factors. These factors are: abnormal spatial field distribution of temperature and carbon monoxide concentration within the limits of the underground space.

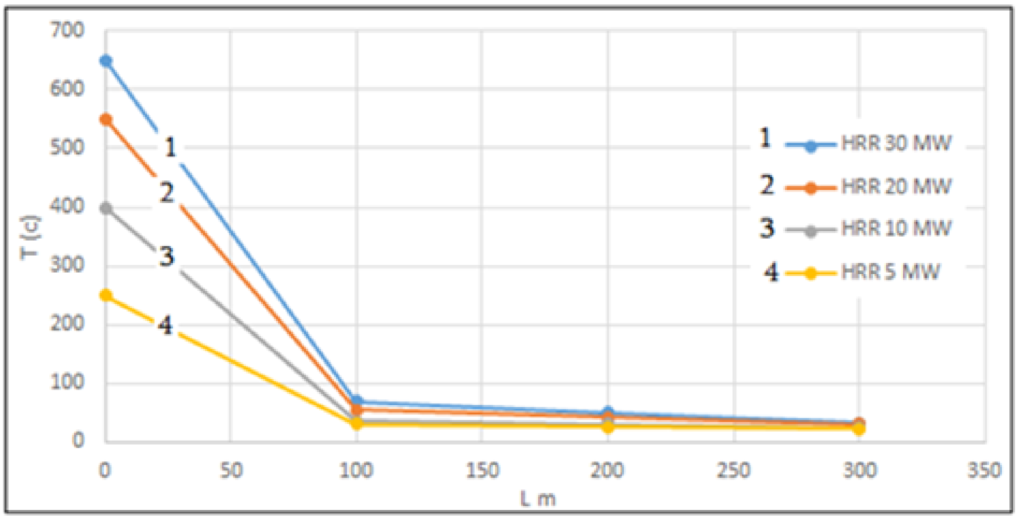

Fig. 2. Changing of temperature in according of the tunnel length by the results of the simulation. The numerical designations on the curves correspond to different fire power

Numerical data of average time of occurrence thermal shock depending on the ambient temperature is shown in Table 3, and Table 4 shows numerical values of the average time of toxic poisoning for human caused by the influence of carbon monoxide. These values of numbers, as well as the results of modelling of spatial and temporal distribution of the damaging factors are important for the assessment of the state of emergency caused by exposure to fire.

Table 3. The average time of occurrence hyper thermal shock for human

The ambient temperature, ^{0}C*	80	75	70	65	60	55	50	45	40
The limit of human endurance, min	1	3	5	7	10	30	40	1000	14000

*Fluctuations of relative humidity: 50-100%.

Based on the foregoing, for a specific tunnel can create a dynamic map of damaging factors - fields of temperature and concentration of carbon monoxide. Marked cards will allow under the initial and boundary conditions of the fire to adequately determine the method and tactics of evacuation. Figures 2 and 3 are given as an example some results of modeling for the distribute of temperature and carbon monoxid fields.

Table 4. The average time of occurrence of toxic poisoning for human

The concentration of CO, mg/m^3	12000	11500-5500	5500-3500	3500-2500	2500-1800	1800-800	800-600
The limit of human endurance, min	1-2	2-5	10-15	20-30	40-80	60-120	120-320

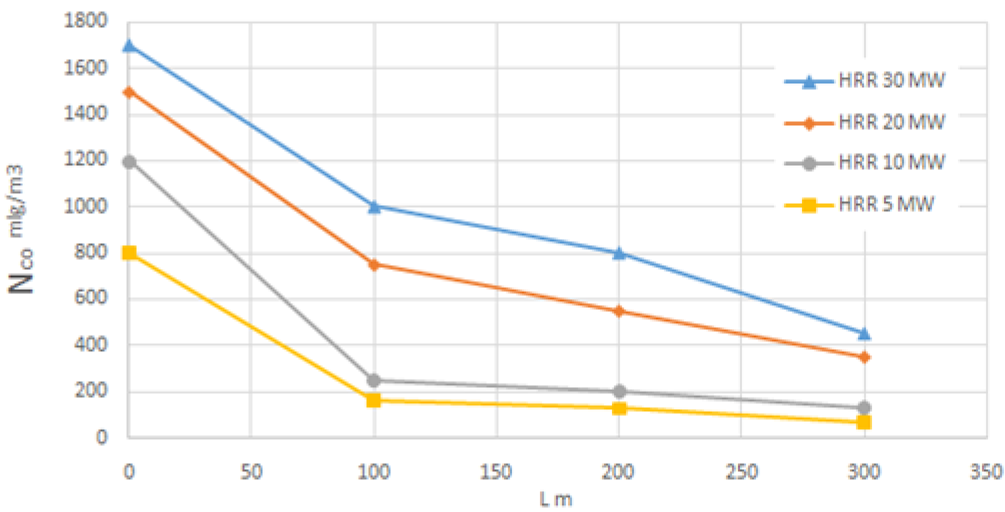

Figure 3. The dynamics of concentration of carbon monoxide in tunnel by the results of the simulation. The numerical designations on the curves correspond to different fire power

The results, shown in Figures 2 and 3 correspond to the first six-minute period after the full power of the simulated fires. As seen from these results, the temperature values 50, 70 and 90 degree, for 6 minutes, respectively, extend to distances of 300, 200 and 100 m from the site of fire. Given this factor, the time for evacuation of at least 6 minutes will be in reserve for any underground space. The results also show that the height of the humans face corresponds to the contour line 50. Considering the data shown in table 3, according to which time interval the heat shock at a temperature to 50, ranges from 40-50 minutes. Consequently, the maximum time for evacuation in this case cannot exceed 40 minutes. Depending on the location of people in the underground space the rescue team can be more adequately plan tactics of evacuation and rescue.

As can be seen from the results of the numerical experiment, for the power of fire of 30 MW, during the first 6 minutes tunnel will be almost filled with toxic carbon monoxide impurities with a density of 150 mg/m^3. The countdown determination can be carried out after achieving a maximum of fire power.

It should be noted that for the mark of 150 m, at a height of 2 m from the bottom of the tunnel, is expected increasing the carbon monoxide concentration to 900 mg/m^3, which is shown well in Figure 3.

3. Conclusions

According to the results of submissions temperature fields and carbon monoxide distribution can be concluded that relaxation of temperature fields along the length of the tunnel takes place faster than alignment of other damaging factors, particularly of concentration fields of carbon monoxide and smoke.

Based on the averaged experimental results and with computer simulation by means of models can be getting spatial and temporal criteria for evaluation of fire that are closely related to the dynamic processes of the spatial and temporal distribution of hazards. This will allow under the initial and boundary conditions of the fire to adequately determine the method and tactics of evacuation.

The studies showed that in case of fire in the power range of 5 - 30 MW in tunnels there is sufficient time to carry out the evacuation process (10-5 min).

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The quality of human capital and the risk in terms of evolutionary psychology

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Abstract

Intense competition and the economic slowdown have forced companies to changes among others in the field of applied management methods and strategies. In order to maintain their position in the market, companies are increasingly often choose the employment restructuring as the most effective way to costs cutting. A typical symptom of this process are layoffs and reduction in staff. This is a common businesses response of necessity to adjust to changing business needs. Unfortunately, such activities tend to have a negative impact not only on the organizational behavior and the mood among the staff, but can also lead to risky behavior of employees, even with signs of deviant behavior. The subject of this paper is to present the reasons for committing the risky or delict tort by employees, in view of evolutionary psychology. The motivational premise of committing illegal or risky behavior is often individuals tendency to aggression. Evolutionary psychology did not formulate single causes of aggression in society. Within its framework clash competing hypotheses of such a behavior. In evolutionary perspective we can speak about at least five types of benefits, gained by people who use aggression, and so they include among others: capture of resources of other people, defending yourself and your family, the pursue of the costs of rivals, fighting for position in the hierarchy, deterring potential aggressors. Furthermore, aggression is closely connected with the selection, which in the evolutionary perspective acts most strongly at the gene level. It should be emphasized that aggression is a common symptom of helplessness and powerlessness that can feel the individual. Aggressive behavior of employees can of course be stimulated by occurring some stressors in the workplace. Therefore in this study was emphasized the need to build psychological safety of employees, in order to maintain employee engagement and the quality of human capital at a level that guarantees the company the existence of a market.

Key words: the risk of the human factor human, work environment, organizational change, quality of human capital

1. Introduction

A key task even a challenge for companies is now not only to maintain the existing in the organization pool of talents - the so-called outstanding employees, but most of all to motivate them, and in special cases (eg. restructurings) to restore their commitment to conveniently develop quality human capital to create value for the enterprise (Tiwari and Lenka, 2015). Moreover, since the mid-nineties the quality ceased to be a source of strategic advantage, and it has become a basic requirement of the competition. According to J. F. Welch: "the best company undoubtedly know where their actual and potential productivity comes from. It comes from an informed, empowered, properly motivated employees. It comes from the commitment of every mind in the organization, making everybody a part of its operations, permits everyone having the right to vote, fulfilling their role in achieving success "(Welch, 2010). Knowing the rank of the importance of human capital for the organization, it seems important the knowledge of determinants of the behavior of individuals in the work environment in view of evolutionary psychology. Capturing the perspective of evolutionary psychology allows to divert the attention to the source of risky behavior of individuals and shows directions for human resource management (Moraru et al, 2010).

Evolutionary psychology is not a single branch of psychology. It must be judged as a synthesis of modern psychology and evolutionary biology, which assumes that people are born equipped to process certain types of information. In the

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development of this trend in psychology the most significant were the so-called. "Milestones" of the theory with Darwin evolution psychology at the forefront, but also its precursors. To this group certainly should be included Jean Pierre Antoine de Monet de Lemarck (1744-1829), who claimed that the differences in the forms of life arise for two reasons: first, the natural tendency for each species to evolve toward a higher form of development, and secondly, the hereditary conditions. Returning to Darwin - his main contribution to evolutionary biology was the development of the theory of natural selection. The essence of this theory are the three basic factors: variation, inheritance and selection. With natural selection we have to do when certain variants of hereditary characteristics lead to greater reproductive success than others (Hołyst, 2010). Another theory affecting evolutionary psychology was etiology. It put emphasis on the organic structures of the evolutionary process. Etiologists interested in the four key issues relating to variables reasons for the behavior of individuals. Among the reasons for behavior articulated by etiologists can be distinguished:

- direct causes,
- causes of development,
- causes of motivation,
- evolutionary causes.

The most famous representative of that trend was K. Lorenz (1986, 1996). He tried to move aggression animal model on human behavior. The main premise of his theory were that in a living organism constantly accumulates aggressive energy. However, whether to reveal it in the form of aggressive behavior, depends on the quantity and strength of external stimuli, with the ability to trigger aggressive reaction. K.Lorenz also supported the view that when the level of accumulated energy is sufficiently high and exceeds the so-called critical level, may lead to spontaneous release of aggression, despite the absence of a direct factor triggering aggression. It should be noted, however, that this researcher in fact considered aggression to be the common and innate property of human nature, however, he did not deny that a person does not have the opportunities of exercising control over it. It should be noted, however, that the views of K.Lorenza, regarding the validity of inferences about human nature by observing the animals were repeatedly questioned by subsequent researchers. It has been noted, for example, that the lack of clear evidence that animals generally tend to be aggressive, whereas there are many evidence to confirm the conclusion that aggressive behavior are taken usually only when other options fail, for example. discouragement or avoiding the enemy (Zastępowski and Grabowska, 2010). In turn, the theory of total adaptation, which the representative was William D. Hamilton, assumed that the process of natural selection is not a simple transmission of hereditary characteristics, only the total adjustment, which takes into account the reproductive success of related organisms. It is measured by the degree of kinship. It is also worth recalling the figure of Robert Trivers, who has a large role in shaping evolutionary psychology (Zastępowski and Grabowska, 2010). That psychologist focused mainly on reciprocated altruism between unrelated people and formulate the conditions under which could develop a mutually beneficial relationship or replacement.

2. Different identity of individuals and the factors stabilizing their behavior

This issue is closely connected with satisfying of basic existential needs of the individual or the community, through the accumulation of all kinds of resources. The mere threat of violence / threat will suffice sometimes to ensure that people return what they possess (Wojciszke, 2006). With the increase in diversity within a given gender the evolution favors relatively risky strategies. It is assumed that men are generally more predisposed to aggression or risky behaviors. According to S.E.Cross and L.Madson, a mechanism of conditioning the intrapersonal consequences is developing by men and women of different individual identities, which implies different content of self-verification and self-presentation processes. In this context, a significant number of data speaks in favor of the conclusion that, among others, women strongly develop a so-called. "I am - common," while men - "I am - independent." But for women an important component of identity are contacts with the environment and interpersonal skills which contribute to building relationships. Men on the other hand, to a greater degree define their identity through self-reliance, autonomy, separating themselves from others. The effect of different identities is a special display of the characteristics typical of a particular sex. For example, women may want to be perceived as indulgent - that is "feminine", while men - resolute, and thus "male". The "model of femininity" (common in many cultures) usually consists of features such as neatness, tactfulness, sensitivity, fragility a tendency to gossip, talkativeness,. While men are stereotypically portrayed as aggressive individuals , dominant, independent, active, physically strong and confident. In this way the content of self-presentation process is internalized by man - in particular, if it has public nature and reinforces gender differences. Another effect of different identities is the diversity of content of self-verification, revealed by women and men. Such processes are understood as taking action towards interpreting their own behaviour (Wojciszke, 2006). Therefore, for example, men often try to lead groups, while women tend to take care of others (Zastepowski and Grabowska, 2010). Besides, the women's contribution to knowledge society results from their capacity to be empathic, to put the human being in the center of the organization and to find the best motivation techniques to meet objectives (Irimie et al., 2013).
To conclude this topic it should be added that the aggression allows the description of the individual through the prism of its application. It is worth recalling the view of Alfred Adler (Wojciszke, 2006), who initially treated an aggression as spontaneous manifestation of the innate instinct, functioning independently of external stimuli. This researcher was also of the opinion that if the suppressed instinct of aggression does not reveal itself in the direct or indirect form, there

is a high probability of directing it inward (Moraru, 2012). This may result in the occurrence of a given individual, eg. a neurotic anxiety or mental discomfort. As a result, the "instinct of power" is created subconsciously, directing men to such behavior, as the pursuit of domination or rule over others, and to strictly aggressive behaviours . Such incentives and individual inclinations allow the discharge of inferiority complex (fulfilling thus the adaptive role) or can cause a lot of problems and conflicts in social relations, due to the fact that they often do not fit within the commonly accepted behaviours (Zastepowski and Grabowska, 2010).
Another cause of aggression in different communities is the need for defense against attack. Thanks to this, we protect our resources from capturing and maintain our own reputation, scaring away potential opponents. What is interesting is the fact that women more often than men use the forms of verbal aggression (Zastepowski and Grabowska, 2010). In Finland, 127 fifteen–year-old teenagers were examined using the techniques of evaluation by peers and according to their relationship. Boys three times more often than girls have used forms of direct physical aggression, such as taking ownership of other students, kicking and beating, seeking revenge during team games, pushing. To the indirect forms of aggression included gossip, avoidance of someone , dissemination of harmful information, breaking contact, revenge by making friends with someone else. The fifteen-year-old girls use various forms of indirect aggression more often than boys, outperforming them in 25% (Hołyst, 2010). Similar studies were conducted in different centers, among others, in the UK, and yielded similar results. It can be concluded that the differences between men and women in terms of physical aggression are substantial and are arranged in a pattern (Hołyst, 2010). The level of aggression and the tendency for risky behaviours are considerably affected by the factors stabilizing the standard of living, such as marital status or having a job.

3. The factors stimulating the risk and aggression vs. psychological discomfort of the individual in the work environment

The survival and maintenance in today's dynamic business environment requires from companies the teeching of the capacity to respond to the more or less unexpected events of strategic importance. Future success depends therefore on the ability of companies to take appropriate measures and flexible response to these changes on time (Simon and Torp, 2015). At present, companies tend to choose cut costs through layoffs and the reduction of personnel. This is their response to the necessity of adapting the company to the changing business needs. And here appears the problem of drivers aggression and psychological discomfort factors of the individual in the work environment .
Unfortunately, this strategy of action usually has a negative impact not only on organizational behavior and the mood of the staff. Workers who survive the restructuring processes are typically more prone to a variety of anxiety, depression, and they are affected by the ambiguity and uncertainty of employment, which could lead to the loss of welfare and occupational diseases (Carpenter, 2009). They lack confidence and they are less willing to take risks, which seriously reduces their perception of psychological safety (Kahn, 1990). Moreover, such employees feel isolated, which can lead to a lack of commitment at work, or even emotional withdrawal from the entire organization (Dollard and Bakker, 2010). Employees who survived the organizational changes may also exhibit deviant behavior at work, such as, neurotic anxiety, or chronic psychological discomfort. As a result, the employees may shun the group or might be afraid to express their views in fear of the negative consequences from the organization. Consequently, their behavior may be very cautious, as if with repressed creativity. Lack of harmony and inner restlessness can also externalize the more indirect, direct aggression - the tendency to risky behavior.

4. Shaping the quality of human capital and building psychological safety for employee engagement

Possesssing by the Company the adequate quality of human capital and its effective at present is now very important for the organization because it enables, in particular:

- continuous advancement, improvement of quality and shortening the response time to market needs,
- quick and cost-effective manufacturing of products and personalized high quality services,
- the introduction of innovative products and services suited to the needs of customer groups target (Skrzypek and Sokol, 2009).

Human resources are the basis for creating new values and new ways to meet the needs of buyers. So they possess the characteristics of strategic resources. Furthermore, the human capital unites, activates and directs the use of other resources - tangible and intangible assets of the organization in the process of value creation. The fact is that along with the economic growth, requirements of human capital grow. It seems, however, that high unemployment rate which accompanies this process, gives a possibility for quick replacement and exchange of personnel. However, data show that the effectiveness of the recruitment process is surprisingly low (Kot and Pigon, 2013). One reason for the low effectiveness of selection and recruitment processes is the level of preparation of potential candidates, and then the high costs of their implementation into the organization. The costs of repeated recruitment and maintenance of vacancies - as unproductive work places - should also be mentioned. So it seems that the best thing the organizations can do is to ensure proper retention of proven employees within the organization, and the best way of doing so, is the creation of

favorable and comfortable working environment. Safety and health at work becomes more important part of the organization since it guarantees continuous positive growth, improvement of productivity and overall performance (Irimie at al., 2013).
Safe working environment in terms of psychology, promotes calm, tranquility, achieving mental balance. The term - psychological safety - has been defined by W.A. Kahn as “an employee’s ability to work freely without any anxiety or fear of retribution to career, status, and self-image. A psychologically safe environment facilitates open, supportive, and trustful interpersonal relationships among employees” (Kahn,1990). And only in such conditions, employees are more effective, inclined to innovation and accepting constructive feedback without fear of being reprimanded by the executives. Figure 1 shows factors, responsible for the psychological safety of employees in regard to their involvement.

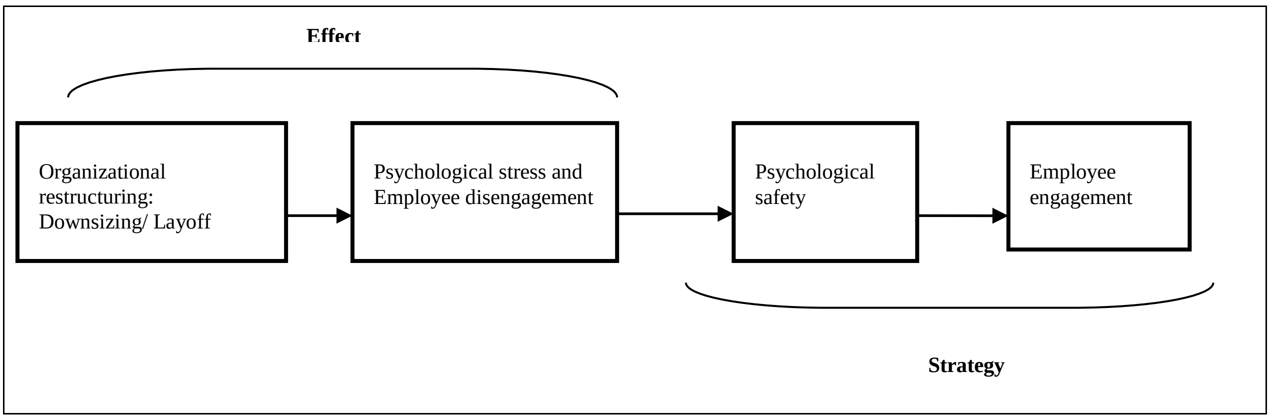
Figure 1. Psychological safety as a precursor of employee engagement

Factors contributing to psychological safety	• Opportunities to share knowledge • Continuous learning • Opportunities to act as intrapreneurs
Facets of Employee engagement	• Physical • Cognitive • Emotional • Behavioural

Source: Tiwari B., Lenka U., *Building psychological safety for employee engagement in post-recession*, Development and Learning in Organizations: An International Journal, Vol. 30 (2016).

It is worth mentioning that “engaged employees demonstrate physical, cognitive, emotional and behavioral involvement to their work”(Kahn, 1990). Physical engagement means - an employee’s effort in performing tasks. Cognitive engagement is defined as an employee’s psychological involvement in performing a work role. Emotional engagement refers to employee’s pride, enthusiasm, in the context of the organization. Behavioral engagement expressed through an employee’s persistence toward their work and goals of organization (Lockwood, 2007).
In a situation where employees feel safe at work, they perceive the methods of personnel management as reliable and accept them. These employees are more motivated to develop, acquire knowledge, and consequently are more engaged and committed to work (Choi, 2004). It is impossible not to mention the fact that the derivative of these factors is the greater quality of human capital from the point of view of the organization. Therefore, the need to create a psychological safety of work environments is now critical if we want to have dedicated employees who are willing to use their competencies for the good of the organization - regardless of the restructuring activities conducted within the staff. In this context the psychological safety should be perceived as an useful and operative tool for stimulating the engagement of surviving employees. Figure 2. Shows the holistic process of organizational restructuring vs. employee engagement.

Figure 2. The process of organizational restructuring vs. employee engagement



Source: Tiwari B., Lenka U., *Building psychological safety for employee engagement in post-recession*, Development and Learning in Organizations: An International Journal, Vol. 30 (2016).

Empowerment of employees is largely dependent on the ability of managers to use the appropriate style of leadership, which supports the involvement of the personnel and creating a safe working environment (Grabara, 2013). The aim is to create such working conditions in which employees could feel comfortable and at ease, also in terms of any expression of doubt, even if they are contrary to the opinion of the board or the applicable procedures (Huang et al., 2010). The issue the risk of human factor within organization, related to the prevention or minimizing the tendency of employees to potential aggressive and risky behavior, cannot be underestimated either. The question of risk may seem complicated, because the risk itself has negative connotations and often means paying attention to the need for change. More importantly, if the risk is not properly managed, this can lead to significant financial losses (Meyer, 2014). Today it is commonly believed that "the approach to risk management practiced by the company's is largely unproven" (Kaplan and Mikes, 2013). Companies, on the one hand, require new structures and holistic system solutions to make it possible to identify, measure and effectively respond to threats, and to report of the potential risks and opportunities within the organization. On the other hand, the key ability is to predict and respond to the pre-emptive potential threats before they become a problem (Ziebacz, 2014). Thus, the creation of psychological safety at work should be seen as a necessity thanks to which can be expected multidimensional benefits for enterprises. In that regard leaders play a key role within the organizations.

Conclusion

From the perspective of evolutionary psychology, aggression is not a single phenomenon. It includes various causes, which manifest themselves in a variety of conditions, and often the most extreme and definitive situations when the individual does not have prospects for alternative actions. Bearing in mind the presented results of research conducted by evolutionary psychologists, is safe to say that from the point of view of gender, the actions of men often contain an element of aggressiveness. Mental formation of man also shows that men more often than women are willing to take risky actions. The reason for this may be biological differences between women and men, formed evolutionarily. In terms of physique, men are generally about 12% heavier than women, which also indicates priority use of aggressive actions, because their structure predisposes them to this and guarantee greater success due to their aggressiveness. However, such a presentation of that problem cannot be considered sufficient. In this study, it was sought to demonstrate that a number of external factors of aggression activates the mechanism of application of aggression in relation to others, particularly when the existential needs of the individual are endangered. The acts of aggression often occur in the aftermath of the prospects of unemployment, job insecurity, lack of psychological comfort in the workplace. Analyzing the statements above, we can reach a convincing conclusion that aggression does not depend on the inheritance of genes – the most import factors are the environment, the community in which the individual operates, or staying - workplace. From the point of view of the organization, the knowledge of the characteristics of individuals (employees) in terms of evolutionary psychology plays an important role, because it indicates the directions and opportunities for stimulating and protecting the accumulated human capital. Intellectual capital is not only the growth of knowledge and skills, but also the awareness of employees and their multidimensional motivation to improve oneself and one's work. In addition, one advantage of human capital is its renewability, and more importantly, its intellectual, motivational and creative resources are not run out while they are used. For this reason, the quality of human capital in the information society becomes the main source of development. Consequently, it is the quality of human capital that is more important nowadays, not its numbers. The reason for this is the progress of civilization, which eliminates low-intellectual positions. These processes can result in the changes in the sphere of the human psyche, and even in one's social behavior. The emerging symptoms of these changes are still neglected and unnoticed by the organizations. In this context, it would be valuable to conduct further research concerning the identification of factors affecting the psychological safety of employees and the depth studies of symptoms of employees' risky behavior.

Another area for future research could be relationship of the psychological safety of employees with other human resource goals like talent retention, motivation and strategic performance management to team strategy, company performance and organizational effectiveness.

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Focusing agro-tourism structures for environmental optimization

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Abstract

The paper presents a preliminary analysis of the sector of agro-tourism referring to two case-studies: one in Italy (in the Trentino region) and the other in Romania (in the Transilvania region). That will be the base of a research on some potential criticalities in the two EU regions in order to improve the environmental performance of agro-tourism building and activities. The comparative analysis of the experience of Italy and Romania can offer an interesting starting point for the optimization of this sector in other EU and non EU countries. The planned research will also contribute in training those involved in agro-tourism activities in order to develop major awareness and attention on the environment

Keywords: sustainability; management; circular economy; agro-tourism.

Introduction

Over the decades, tourism is one of the fastest growing economic sectors in the world. In 2015 the World Tourism Organization indicated that international tourism marked an impressive six consecutive years of above average growth in terms of international tourist arrivals, with a total of 1,184 million tourists travelling the World (UNWTO, 2016). Tourism is defined as "comprises the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes not related to the exercise of an activity remunerated from within the place visited" (UNWTO, 2016). The agro-tourism regards the "welcoming and hospitality activity accomplished by individual agricultural entrepreneurs or associations, as well as by their families utilizing their own establishments (houses, exploitations)" (Ceccacci, 1999). Presently, this type of tourism is one of the most compelling practiced in most of the European countries, inducing/stimulating economic development through capitalization of local resources from the rural environment. In Europe, the agro-tourism sector is a highly competitive business, facilitating the creation of associations and organizations to promote the rural tourism (EuroGites, 2016; ECEAT, 2016).

Romania and Italy are two of the countries with a tourism heritage both for winter and for summer seasons thanks to their climate, geographic development and architectonic heritage. The legislation for this sector is under development in Romania being implemented only since 1989 (ANT, 2016). However, a very good impact had the European funds for the agro/rural tourism development. On the contrary, in Italy there is an older experience in the regulations of this sector, thanks to its presence in the European Union since a longer time.

The paper presents some preliminary aspects suitable for a comparison between the sectors of agro-tourism in Italy and Romania, taking into account the main topics that can affect their sustainability. The concept of circular economy is involved too.

Case studies

Agro-tourism is a tourism which directly or indirectly promotes and supports the sustainable economic development. The cultural side of the Italian and Romanian agro-tourism can positively affect the interest for environment protection and circular economy, in order to reduce the production of waste and the environmental pollution also by informing the tourists about what they can do in order to not disturb the natural areas, resources and their use (Rada et al., 2014; Brad et al., 2015; Sæþórsdóttir and Saarinen, 2016). Climate change is a reality all over the world, and its complexity is increasing. Therefore, sustainability has become a national and international concern, ingrained in many organizational processes. The ability of organizations to respond to sustainability concerns is sometimes hindered by the complexity of integrating sustainability into business models and by the need to rethink their strategic directions (Cioca et al., 2015).

In this paper two case-studies are presented for a future deep comparison expected in a multi-year research. The chosen areas are one from Italy, the Trentino Region (Figure 1) and one from Romania, the Sibiu Region (Figure 2). In both case-studies the agro-tourism is well developed, both being well known destinations for national and international tourists.

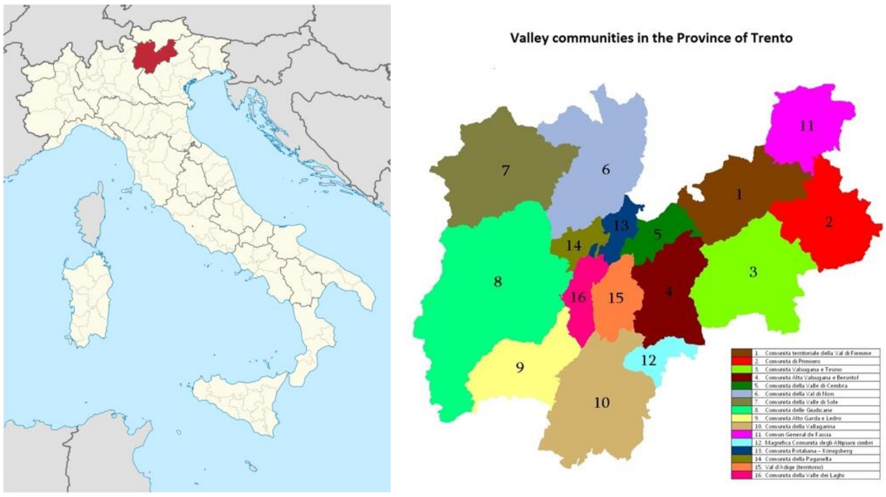

Fig. 1. Administrative map of Italy with Trentino highlighted and the valley communities in the Italian case-study (Rada et al., 2014)

Fig. 2. Administrative map of Romania with Sibiu County highlighted.

The classification of the agro-tourists boarding houses in the proposed case-studies takes into account the assignment of daisies (a scale from 1 to 5 daisies). In Trentino there are 441 agro-tourist boarding houses (Trentino Agricoltura, 2016), while in Sibiu County they are 118 (NIS, 2016).

The first case-study refers to an Italian province (Trentino-Alto Adige) that has about 538,223 inhabitants and has an area of 207.12 km². This region is characterized and divided in small and medium size communities, the number of municipalities today's being 177 (Provincia Autonoma di Trento, 2016). The climate is the alpine one and is very variable due to the presence of numerous mountains and lakes (Fazzini et al, 2003; Laiti et al., 2014). For this reason it is possible to enjoy sports and movements outside the whole year and the tourism sector is growing every year (Brida et al., 2010 and 2013). The waste and waste-water sector are very well developed complying the latest EU legislation, the IPCC and they are in concordance with environmental protection and circular and sustainable economy concepts (Rada et al., 2014; Ragazzi et al., 2015). From little ages the inhabitants are informed how to love and to protect the environment from many point of view. For example in schools there are many projects regarding the waste managements and each citizen can contribute with its improvement (Rada et al., 2016; Castagna et al., 2013). In the selected case-study all the agro-tourism boarding houses have drinking water and waste-water systems but only a part of them are connected to a district heating, the other ones use wood in domestic stoves/boilers from nearby areas. However taking into account the PM pollution, the province implemented a project to reduce the emissions in the domestic sector (Rada et al., 2012; Autret 2011). In order to reach these houses and to reduce the air pollution from traffic (Vogt et al., 2003; Istrate et al., 2014; Iglesias Merchan et al., 2014), mainly from the ones situated at high altitudes or in national parks the use of personal cars/motorcycle or other ones is forbidden or restricted. Statistical data of tourism indicators in Italy, in 2009-2014, indicate an evolution of this sector (Eurostat, 2016).

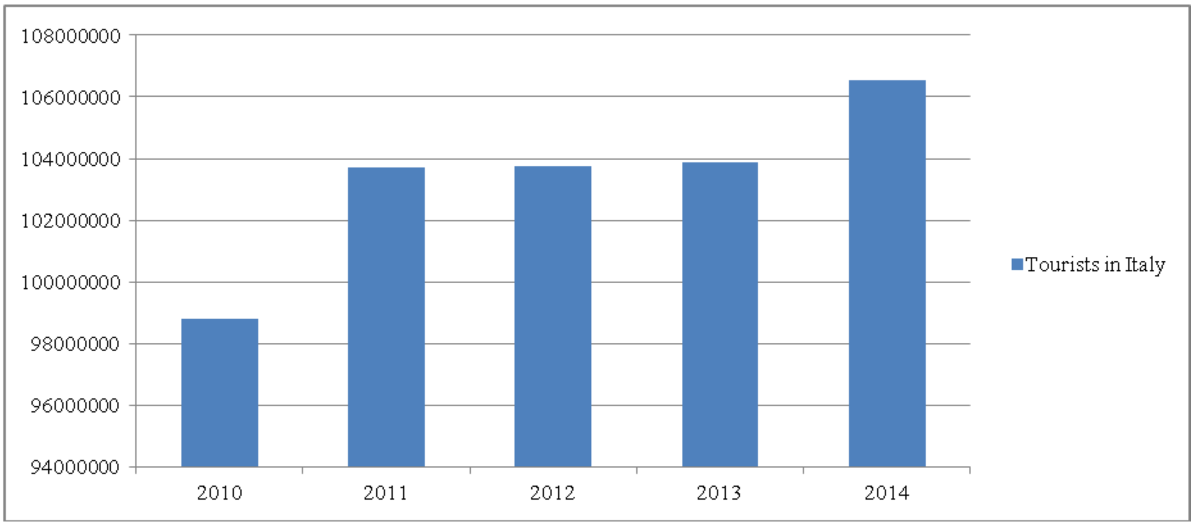

Fig. 3 Arrivals of residents/non-residents at tourist accommodation establishments
Source: Eurostat 2016

The second case-study refers to a Romanian county (Sibiu). This county is situated in the historical Transylvania region and has a population of about 397,322 and an area of 5,432 km². This county has 2 municipalities, 11 towns and 53 communes (NIS, 2016). The climate is a moderate continental one with temperature depending on landforms. In the South side there are the Carpathian Mountains - Făgăraș Mountains with heights over 2500 m. Also in this case-study the waste management and sustainable development from many points of view were studied in order to improve and reduce its impact on the environment (Ciudin et al., 2014; Cioca et al., 2015). In which concern the statistical data on the evolution of tourism indicators in Romania, in 2009-2014, shows increasing interest manifested both among tourists from Romania and abroad (Eurostat, 2016).

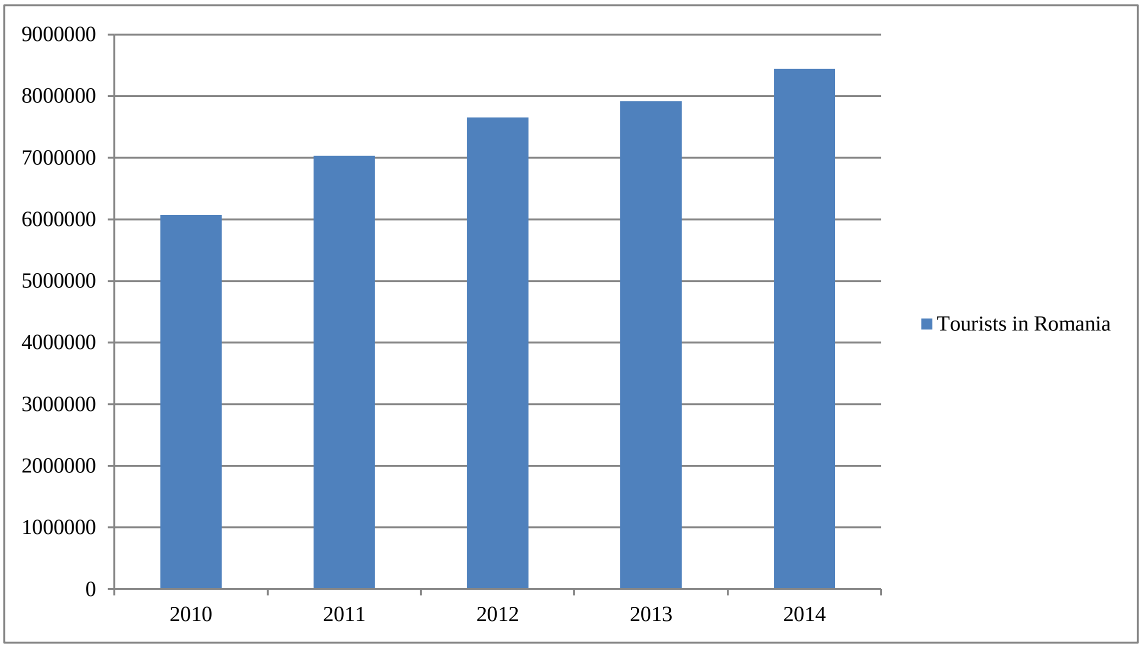

Fig. 4 Arrivals of residents/non-residents at tourist accommodation establishments
Source: Eurostat 2016

Material and methods

The main aspect is to develop and propose a healthy agro-tourism development strategy for both regions. It is also important to know that the regional governments can lead the development of agro-tourism sustainability by framing their policy instruments. By following good practices, agro-tourism can be an important part of sustainable development. Taking into account the literature, it was documented that agro-tourism can contribute to reduce pollution and to improve the sustainability of their businesses with the help of good practices of zero waste initiatives too. Properly, the concept of wastefulness in tourism has been discussed since decades (Leiper, 1997). Russo (2001) put a notice against the vicious circle of tourism development and environmental degradation. Different studies have documented the effects of tourism waste on the ecosystems that frequently label tourism destinations. Thus, it is expected to take action on the following environmental factors: waste, energy, air, water. The following are the different methodological aspects of the research that the Authors are focusing.

● Muncipal Waste

The first part will cover the quantification of waste produced by agro-tourist boarding houses for each fraction of the collection. This is aimed at finding a balance between the costs of disposing of waste being generated by the structure and the amount of waste actually attributed to the collection system. That costs, in fact, a growing burden on the economy of agro-tourist boarding houses having suffered in recent years a significant increase. An important aspect is also the proper waste separation by guests of the agro-tourist boarding houses. For example, by a dedicated poster, multilingual information can be placed at key points, allowing a clear and immediate communication of the source separation system through the identification of the types of waste produced by most tourists. One of the options that will be assessed will be that of making available a tablet (low cost) in the common area (breakfast room or other) to be accessed, following the selection of the language, to inform at different levels of details and to enable to understand the local organization of the collection and the environmental benefits of proper separation. The use of printed material will be minimized as far as possible favoring the dematerialized information. The languages provided could be adequate to the expected tourism fluxes (e.g. 6 languages). The organic fraction represents a significant waste production. In most cases, it is removed at the corporate level through the use of manure or compost. Therefore, there is a need of training to ensure a correct conduction of the composting process. A more careful management of the process would reduce the problem of odors and improve product quality compost and processing time.

●Energy

To reduce energy consumption a study on the efficiency of combustion systems used for heating and cooking will be developed. Electricity consumption can be reduced by the gradual replacement of traditional light bulbs with LED bulbs with a profitable life and higher energy consumption considerably smaller. For this purpose, it will be an analysis of the potential costs and so to have criteria for optimized replacement. On the domestic energy balance weights the high consumption of obsolete appliances. For this reason, their energy class will be identified and evaluated according to specific criteria, as the replacement needs a cost-benefit balance between energy savings and time required to recover the investment. Significant is the role of the installation of solar thermal systems, particularly in the case of agro-tourist boarding houses that provide accommodation. These systems, in fact, allow producing hot water in sanitary use allowing a saving on gas or electricity consumption up to reset the management costs for the sanitary water.

●Air

Domestic emissions are a major source of air pollution. However, nowadays, measures taken to reduce their impact are inadequate. The aim is therefore to assess the efficiency of combustion systems and fuels used to identify enterprise-wide. In fact, the impact on indoor and outdoor air varies depending on the fuel used and the achievement of a proper combustion process. In rural areas wood stoves are widely used with a low energy that lead to production of larger particles commonly used. It is therefore necessary to study the firing system, to provide replacements and to provide information on the use and management practices of the self-produced wood biomass.

●Water

The study involves analysis of water consumption of agro-tourist boarding houses in order to identify a way of saving and practices such as reusing water for irrigation purposes and for toilets. Even appliances (washing machines, dishwashers) causes a large consumption of water, so it is necessary to analyze the annual water power consumption, in order to assess whether it is appropriate to conduct a replacement of appliances and to support economically this transformation. The tourist should be informed and it will be introduced policies to encourage good practice.

Expected results and conclusions

The development of a research based on the above listed sectors of interest for environmental optimization could lead to an original method suitable at international level for the reduction of the impact of agro-tourism activities. The development of the research in parallel in Romania and Italy will help to cross check the viability of the criteria of optimization set during the work.

To promote interventions and environmental practices adopted by individual agro-tourist boarding houses it is expected to accomplish a classification of agro-tourist boarding houses based on purely environmental criteria such as for example the use of photovoltaic and thermal solar panels, the 'use of LED light bulbs, a class appliances A+ or A

++, etc. It is expected to assign a certain number of symbols according to the classification levels. The largest number of symbols owned will correspond to greater environmental protection by the agro-tourist boarding houses.

Conclusions

Agro-tourism represents one of the main types of tourism with the highest potential; its development is for the rural environment a way of sustainable economic, social and cultural development. The quality of the agro-tourism product is significant: it requires special attention on the environment being the "raw material" the field of development of agro-tourism activity. Sustainable development involves a complex and long-term action within any organization. All processes share this approach and the overall goal is to maintain a long-term equilibrium and resource utilization in a balanced manner (Cioca et al., 2015).

Agro-tourism, from one point of view, is intensive in producing waste and environmental pollution, but from another point of view, it could be an improvement source for generation and management due to the sensibility of agro-tourism destinations image on environmental damage. This paper is coordinated by a desire to fill this gap: by the need to develop and to improve the environmental performance of agro-tourism activities. This approach provides consensus while also guaranteeing the practical efficiency in order to improve the environmental performance, which is meant to ensure an operational framework for agro-tourism managers, enabling them to obtain sustainability a component part of decision-making and management processes.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Improving the quality of the process for selecting electrical equipment intended to be used in potentially explosive atmospheres

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Abstract

The explosion risk is one of the major industrial risks, being present in all units which produce, process, use, handle, store or transport hazardous substances, respectively products with flammable and explosive properties.
Since electrical equipment may represent an ignition source for explosive atmospheres, they have to be selected and installed properly. The paper presents an improvement of the selection process for electrical equipment from technological installations operating in explosive atmospheres, by the development of an expert system which represents a tool for finding the optimal solutions for selecting electrical equipment, in accordance with the safety and protection to explosion requirements specified in ATEX Directive 2014/34/EU which covers equipment and protective systems intended for use in potentially explosive atmospheres and in European Standards in the field.

Keywords: explosion risk; explosion-proof, electrical equipment;

1. Introduction

Within industrial installations in which are processed, circulated or stored flammable or combustible substances is likely to occur an explosive atmosphere, generating an explosion hazard. In this regard, from the protection to explosion point of view, electrical equipment used in such facilities have to be chosen correctly in order to increase the occupational health and safety level by preventing them from being an ignition source for the explosive atmosphere, thus decreasing work accidents and unplanned financial losses generated by explosion type events (Buica et al., 2012). In this paper are highlighted the characteristics of some parameters involved in the occurrence of an explosion and the ones related to the safety of electrical equipment intended to be used in areas with explosion hazard generated by flammable gases, vapours, mists, or dusts. The process for selecting electrical equipment intended for use in such atmospheres is quite a hard one, involving extensive knowledge of these parameters and it often is very time-consuming. In order to improve the quality of this process, there has been developed an expert system tool, based on the parameters and factors studied, which to facilitate the fast and proper selection of electrical equipment intended for use in potentially explosive atmospheres generated by flammable gases, vapours, mists or dusts. (Cioca and Moraru, 2012)

2. Basic concepts of flammable gas and dust explosions occurrence

Explosion prevention and protection to explosion is of major importance for the occupational health and safety field, leading to the decrease of human losses and sometimes to very costly material damages. For an explosive atmosphere to occur, the flammable substance has to be present in certain concentrations. If the concentration is too low or too high, no explosion can occur. In fact, a small combustion may occur, but not a reaction within the entire mixture. Therefore, the explosion may occur only if an ignition source is present and only if the concentration falls within the explosivity range of the substance, namely between the Lower Explosive Limit (LEL) and Upper Explosive Limit (UEL) (Querol et al., 2006; Ghicioi et al., 2012). The explosivity limits of the substance depend on pressure and oxygen share in air. The

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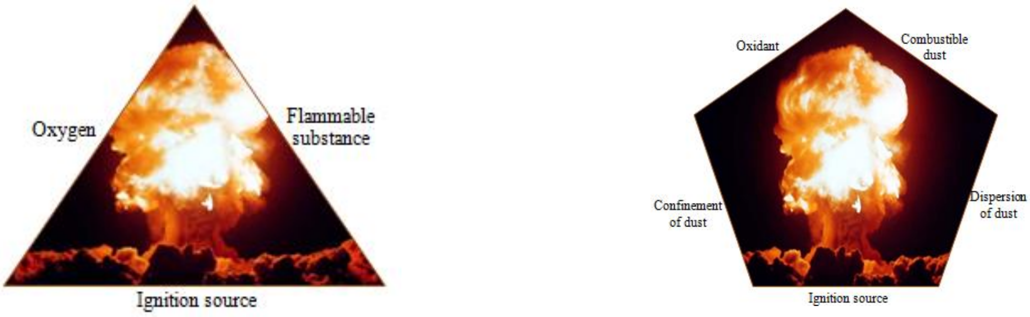
mechanism of an explosion generated by a mixture of flammable gas, vapours or mists with air may be expressed by the well-known explosion triangle presented in Figure 1 (a). From this figure may be concluded that an explosion may occur if there are simultaneously fulfilled three conditions:

1. fuel presence (flammable gases, vapours, dusts /powders, mists);
2. comburent presence (oxygen, oxidizing substances);
3. efficient ignition source for ensuring the activation of molecules in order to ignite and propagate the fast combustion reaction.



a) b)

Fig. 1. (a) explosion triangle; (b) explosion pentagon

The dust explosion has characteristics which are different than the ones of the gas explosion and may be in many cases more devastating. If for example an air current swirls a dust layer, within a small space, dust along oxygen generates a flammable air-dust mixture. If this mixture is ignited by an ignition source it triggers an explosion. The force of the explosion swirls more dust in the air, being in its turn ignited.

New concepts for prevention and protection to explosion develop new strategies for preventing the propagation of explosions or for limiting their effects, fact which involves taking into account aspects concerning the confinement (limitation, restraint, capsulation) of the explosive mixture (Riikonen, 2010; Vasilescu et al., 2015). Also, there have to be taken into account aspects concerning the fact that for considering a dust as combustible, it has to be explosive - to be in suspension in air, to have a distribution of particles able to propagate the burning and a concentration ranging between the explosion limits. Therefore, there may be defined the explosion pentagon presented in Figure 1 (b), by adding to the explosion triangle aspects concerning the mixture or dispersion of flammable substances and of the oxidizer, as well as the ones related to the mixture's confinement.

This representation provides a clear image on the explosion conditions and allows the identification of safety engineering measures for designing, manufacturing, installing and repairing installations in order to prevent the occurrence of an explosive atmosphere, of ignition sources or for decreasing the effects of eventual explosions by using protective systems.

3. Groups and categories of equipment used in potentially explosive atmospheres

Directive 2014/34/EU defines several types of groups and categories of electrical equipment (EU Directive, 2014):

Equipment Group I: equipment used for underground mines and for parts of the installations located at the surface of these mines, susceptible to firedamp and/or combustible powders (Moraru et al., 2013; Moraru and Babut, 2014). These types of equipment are not going to be treated in the current paper, the research focusing on the types of equipment presented in the following.

Equipment Group II: equipment intended to be used in explosive atmospheres, other than the ones in Group I.

Category 1 comprises equipment designed to operate in accordance with the operational parameters established by the produces and to ensure a very high level of protection. Equipment in this category are intended to be used in environments in which explosive atmospheres caused by air/gas, vapours, mists mixtures or by air/dusts mixtures are continuously present, for long time periods or frequently.

Category 2 comprises equipment designed for operation in accordance with the operational parameters established by the producer and to ensure a high level of protection. Equipment in this category are intended to be used in environments in which occasionally are likely to occur explosive atmospheres generated by air/gas, vapours, mists mixtures or by air/dusts mixtures.

Category 3 comprises equipment designed for operating in compliance with operational parameters established by the producer and for ensuring a normal level of protection. Equipment in this category are intended to be used in environments in which it is unlikely to occur explosive atmospheres generated by mixtures of air with gases, vapours, mists or dusts, or they occur seldom and only for a short time period. Equipment in this category ensure the protection level required during normal operation.

New standards in the field divided Group II of non-mining equipment into Group II for gases, vapours and mists and Group III for flammable powders in air. These standards have also introduced the EPL (Equipment Protection Level) concept (EN Standard, 2009, EN Standard, 2013): Ga, Gb, Gc for gases and Da, Db, Dc for equipment intended to be used in potentially explosive atmospheres generated by flammable dusts in air, equivalent to categories 0,1,2.

Therefore, a new classification in groups and categories arises (Nalboc et al, 2015; Pupazan et al., 2015):

- Gr I – mining
- Gr II (A, B, C) –surface gases
- Gr III (A, B, C) – dusts

Table 1 presents the connection between the ATEx category of equipment and EPL's on explosion groups for non-mining equipment.

Table 1 Connection between equipment categories and EPL's on explosion groups for non-mining equipment

Explosion group	Equipment category	EPL
Group II	1G	Ga
	2G	Gb
	3G	Gc
Group III	1D	Da
	2D	Db
	3D	Dc

4. Equipment selection criteria

Proper selection of electrical equipment for hazardous areas requires a series of information, such as:

- classification of the hazardous area, including the requirements for the equipment's protection level, if it is the case;
- if required, classification of gases an vapours in relation with the group or sub-group of the electrical equipment;
- temperature class or ignition temperature of gases or vapours involved;
- minimum ignition temperature of the flammable dust cloud, minimum ignition temperature of the flammable dust layer and minimum ignition energy of the flammable dust cloud;
- external influences and ambient temperature.

4.1 Electrical equipment groups and categories classification

Electrical equipment in Group II is divided in accordance with the nature of the explosive gas atmosphere for which it is intended. Divisions of Group II are: IIA – characteristic gas is propane; IIB – characteristic gas is ethylene; IIC – characteristic gases are hydrogen and acetylene.

Electrical equipment in Group III is divided in accordance with the nature of the explosive dust atmosphere for which it is intended. Divisions of Group III are: IIIA - ignitable fibers/flyings; IIIB - Non-conductive dusts; IIIC - Conductive dusts.

Table 2 Selection of electrical equipment based on equipment group, category, EPL and hazardous area

EN 60079-0		Directive 2014/34/EU		EN 60079-10-1 EN 60079-10-2
EPL	Group	Equipment Group	Equipment category	Zone
Ga	II	II	1G	0
Gb			2G	1
Gc			3G	2
Da	III		1D	20
Db			2D	21
Dc			3D	22

4.2 Types of protection to explosion for electrical equipment

The types of protection to explosion represent those specific measures applied to the electrical equipment in order to avoid the ignition of an explosive atmosphere which surrounds it. From the constructive point of view, electrical equipment may dispose of several types of protection specified by the producer in the Ex marking, in compliance with standards in force. Types of protection for electrical equipment are categorized as follows: Intrinsic safety “i”, encapsulation “m”, flameproof enclosure “d” (Magyari et al., 2014; Magyari et al., 2015), increased safety “e”, pressurization “p”, oil immersion “o”, powder filling “q”, non-incendive “n”, optical radiation “op”. Details related to each type of protection are explained within national and international standards in the field (Niculescu and Pasculescu, 2015; Niculescu et al., 2014; Pasculescu and Niculescu, 2015)

4.3 Electrical equipment selection depending on the ignition temperature for gases/vapours and ambient temperature

Electrical equipment has to be selected in such a manner which to ensure that the maximum surface temperature does not reach the ignition temperature of all gases/vapours or dusts which may present (Petrilean et al., 2015). Symbols for temperature classes which can be marked on the electrical equipment are indicated in Table 3 which presents the connection between the ignition temperature of gases or vapours and the equipment’s temperature classes.

Table 3 Connection between gases or vapours ignition temperature and temperature classes of equipment

Temperature class required for area classification	Ignition temperature for gases or vapours °C	Admitted temperature classes for equipment
T1	>450	T1-T6
T2	>300	T2-T6
T3	>200	T3-T6
T4	>135	T4-T6
T5	>100	T5-T6
T6	>85	T6

5. Expert tool for selecting electrical equipment intended for operation in potentially explosive atmospheres

Aiming the optimization of the process for selecting and installing electrical equipment in potentially explosive atmospheres (Pasculescu et al., 2015, Pasculescu et al., 2013), there has been developed an expert system which to facilitate this. The reasoning of the expert system addresses the issue of finding the best and fastest solutions for selecting and installing explosion-proof equipment, in compliance with safety and protection to explosion legislation in force. The expert system, whose interface is presented in Figure 2, has been developed in C# programming language and tested on Microsoft Windows XP and 7 operating systems.

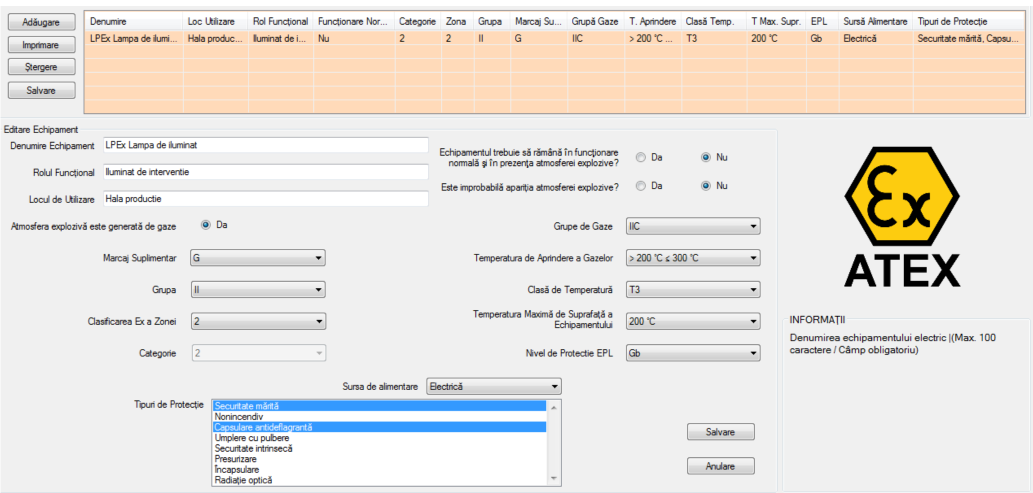


Fig. 2. Interface of the expert system

The expert system is based on a complex algorithm relying on the input of certain data concerning the place of use, hazardous area classification and operational role of the electrical equipment. It provides the user with the possibility to select certain significant parameters regarding the necessity for the equipment to operate in normal conditions in explosive atmospheres.

Other parameters and data which can be selected by the user deal with the group and category of the electrical equipment, with the gas and dust groups, ignition temperatures, Equipment Protection Level (EPL), maximum surface temperature of the equipment and types of protection to explosion applicable for each situation.

After the proper input of every equipment into the expert system's database, the computer generates a report (Figure 3) which can be printed, and in which it is specified the fact that the electrical equipment has been selected and installed properly for operation in potentially explosive atmosphere, in compliance with the requirements specified in the ATEx Directive 2014/34/EU and applicable standards in force. At the end of the report, the Ex marking which has to be present on the equipment's labeling is also specified.

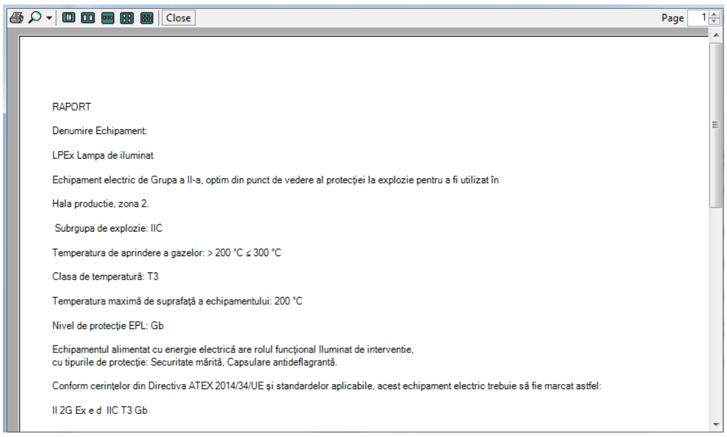


Fig. 3. Report generated by the expert system

6. Conclusions

The process for selecting electrical equipment intended for use in potentially explosive atmospheres generated by mixtures of air and flammable gases, vapours or dusts requires extensive knowledge in the protection to explosion field. This process is quite time consuming, and in order to increase its quality and to facilitate the proper selection of electrical equipment intended to be used in such atmospheres, there was developed an expert system which to represent a useful tool for staff operating in industries which process, store or transport flammable substances.

The expert system presented in the current paper provides technical staff with an easy-to-use tool for fast and reliable selection of explosion-proof electrical equipment. Equipment are selected in compliance with the safety and protection to explosion practices in force and brings along an increase of the occupational health and safety level in industries with potentially explosive atmospheres generated by flammable gases, vapours, mists or dusts.

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Appropriate management of preventing actions an health and safety for testing activities of high explosives in confined environment

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Abstract

The specific activities of testing civil use explosives in test ground presume a significant risk level for health and safety of the operating personnel and even for other people situated in the area. The preparing operation of the explosive charges, the priming of them in confined environment their detonation should be mode by taking in count a series of factors which can generate uncommanded explosion risk of the exposed personnel. In the paper is presented the assessment of the applicable safety measures at two testing technical facilities for the high explosives, tested confined in steel pipes. The mass in confined environment (in steel pipe) is characteristic for high explosives with low sensibility to the initiating impulse from detonators with initiation capacity no.8, as example ANFO type explosives mixtures. The high of the explosive charges is up to 6 kg equivalent TNT and the shrapnel generation by the explosion is the major risk in these tests.

Keywords: explosive testing, confined environment, risk, prevention

1. Foreword

Activities related to explosives involve significant risks for workers running them and for other people in the area of influence. Such manufacture, packaging, handling, transportation, storage, preparation blasting at a controlled detonation of explosives or eliminate unusable (irregular or guarantee out) rises a series of problems regarding security of persons and property. In specialized laboratories (LMEAP - Laboratory explosives for civil use and pyrotechnics LTI - Laboratory for Blasting Techniques) within the Department of Safety Explosives and Pyrotechnic Articles (DSEAP) activities are carried out often with explosives that had not yet meet health and safety features, they will during the tests and certifications for verifying and ensuring measures for the safe use throughout the life of these products.

Thus, the jobs / workstations existing in the specialized department DSEAP these measures for safety and health at work must be applied very carefully in order to achieve full control of specific risks arising from their activities with explosives.

2. The explosive detonation mechanism

Detonating the explosive in a controlled action is scheduled and carried out taking all the security measures applicable. The explosion occurs as a result of energy transfer from an external stimulus that will trigger the explosive charge violent exothermic decomposition reaction (oxidation) of explosive material. This reaction is of a "chain" type with its spread throughout the explosive and totally consumption of it without the need for external energy or other interventions or addition of atmospheric oxygen in its deployment.

In contrast to the phenomenon of burning normal or bursts character deflagrate where the propagation velocity is of the order of m/s up to hundreds of m/s for the detonation reaction is carried out with the speed of propagation of sound, with thousands of meters per second, the phenomenon is perceived by the human sense (sight, hearing) as instantly.

Phase transformation from solid compound, gelatinous or liquid phase material with gaseous aggregate state at this speed of reaction leads to higher volume through the phase change from solid - gas many thousands of times, the sudden

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release of energy manifesting itself with develop a high pressure on the order of tens or even hundreds of kilo bar in the reaction zone and a sharp rise in temperature. So in response to the explosion energy is manifested as both thermal and mechanical energy, the first being exploited technically in the process of blasting (mechanical destruction of material) in area of influence.

The mechanical energy developed by the detonation of the explosive process acts as a shock over the environment. In this open space pressure decreases after a commandment that is characterized by the expansion of gas explosion on available space to the inverse cube of the distance from the epicentre. Such a relationship is synthesized by Richards and Moore:

$$P = A * (R/(W)^b)^a \tag{1}$$

where:

P - wave peak overpressure [kPa];
A - constant specific to load location;
R - distance from the source point of detonation considered, [m];
W - equivalent detonated explosive mass[kg TNT]
a - empiric exponent experimentally determined (negative);
b - exponent assigned for explosive charge.

Fig. 1. Measurement of explosion pressure in blast bunker with two piezoelectric transducers - catch oscilloscope image

3. Risks generated by the detonation of explosive charges in test polygon

Exposure to the effect of explosion pressure of air pressure front is one of the most important effects of the explosion and inadequate exposure to it, may endanger the people of the impending fatal influence. To the extent that this pressure decreases in the tens of mili-bars respectively on logarithmic scale to a level of 120 to 140 dB can permanently damage the hearing aid. The main preventive measure is the shelter of the staff and remote triggering the explosion.

Generating explosive shrapnel confined in steel tubes are a major risk of injury or killing of people in situations that are throwing their fly-path. The kinetic energy of this shrapnel is particularly high speed when throwing disintegration of the steel tube is even detonation of the explosive speed that is confined between 2000 and 5500 m / s in plain situation. Therefore the kinetic energy of released shrapnel:

$$E_s=m_s*v^2/2 \tag{2}$$

where:

E_s - kinetic energy of shrapnel [J];
m_s - mass of shrapnel, [kg];
v - shrapnel speed launching [m / s].

In the event of shrapnel weighing 50 grams, the kinetic energy will certainly higher to 100 kJ and throw distance in open space can reach hundreds of meters or even kilometres.

Fig. 2 Confined explosive charge in steel pipe prepared in blast bunker

Other factors also increase the danger of shrapnel penetration and formation of very sharp cutting edges with the heating to high temperatures of hundreds of ^{0}C.

Fig. 3 Preparing confined explosives charge and installing booster and detonator

These tests on explosive charges are frequently in the technical facilities of the test site. All explosives are not sensitive to initiation with detonator no. 8 must be loaded in steel tubes and the initiation is done with booster made of high power explosives. Also the determining the property detonability high nitrogen content fertilizer is carried out in a steel pipe with an inner diameter of 100 mm and a length of 1 meter with wall thickness about 5 mm, the material under test load size with 500g hexogen booster reaches over 5.5 kg TNT equivalent mass and the steel pipe being approximately 7 kg, that will generate on a complete detonation 7 kg of extremely dangerous shrapnel.

Fig.4 Scrap and shrapnel generated by pipe when testing an explosive gel - 200g cartridge conditioned to hydrostatic pressure

As a measure to protect staff these works, detonating confined explosive charges is carried in the baffled blasting bunker designed to withstand blast pressure generated 10 kg eq. TNT, respectively in an armoured explosion chamber for the determination of toxic gas explosion that can detonate loads of up to 600 g net explosive under perfect seal during the explosion and subsequent measurement. Both reinforced concrete walls structures are lined with material wear to stop shrapnel and to withstand the explosion pressure exerted on the walls, ceiling floor. The baffled blasting bunker allows detonate larger explosion charges, explosion pressure is vented through the baffle with section 2x3 m the replaceable liner elements of bunker retaining all the shrapnel.

The presence of **explosion toxic gases** expose personnel can cause acute or chronic poisoning. Explosion gases are dangerous from the point of view of toxicity consist mainly in carbon oxides (CO and CO_2) or nitrogen oxides (NO,

NO_2 and NO_3) the gases is in high amount considering that the solid mass of the explosive is converted to the mass of the gas mixture with very high concentrations in enclosed spaces.

Fig. 5 Armoured explosion chamber for the determination of explosion toxic gases

This appears at testing tunnels for explosives and detonators and also in the two both blasting equipments mentioned above. After carrying out a test the operator blaster and the test responsible engineer should check the result (i.e. complete detonation) and for placing on the location the next charge which is one further test needs to enter into this space. This is done strictly by finding complete cleaning of air by means of mechanical ventilation in tunnels and the gas chamber or by natural draft when blasting is made in baffled the bunker.

4. Conclusions

Testing explosives in the stands and the existing facilities of the explosives polygon at INSEMEX is taking measures to prevent the manifestation of risks for their staff and people from the adjacent area, due to the identification and quantification of the effects of controlled explosions by the existence and use of adequate technical equipment and facilities for this purpose, awareness and training of personnel for proper implementation of work instructions necessary to technical and organizational measures conducting activities safely.

Acknowledgements

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Securing fire safety for underground structures

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Abstract

For science-based introduction of the effective organic construction materials (OCM) in underground constructions, two principles of normalization of their application are offered. One of them, so called logical is based on comparison of fire - technical properties (FTP) – combustibility, inflammability, heat release, propagation flame over surface, smoke ability, toxicity of fire gasses of the newly developed material with the same properties widely used in practice of underground construction materials. The second principle which can be called estimated - analytical, is that having a construction with concrete mining-technical characteristics and operation conditions and based on certain theoretical prerequisites, the dangerous factors of fire (DFF) quantitatively are defined as in fire growth zone, as well as beyond this zone. Before carrying out normalization of OCM application by these principles, it is offered to make an assessment of materials on their main operational properties - durability, deformability, thermo-physical characteristics, air permeability, depending on a purpose of OCM. The work provides OCM requirements by these properties. It is shown that the logical principle of normalization though toughens the requirement to the materials on fire safety, but doesn't promote forbidding of the most effective material. The estimated-analytical principle of fire safety assessment of the constructions brings to definition of computational probability of DFF influence on a person per year. The last is considered as a function of fire probabilities, evacuation of people, and an effective work of technical solutions for fire-prevention protection. In this work, the issue of recording the main DFF influencing on survival of a human and their limit values is discussed. The increase of fires around the world, apparently, should be explained with the growing volume of capital construction and large-scale utilization of the constructive, insulating, protective – insulating and technological new effective organic construction materials (OCM) with low resistance against fire in different units of the developed countries. The intention is occurred to limit utilization of these materials not taking into account the technical-economical effectiveness obtained by their introduction, and that a level of fire safety is defined not only by fire-technical properties (FTP) of the materials, but also by the means of its active protection. Fire safety of underground structures means such a condition, where regulating probability excludes fire origin and propagation, influence of dangerous factors of fire (DFF) on humans, and provides protection of material values.

Keywords: organic construction materials; fire-technical properties; dangerous factors of fire.

1. Introduction

Frequently, normalization of use the effective OCM in underground structure is happened by examining – competition of two opposite tendencies: intention to provide maximum fire safety of the object not taking into account the expenses for fire protection, and intention to increase reliability and longevity of structures without recording of damage from possible fire. Such approach to embed progressive materials at construction of structures cannot be considered rationale and it is necessary to optimize normalization of OCM utilization, i.e. to develop such norms that would promote wide application of effective materials with simultaneous securing of a normative level of fire safety of structures. For science-based utilization of materials in structures, it is considered reasonable to use two principles. One of them so called logical is based on comparison of FTP of new OCM with the similar properties of widely applicable in practice materials. The meaning of this principle is that if application of any traditional material ensures a specific satisfactory level of fire safety of structures, then application of FTP new material in the same places of structures should not decrease a level of fire safety of structures. In this regard, the databank has been developed on FTP (combustibility, flammability, heat release, propagation flame, smoke, toxicity of combustion products) materials – etalons widely used in underground construction.

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The second principle of normalization of use the materials called estimated – analytical, is that having a structure with concrete mining-technical characteristics and operation conditions (based on certain theoretical prerequisites shown in (Lanchava *et al.*, 2007; Ilias *et al.*, 2005; Abashidze, 1986; Abashidze *et al.*, 2006; Churadze and Abashidze, 2004)) the DFF quantitatively are defined as in fire growth zone, as well as beyond this zone.

2. Materials and methods

Normalization of utilization the materials under logic or estimated – analytical principles should be preceded by their normalization through their basic operational properties. All four groups of OCM – constructive materials (CM), insulating (IM), protective – insulating (PIM) and technological (TM), first of all, should have strength and deformation characteristics. Besides, IM additionally should have thermo-physical properties (heat conductivity, heat capacity, linear temperature expansion) and air permeability. The methodological issues related to definition of the properties of these materials are shown in (Churadze and Abashidze, 2005).

3. Results and discussion

The databank on strengthening and deformation characteristics of the main type OCM used in underground construction is created. The Figure shows the essential levels of strengthening, deformation, thermo-physical characteristics and air permeability. These levels are offered based on the analysis of working conditions of materials in underground structures and on definition of property values of main operation properties of OCM, successfully used in such conditions for a long time. The following notations are shown in the Figure:
$1-R`_{ten}$ , $2-R`_{ben}$, $3-R`_{com}$ , $4-R`_{spal}$, $5-R`_{sl}$ , $6-R`_{adh(con)}$, $7-R`_{adh(met)}$ , $8-E`_{ten}$, $9-E`_{com}$ , $10-E`_{sh}$, $11-\lambda$, $12-c$, $13-\beta$, $14-K`_{ap}$, where $R`$ and $E`$ are correspondingly design resistance and axial module of elasticity. λ - coefficient of heat conductivity; c - heat capacity; β - coefficient of heat linear expansion; K_{ap} - coefficient of air permeability. The indexes: $ten, ben, com, spal, sl, sh$ accordingly are: tension, bending, compression, spallation, slice, shearing, and index $adh(con)$, $adh(met)$ – adhesion to concrete and metal. The white and black columns accordingly mean that notations of the characteristics have to be not lower and not higher of the values indicated in Figure.

At replacement of traditional materials by new ones, assessment of fire safety acc. to only a single indicator – combustibility (as it is acceptable in the normative documents), in our opinion, is not enough. Because the proposed material can be at the same level as traditional material on combustibility but can concede in others. In this regard, complex assessment of fire safety of untraditional effective materials is essential. To conduct such assessment, the results of fire testing of materials are used – etalons, namely, values of the following FTP (and their parameters): combustibility (group of combustibility, oxygen index – OI); inflammability (density of inflammability heat flow); heat release (quantity of heat, speed of heat release); propagation flame on surface (limit and speed of propagation); smoke (coefficient of smoke); toxicity of fire gasses (quantity of combustion products).

The logical principle of normalization although toughens requirements for the materials, but does not promote prohibition of the most effective materials at construction and exploitation of structures. This principle reveals those properties of material according to which it concedes material – etalon. It is important to know to secure fire safety of structures through available means of fire prevention and fire protection. A condition for the material to be admitted is a correspondence of combustibility groups (proximity OI), as well as proximity of densities of heat flow necessary for inflammability of the proposed material and material –etalon. At revealing of one or two with the worst properties compared to analogous parameters of material – etalon, the systems of fire prevention and fire protection should be introduced into the object. The first of these systems should be used if OCM concedes to the etalon only by the parameters of heat release. The second – only if OCM have the worst parameters of propagation flame. Application of both systems is essential at availability of OCM worst parameters on toxicity of fire gasses and smoke. If OCM concedes to the etalon by parameters three or more properties, its utilization is inadmissible at construction and exploitation of structures.

The estimated –analytic principle of evaluation of underground structure`s fire safety is connected with definition of design probability of effect DFF on a human per year: $Q = f(P_f, P_e, P_{fs})$, where P_f is probability of fire origin in a structure per year; P_e - probability of evacuation of people; P_{fs} - probability of effective work of fire safety’s technical solutions. P_f and P_{fs} can be defined by the certain methods knowing the conditions of a structure’s exploitation and technical characteristics of fire safety means.

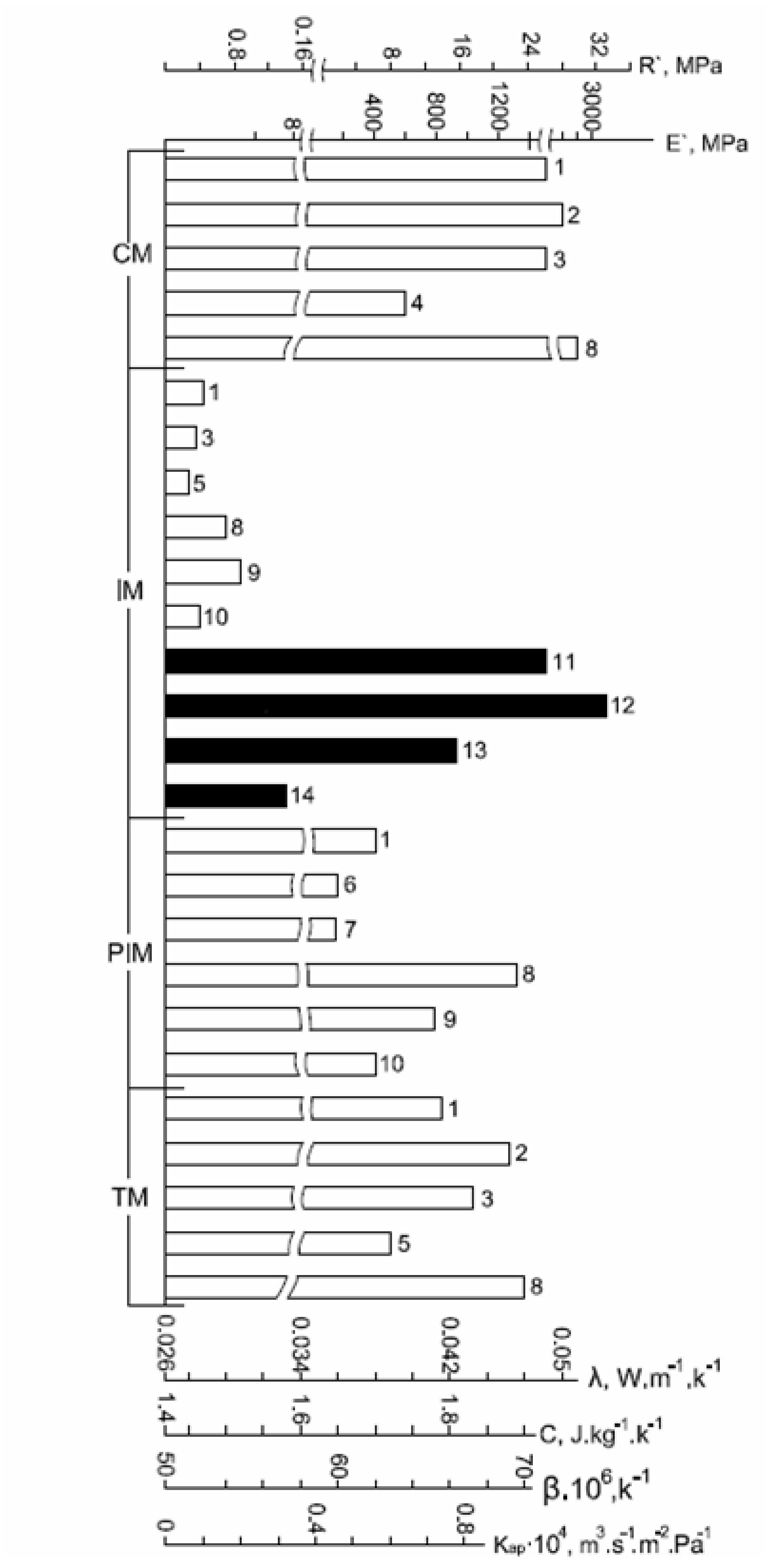

Fig. 1. The essential levels of strengthening, deformation, thermo-physical characteristics and air permeability of OCM

Probability of evacuation is $P_e = 1-(1-P_{ew})(1-P_t)$, where P_{ew} – probability of evacuation through evacuation ways; P_t – probability of evacuation through transitions in the adjacent units of a structure. Calculation of P_{ew} needs the value of time from the beginning of fire to blocking of evacuation paths consequently DFF propagation (τ_{bl}, min.), as well as estimated time of people's evacuation and time interval from fire origin to starting evacuation (τ_{f-e}, min.).

Underground objects, as a rule, are not structures where the fire can be revealed simultaneously with the people inside. Therefore τ_{f-e}, cannot be considered equal in zero. Taken into account that in the structures can be fire alarm systems, the value τ_{f-e} should be accepted equal to time of system's operation in consideration of its inertia. In tunnels without alarm systems, for example, value of τ_{f-e} should be 0.5 -2.0 min.

Hereby, to estimate probability of evacuation, and in final, probabilities of DFF influence on a human, it is essential to have value of τ_{bl} that can be obtained by estimation of DFF on evacuation paths in different moments of time.

4. Conclusions

The issue is emerged about recording the main DFF effecting on survival of people and the limiting values. In our opinion, the main DFF should be temperature of fire gasses, heat radiation, concentration of oxide, carbon dioxide and oxygen, the indicator of light attenuation by smoke per unit length (visibility). As a result of the analysis of the existing in literature data in this direction, we have accepted the following limiting (critical) values of DFF: temperature - 338 K, concentration: carbon oxide -0.1%, carbon dioxide – 7%, oxygen – less than 16%. Concerning visibility of smoke-filled area, it should be mentioned that at optical density of smoke, 1-3 B visibility is 2m, and at optical density 0.4 B and 0.1 B – 5 and 10 m accordingly. If take account that a human can freely move in smoke-filled area at distance visibility 5m, then as critical values of visibility the optical density of smoke – 0.4 B is accepted. Although, as obtained results of experiments on a tunnel model have shown, optical density of smoke with a value 0.4 B is reached after 15 – 20 minutes of fire beginning. Other DFF are occurred in a construction much earlier. Therefore, in our opinion, optical density of smoke is not a determining dangerous factor at evaluation of fire safety of a structure.

Having had the estimation results of initial stage of fire growth in a structure, the minimum time (time for blocking evacuation paths) can be determined before approach of critical value of any above described DFF.

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Improving the group decision by optimization of risk management for specific activities with explosives for civil use

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Abstract

Risk management is associated with all interests and objectives in any economic environment for expression, both in normal situations and in crisis throughout the whole range of actions, decisions and activities. Risk management is not a new concept to the scene of important actors national and international political economic. Risks are a component of all activities being found in various forms and whose consequences were magnified as a result of development of human society. Thus, all organizations, the risks must be addressed in a holistic manner, embedded in a system of risk management. Many decisions both in personal life and in business organizations are taken under risk and uncertainty but insufficient knowledge of their plans explain differences in probability of actions taken to mitigate them. Under national law, each public entity should analyse systematically at least once a year, risks related to their activities, develop plans to limit the possible consequences of these risks and nominate responsible for implementing those plans. European Union Member States were required to integrate risk management in public management reforms. A first objective of this work is represented by disclosing the results of research undertaken to risk analysis and risk management issues specific activities with explosives for civil uses. In this way, to achieve the objectives set by the economic activity in explosives for civil use depends largely on efficient management and thus risk management operations associated with these types of products. A second main purpose of this paper is to analyse the risk response strategies and streamline decision in the light of risk analysis within business operator with explosives for civil uses. The process of risk management is the main tool to reduce the risk and is a fully integrated element in planning and conducting operations with explosives for civil use, allowing successful deployment of specific actions in an environment with high risk. Moreover, risk management in these economic operators to ensure: efficient use of human and material resources engaged in all activities in situations of normalcy and economic crisis, and risk assessment; informed decisions to promote certain interests or implementing action plans to achieve them; offering reasonable alternatives to achieve the objectives set; identification of feasible and effective control measures where there are no specific standards. Through proactive attitude without risk and risk management and throw efficientization of decision in risk analysis, the economic operator with activities in the field of explosives for civil use could be enforced in three major areas of interest: actions, processes and strategies. These three areas will be a result of this pro-active, more effective attitude.

Keywords: explosives for civil use, risk management, strategy, risk analysis.

1. Introduction

World twentieth century and the first decades of the XXI century is characterized by complexity of the risks, complexity requires different and more effective solutions to global problems. Any activity is conducted under risk, these dangers are more or less known, more or less serious.

A first objective of this work is represented by disclosing the results of research undertaken to analyze risk and risk management issues specific activities explosives for civil uses. So, how to achieve the objectives set by the economic

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activity in explosives for civil use depends largely on efficient management and thus risk management operations associated with these types of dangerous goods (EC/43/2008; Mannan, 2005).

A second main purpose of this paper is to analyze the risk response strategies and streamline decision in the light of risk analysis within business operators explosives for civil uses. The process of risk management is the main tool to reduce the risk and is a fully integrated element in planning and conducting operations with explosives for civil use, allowing successful deployment of specific actions in an environment with high risk.

Moreover, risk management in these economic operators to ensure: efficient use of human and material resources engaged in all activities in situations of normalcy and economic crisis, and risk assessment; informed decisions to promote certain interests or implementing action plans to achieve them; offering reasonable alternatives to achieve the objectives set; identification of feasible and effective control measures where there are no specific standards (RO 2007/IB/EN-02 TL).

Through proactive attitude without risk and effective risk management and decision risk analysis, the economic operator with activities in the field of explosives for civil curable in three major areas of interest: actions, processes and strategies. These three areas will be a result of this pro-active, more effective.

The issue of risk in the economic organization of explosives for civil uses stems from the fact that it is not isolated from other social organizations from the fact that we live in a civilization of risk. Three permanent risk accompanying verbs: analyze (risk identification and assessment of direct and indirect consequences), reduce (or eliminate their risk prevention) and finance (costs and potential losses means accepted) (EC/43/2008; RO 2007/IB/EN-02 TL).

2. Economic risk management in the organizations from the field of explosives for civil use

Contemporary studies of sociology specific economic organizations, characterized by a unique spirit of discipline, common to the military, from an institutional perspective, rooted in the writings of Max Weber on bureaucratic organizations (economy and society) (EC/43/2008; Ozunu and Anghel, 2007).

The specific characteristics of these types of organizations are derived from primary goal, namely the proper management (under absolute law applicable), substances and dangerous products. Under the impact of new technologies, content crossed economic goals important changes, the organization is not free from risks. However, referring to the risk of the organization, we cannot ignore the uncertainty, the difference between risk and uncertainty being given by the concepts of information and knowledge and deep domain. In terms of effective management - as an organization's security, it is imperative instructive configuring a complex process whose aim must be endorsed by the whole endeavour theoretical - methodological and practical use of leadership subsumed. Analysis and risk assessment in economic organizations in the field of explosives for civil use, highlights the main conceptual elements of specific risk management generated by explosives, meaning they are studied developments in risk management, the effectiveness of the management according to the progress of the scroll process organization and management, after analysing risk influence on the decision of the economic organization need to implement risk management across the organization and preparation for risk - a definite problem will occupational education.

Risks in an economic organization of explosives for civil uses are many and diverse. It is widely accepted that the assignment and mitigation involves proper training in integrated management (SSM-Medium Quality-Information Security), and a degree of cohesion of the team and the organization as a whole. The risk management process must be permanent because at any moment may appear new derivatives risks that must be controlled before the throne and lead to disaster. The primary objective of an effective risk management is the ensuring global security indicator predictable specific safety zone within the limits of acceptability corresponding to a risk of a bearable level which is characterized by damage at a reasonable cost. For easy tracking risks identified and evaluated it is important for every organization to have a database of them or risk registers. Risks can be grouped into categories according to the activity subject to risk factors that may generate risk, probability and estimated impact, the person responsible for pursuing risk management strategies. Further provided are synthetic approaches usual customary risk analysis (EC/43/2008; Cavender et al., 2008; Moraru and Băbuţ, 2010; Băbuţ et al., 2011).

The deterministic approach

- Focuses on assessing the consequences of a series of scenarios based on an assessment preselected default frequency. Approach leads to a site representation affected areas for high lethality, irreversible effects, etc., for a range of scenarios analysed;
- This analysis evaluates the importance of the consequences in detail only undesirable event and not its frequency, which is the default examined;
- Selection of pre scenarios will be made through a qualitative determination of frequencies production based on historical analysis, expert opinion, rules of good practices on prevention and protection, specific regulations;

- Consequences of accidents are measured in quantitative terms, an estimate distances damage assessed values calculated confronting, radiation, toxic concentration etc. thresholds for initiating various effects (high lethality, the early stage of lethality, irreversible etc.);

This approach can be applied to simple installations with high level of standardization (eg. LPG storage, flammable and toxic substances, etc.).

Probabilistic approach

- Focuses on assessing in detail both the consequences and frequencies. For a particular location results in areas where representation is estimated some probability, having a particular effect (eg. High lethality) due to adverse events analysed.In addition, there are derivatives of the above approaches, namely: „Consequence based" The approach of distances "generic".
- Focuses on getting "of distances generic" based on the evaluation of the activity and / or quantity of hazardous substances without providing a detailed assessment of consequences and frequencies. Determining these distances it is mainly based on historical reasons and analysis of accidents that have occurred, operational experience in similar locations, specific regulations etc.

"Hybrid" approach semi quantitative

- Evaluating the consequences of this approach and / or frequency is performed alternately in terms of quality or quantity, they risk being integrated in the index.Starting from the approach used will need to adopt a methodology for analyzing structured and organized based on the recommendations presented in Table 1.

Table 1

Step	Abordarea ″RISK BASED″/ Abordarea ″HYBRID″	Abordarea ″CONSEQUENCE BASED″
1.	Preliminary analysis of critical units. (PHA-Preliminary Hazards Analysis)	
2.	Identification of the final events. (TOP EVENT or LOC)	EVENTS final identification (TOP EVENT or LOC) and scenarios - based on historical analysis, expert opinion, best practice rules, laws and regulations.
3.	FREQUENCY estimate scheduled for each event.	
4.	Analysis and calculation of expected RATE SCENARIOS related to each event.	
5.	Defining terms for each event SOURCE.	Defining terms for each event SOURCE.
6.	Evaluation of the extent of the consequences of each SCENARIO.	Evaluation of the extent of the consequences of each SCENARIO.
7.	Integration into overall risk indices that may include both individual risks and societal.	
8.	Comparison of the calculated risk acceptance criteria: (1) risk matrix, which is the compatibility of certain levels of risk (in terms of frequencies and distances loss) and urban development / environment; (2) individual risk, the threshold of acceptability on the frequencies of certain physical effects (eg. The probability of irreversible effects equivalent to 10-6 where only allow limited residential development); (3) social risk (curves F / N)	Are proposed areas of damage calculated for different categories of effects on existing territorial classifications.

The schematic diagram bellow are fundamental elements of a common risk analysis (Fig 1).

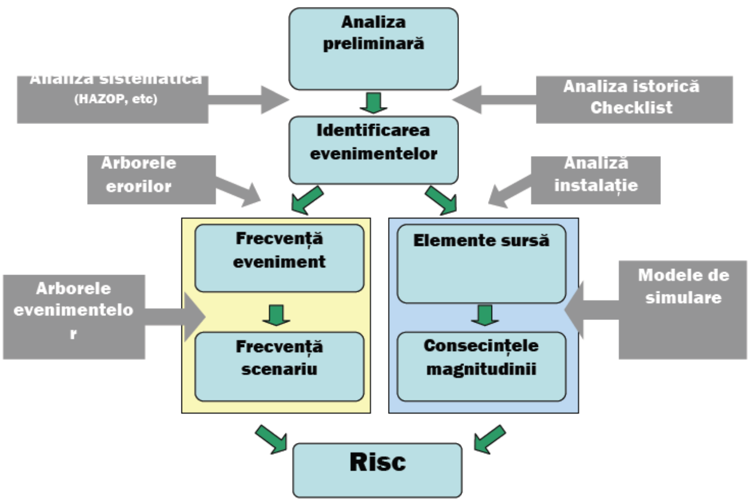

Fig.1. Diagram with a fundamental risk analysis

Safety management system (SMS) is part of the overall system management organization that includes the organizational structure, responsibilities, documents (practices, procedures, processes) and resources for determining and implementation of major accident prevention policy; include the following: organization and personnel, identification and evaluation of major hazards, operational control, management of change, planning for emergencies, performance monitoring, audit and review.

Security management system is designed to implement in practice the concept of safety, to prevent occurrence of unwanted events and accidents, including major accidents involving dangerous substances. Security Management System structure is shown in Figure no. 2.

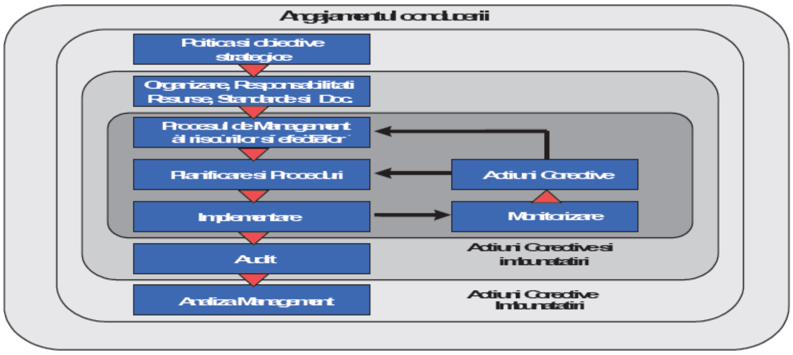

Fig.2 The integrated security management system

Security management system documents

The main documents of the SMS are:
- Internal emergency plan in the event of major accidents (the review procedure);
- Rules of organization and operation of private emergency service;
- Intervention plan to fire;
- Intervention plan in case of accidental pollution;
- The evacuation plan displayed in every workplace;
- Procedures and Specific instructions:
- Instruction environmental activities;
- Specific instructions for hazardous substances;
- Intervention in emergency situations;
-Software maintenance and overhaul;
- Fire patrol program;
- Register the fire patrol;
- Register of accidents, accidents, incidents;
- Register control systems technical security and safety;
- Registry for registration of vehicles and persons entering the goal;
- Job descriptions with specific responsibilities for security management system.

Organization and staff

The coordination of technical security management, security and occupational health, emergency, environment within the company represents all the leading technical structures.

Top management develops and makes its own policy known workers on preventing workplace accidents, major accidents involving dangerous substances, occupational diseases, protection against fires. To meet these requirements, top management will consider improving and implementing integrated management system of the company.

It should also be documented aspects of the role and responsibilities of personnel involved in the management of major hazards, namely to:
- Management Peak;
- Personal Intervention;
- Personal Security and protection, including the one with responsibility for special transportation of explosive materials;
- Chief / Deputy Chief of explosives warehouse;
- Artificers

Involving workers and subcontractors where appropriate

Workers must comply with all legal requirements and regulations relating to working with hazardous substances. Thus, safety issues strictly related to persons responsible and performers.

Responsibilities are described in the job and the staff is trained regularly and whenever significant changes are implemented.

During the trainings are envisaged:
- Explain properly the necessary information;
- Verifying the understanding, purpose and importance of information;
- Identify possible communication needs;
- Answers to the questions raised.
- Keep a log of your training.

Contractors

When you visit the site or in the case of work performed by subcontractors, the people involved are informed about the risks of the site.

At all levels of the organization, responsible for the contract must ensure that all contractors and their employees comply with requirements for security management system.

The initiator is responsible contract clauses stipulating the security contract for subcontracted activities.

Contract holder is responsible to the originator's contract on the management aspects of prevention of major accidents stipulated in the contract.

3. Planning, evaluation and identification of strategies in response to risk. strategies to prevent the risk of economic area organizations explosives for civil use

Develop and implement risk management in economic organizations in the field of explosives for civil use, require proper preparation and creative driving style. In addition, the mechanism requires that the decision to support the whole process of risk management (EC/43/2008; Moraru and Băbuţ, 2010; Băbuţ et al., 2011).

Quality of management, the results obtained by the organization, and risk management training depend on the various qualities and skills of managers, based on the management of these organizations there is a complex of principles, rules, requirements to ensure constant updating. *Diagnosis and weather risk* in the economic organization of explosives for civil use, provides a picture of the attitude of the organization against risk arising from transactions with explosives, as well as aspects of education / culture to prevent OSH and estimation / assessment of risks analyzed and evaluated.

Risk response strategies in the economic organization active in the field of explosives for civil use, based on a science complex, namely examine the strategy as a way to answer the risk question: concept, features, components; typology presenting risk response strategies; Highlighting how to identify risks in these types of business organizations.

Strategies to prevent risks in economic organizations in the field of explosives for civil uses, primarily aimed at analysis of the dimensions of risk exposure - frequency and severity, risk profile of these types of economic organizations, namely tolerance for risk and how laying decision risk conditions. Risk management implies a system of effective control in these types of organizations, work to prevent having a particularly important role. Applying risk prevention strategies aims to reduce / eliminate exposure to these organizations.

4. Improving the decision from the perspective of risk analysis in the field of economic organization explosives for civil use

Managers of the economic organizations explosives for civil uses, depending on the situation, must make decisions under conditions of risk, based on a prudent and predictable conditions subject to prior knowledge of existing health and safety at work across the organization. In this respect, the decision established quality is essential to achieving the objectives and the smooth functioning of the organization. (2, 3, 7)

Within these organizations, by decision finding those seeking future courses of action designed to ensure maximum efficiency of all management actions. The decision is the key factor for the organization in implementing and sustaining organizational change, given that adaptability to change tends to become an urgent requirement for the selection and evaluation of personnel, already a goal of organizations changing. The success decision is based on individual factors (such as cognitive and personality) and studying these factors allows to identify people who have the potential to take effective decisions in dynamic and complex organizational environments, the specific situation of organizational change. There are situations where the volume increased information and uploading information forces the decision maker to allocate more time searching for information (critical skill in most managerial roles) and less time learning derived information. On a personal level, charging information is associated with the inability to cope with stress caused by inadequate knowledge and potential adverse effects are obvious decision - makers cease to operate effectively with an increasing volume of information to be processed for the decision. The economic organization of explosives for civil use shall be taken in the process of decision making in the ideal case being that of using a logical process configuration and decision making, which means the systematic options and establish clear criteria assessment as to assess each option and conducive to choose the most optimal solutions (EC/43/2008; Ozunu and Anghel, 2007; Mannan, 2005).

Management decision-making at every level of command is made up of decision-making structure of the components functionally interconnected and decision-making process, thus ensuring decision superiority.

Decision-making in the organization of explosives for civil uses is an activity of producing new knowledge committed to a particular course of action and involve a number of specific -administrative functional elements of this approach. The decision in the specific risk assessments of the organization explosives for civil covers the whole management process in terms of efficiency and effectiveness of decision established following risk analysis. Thus, decision-making factor is the specific task of liability that have a significant effect on the whole organization of the activities and results. Given the nature of activities under the economic organizations of explosives for civil use is estimated optional analysis is an analytical model suitable for decision-making. Based on this model participatory structures to build process diagrams responses and counter-responses for each option / option / solution analysis. (EC/43/2008; AIChE, 2000; APSWG; Cavender et al., 2008)

Group takes note of this decision and assess probabilities and utilities each branch to calculate the maximum or minimum possible outcomes of a decision scientifically. The role of the analytical model is to standardize the decision-making process at the strategic level, contributing to the management decision-making, part of the decision superiority. However, this model implies a decision and control structures well defined and structured at top management level.

5. Conclusion

- The issues addressed in the paper is topical because the issue of risk management is not a permanent solution, the very concept of risk becoming more complicated and debatable.
- Implementation of integrated management of risks in economic organizations in the field of explosives for civil brings a number of benefits such as a greater likelihood of achieving objectives, improve understanding of key risks and the implications activities, management's ability to -and assume a higher risk for a reward (benefit) greater etc.
- The effective management of risks from an economic organization of explosives for civil use requires information on both the magnitude of risk and the importance that the organization must pay to reduce risk(s).

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Occupational safety risk analysis tools depiction in a selected off-shore drilling company

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Abstract

A risk analysis tool applied in highly hazardous working activities, such as is the case of *off-shore* drilling should be both efficient in terms of risk identification/quantification, and cost-effective. It also should provide sufficient detail to enable the ranking of risks for further consideration of risk prevention and appropriate protection measures selection. This papers aims at briefly depicting an operational risk analysis tool employed in such a company for occupational safety and health management purposes, within an integrated management system. Our main goal is to highlight the need for complementary use of various methods and tools in the risk assessment practice of Romanian companies, regardless of their field of activity.

Keywords: risk analysis tool; off – shore; Job Safety Analysis; risk matrix; integrated management.

1. Introduction

Any organization operating in an environment that influence the risks but creates at the same time, a context that fixes the limits within which risks must be managed. Moreover, each organization has partners relying on their approach for achieving the goals (Cioca et al, 2002). As emphasized by Moraru et al. (2014), an effective risk management for occupational health and safety (OHS) must take into account the priorities established by the partners too with respect to risk management processes. Therefore, the environment in which the organization subsists is not neutral. In theory and practice devoted to risk we are speaking even about the *extended organization* (at the level of the interacting environment).Risk management must be subordinated to the objectives that form an integrated, coherent and converging system, towards the overall objectives, so that activity levels to support each other (Cioca and Moraru, 2012). This approach allows the organization to define and implement a risk management strategy that starts from the top and is integrated into routine activities and operations of the organization.

As highlighted by ABS (2000) and Barker et al (2000), offshore oil industry is complex and governed by rules and conventions developed by national and international authorities. The goal of implementing an integrated management system is helping the company personnel to interpret the requirements of ISO 9001, ISO 14001, OHSAS 18001 when applied to maritime management, fulfilling the ISM Code requirements. ISM Code is based on safe management operation of ships and pollution prevention. ISO 14001 brings elements for effective management of the environment, while ISO 9000 series of quality ensure that the needs of the client are met (IMO, 2002). OHSAS 18001 helps the organization to control risks and to increase performance. As these three standards together with the ISM Code are complementary in nature, they were integrated into a management system that is implemented in the company which is the subject of this paper.

2. Analyzed off-shore drilling company description

The Offshore Drilling Services company is a unit with legal personality, which was founded 17 years ago and develops the following main activities:

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- offshore towage, offshore fastening and assembly on location, towage and installation of steel structures at sea;
- material, technical and food supplies to offshore platforms;
- execution of works, renting and services for third parties, internally and externally, depending on the availability of existing equipment - ships, equipment, heavy equipment, etc;
- execution of "directional drilling" services using own or hired specialists and equipment;
- special operations and service to offshore platforms with own teams;
- rescue operations interventions with own vessels/ships of the company;
- storing, storage, preservation and maintenance of equipment, tooling, facilities, material and other tubular material supplied;
- development of social activities for employees ;
- periodic medical examination and primary treatment in the doctor's office and points inside the medical wards.

The company has three towing supply vessels and two floating cranes, all under the flag of Malta, transport and heavy equipment for industrial activities on land and drilling tools and tubular material. The company is a member of International Association of Drilling Contractors (IADC). In the company, of a total of about 370 employees there are about 40% higher level education specialists. The company provides technical and safety management for five mobile self-erecting offshore drilling platforms. The organization comprises the following main subunits: ships; drilling fluid station; ramp for drilling tools; internal domestic services (deposits, automobiles, other vehicles); administration.

3. Inventory and depiction of occupational safety risk analysis tools employed

The organization has identified two broad categories of risks: i) associated with individual operations carried out in the various processes; ii) related to emergencies situations that may arise in certain locations (ships, platforms, departments). Identification and analysis of operational risks aims to establish whether or not the risks are managed properly. As shown in Gerigk (2006), risk assessment aims at a simple mathematical way to determine whether:

- risks are reduced to the lowest acceptable level to ensure a safe system of work;
- best working practices are followed;
- applicable regulations are complied with.

Risk assessment techniques commonly applied to operations Offshore Drilling Services include:

- inspections / checks using checklists;
- risk analysis per operation, basically employing Job Safety Analysis (JSA);
- supervision and monitoring of identified hazards to health and safety at work;
- continuous hazard management emerged from the investigation of unwanted events;
- audits of the Integrated Management System.

Operational risk assessment is carried out in the HSEQ department and provided to all coordinators and organizational structures to be processed periodically with staff, under specific training (Kontovas and Psaraftis, 2006). To assess potential emergency situations that may occur on ships and platforms, the committee for safety situations of the company and safety committees of each ship and platforms are analyzing:

- operations, maneuvers and events held on board and which, through an inadequate evolution could affect the safety of its crew and on-board equipment or could lead to marine pollution;
- the risks associated with introducing new technologies and equipment on board;
- hazards associated with maintenance and repair work carried out by staff or third parties both on board and in various repair yards;
- potential hazards generated by faulty operation of equipment, handling of dangerous goods or human error in the operation of the vessel / platform;
- conclusions of the reports on accidents, incidents and emergencies that has involved any vessel / platform of the company;
- conclusions of the reports on accidents, incidents and emergencies that has involved any vessel / platform of similar companies;
- the result of studies and research carried out internally or international regarding emergencies on board of supply vessels and mobile offshore drilling platforms;
- internal and external safety audit recommendations;
- conclusions drawn after carrying out emergency exercise on board of own vessels/ drilling platforms.

After identifying potentially hazardous situations the safety committees describe them as sequences (scenarios) and propose appropriate measures of prevention and intervention. According to International Maritime Organization (2002), risk analysis includes ways to reduce both the consequences (the safeguards) and their probability of occurrence (by measures of avoidance and / or prevention). Assessing consequences will be in done, according to the scale shown in Table 1, while probability classes are defined according to the scale depicted in Table 2

Table 1. Gravity quotation scale employed in Offshore Drilling Services

		-	Description of consequences (always take into account the maximum foreseeable consequences)	
Value	Degree of damage	Risk consequence on workers	Risk consequence on equipments (property)	Environmental risk consequences
5	Catastrophic	Fatal or collective accident	Catastrophic damage, indefinitely shutdown	Uncontrolled pollution
4	Very serious	Serious injuries requiring long-term hospitalization	Major damage, very long term shutdown	Pollution imposing external support
3	Serious	Accidents with temporary work incapacity of more than three days	Serious damage, long term shutdown	Important pollution on large surfaces
2	Moderate	Injuries requiring medical supervision; not work accident	Important damage, short term shutdown	Moderate pollution on small surfaces
1	Low	Minor injuries requiring first-aid	Low damage, very short term shutdown	Very small, controllable pollution

Table 2. Probability scales employed within the company

Value	Probability	Descriptor
5	Unavoydable	Damage will occur certainly
4	Very likely	Damage will occur frequently
3	Likely	Damage will occur with low frequency
2	Unlikely	Damage will occur occasionally
1	Highly unlikely	Damage is unlikely to occur

Risks associated with the identified hazards are assessed / reassessed according to the instruments given in Tables 3 and 4, as follows :

- annually, when the structure of activity / location has not changed;
- immediately after the coming into operation of new equipment (for that location and related activities);
- mmediately, if change from normal operation or technology (for location and related activities).

Table 3. Risk level evaluation

RISK LEVEL **(Probability x Consequences)**	
(red)	= **HIGH** (Unacceptabil) - 15 to 25
(orange)	= **MEAN** (Acceptale, if adequate mitigation measures are implementedi) - 5 to 12
(green)	= **LOW** (Acceptabil risk) - 1 to 4

Table 4. Risk matrix

PROBABILITY						
Unavoydable	5	**5**	**10**	**15**	**20**	**25**
Very likely	4	**4**	**8**	**12**	**16**	**20**
Likely	3	**3**	**6**	**9**	**12**	**15**
Unlikely	2	**2**	**4**	**6**	**8**	**10**
Highly unlikely	1	**1**	**2**	**3**	**4**	**5**
CONSEQUENCES		**1**	**2**	**3**	**4**	**5**
		Very low	*Moderate*	*Serious*	*Very serious*	*Catastrophic*

The matrix of simultaneous operations is outlined in Table 5, which allows the optimization of the Work Permit6 system.

Table 8. Matrix of simultaneous operations and optimization of work permits issuing

4. Discussion and conclusion

The investigated company establishes and maintains targets for maritime safety, occupational health and safety for each job level and within the organization. In setting the organization's objectives there are taken into account legal requirements, the risks and dangers of environmental pollution and health and safety at work, maritime safety, technology options and business development as well as the views of stakeholders. Management at the highest level has delegated a representative with defined authority to deploy, maintain and develop the Integrated Management System so that it always be appropriate and adapted to the activity of the organization.

WORK OPERATIONS	Production / Injecton	Platform relocation	Rig translation	Conductors fixation	Demontare trapa	Trap dismantling	Mantling/dismantling	Open-fire work	Inbalance of support foot	Production drilling	Drill outside production	Fluid losses/inflow	Drill "killing"	Casing insertion	Cementing
Production / Injecton	A	F	F	R	A	R	R	A	R	A	A	A	F	A	A
Production tests	A	F	F	R	A	R	R	R	F	F	A	F	F	A	A
Platform and rig head maintenance	A	F	F	R	A	R	R	A	R	R	A	R	F	A	A
Crane operations	A	F	F	A	A	A	A	A	A	A	A	A	F	A	A
Supply vessels operations	A	F	F	A	A	A	A	A	R	A	A	A	F	A	A
Open-fire work	R	F	F	R	R	R	R	F	F	F	R	F	F	R	R
Divers and ROV (Remotely Operated Vehicle)	A	F	F	R	A	R	R	A	R	R	A	R	F	A	A
Overbord and high level workings	A	F	F	F	A	R	R	A	R	R	A	R	F	A	A
Radiography and fault detection	A	F	F	R	R	R	R	R	F	F	R	F	F	R	R
Testing pressure vessels and pipelines	A	F	F	F	R	R	R	R	R	R	R	R	F	R	R
Emergency simulations	A	F	F	A	A	A	A	A	A	A	A	A	F	A	A
Construction operation	R	F	F	R	R	R	R	R	R	R	R	R	F	R	R
Helicopter operations	A	R	R	A	A	A	A	A	R	R	R	A	R	A	A
Flow-line installation	A	F	F	F	A	R	R	A	A	R	A	R	R	A	A
Working at the eruption (blowout) preventers	A	F	F	F	A	R	R	F	F	F	A	F	F	A	A
Flaring production tests	A	F	R	F	A	A	A	F	F	F	A	F	F	A	A

A - allowed R - restricted F - forbidden

These responsibilities were allocated to the HSEQ department director who is at the same time designated as person ashore for the entire company.Admitting the fact that offshore drilling platforms are socio-technical systems, which are characterized by a high level of complexity, we however appreciate that the basic levels of work processes are unchanged. As a result, we consider that in the selection of risk analysis tools, the professionals from the studied company taken were based on a sound knowledge of the strengths and limitations of different methods, being able to critically assess patterns most suited to application in practice.Nevertheless, the HSEQ experts need to gets the ability to distinguish between "*what is happening*" in the working system and what "*should be happening*" so to be able to differentiate pragmatically various potential accident scenarios and to apply purposeful the available tools.

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Municipal solid wastes in the south-eastern mediterranean region: quality, quantity and management

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Abstract

The paper reports an analysis of the municipal solid waste (MSW) generation and composition in various Mediterranean countries comparing a high income level country (Italy) with emerging countries of the Southern East Mediterranean Area. The disposal systems of MSW are very different in each examined country of Mediterranean area and from Italy, where the separate collection (SC) has shown a positive trend in the last years. Based on consolidated Italian experience, compost represents an optimal treatment/disposal system to be implemented widely in other Mediterranean emerging countries where the organic fraction is the highest fraction. Waste to energy(W-to-E) options have been analyzed and greenhouse gas limit emissions should be fixed as a standard in every Mediterranean country.

Keywords: collection; disposal; treatment; waste to energy, municipal solid waste.

1. Introduction

Urban growth in Mediterranean regions has caused an increase in the generation of household, special handling, and nonhazardous industrial wastes (Aguilar-Virgen et al., 2013). A fundamental step in municipal solid waste (MSW) management is the assessment of the quantities and composition of the wastes (Ciuta et al., 2015).

In Mediterranean countries the composition of the waste is quite different than in northern Europe countries. Particularly, the organic fraction is predominant in countries from Mediterranean basin. The composition is dependent on the income levels and the type of the population living in the specific area (Cointreau-Levine, 1999; Gidarakos et al., 2006; Taboada-González, 2010). Urban growth has caused an increase in the generation of household, special handling, and nonhazardous industrial wastes. Such wastes are accumulated at final disposal sites and can cause air, water, and soil pollution if proper waste management practices are not followed (Aguilar-Virgen et al., 2013, Ciudin et al., 2014; Ranieri et al., 2014a, 2014b; Van Lienden et al., 2010).

Because MSW arises as a direct consequence of human activities, the population of a country has been chosen as the first major parameter determining the amount of waste generated: the more people living in a country, the more waste produced. The mean living standard of the population of a country is the second major parameter that can be related to the rate of municipal solid waste (MSW) generation (Daskalopoulos et al., 1998).

Otherwise the composition of solid waste in Mediterranean basins is also different from other lower income countries such India where the generation of solid waste is 0.40 kg/capita-day and the characterization shows a high proportion of mixed residue (organic material mixed with soil, mud, sand and other inert materials) to the extent of 81% (Kumar and Goel, 2009; Sharholy et al., 2008). This is attributable to the lower living standards of low-income groups since generation rates are generally dependent on income levels (Chung and Poon, 1998).

The MSW management in Italy and in the EU countries is changing rapidly thanks to the up-dating of the old legislation or to the development of new technologies for energy recovery from MSW and to selective collection increase (Ragazzi and Rada, 2008; Rada, 2014; Ciudin et al., 2014).

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The European Community aims to ensure that member states adopt a waste management hierarchy in which management systems are ranked based on their environmental impact. Among the various options, incineration and landfill score the lowest. The most preferable options include prevention, material recovery, and recycling (EC, 1997; EC, 2008b; López et al, 2010). The targets outlined in the Landfill Directive 99/31/EC state that the biodegradable municipal waste (BMW) sent to landfill must be reduced by 75% for 2010, 50% for 2013 and 35% for 2020 (% of 1995 levels). In 2008, with the recycling and/or recovery of packaging waste, "a new era begins". For the year 2015, and taking into account the Council Directive 94/62/EC, new targets were requested at EU level: 60% for paper, cardboard and glass, 22.5% for plastics, 50% for metals and 15% for wood. At European level, the norms for the combustible material (RDF/SRF) that can be obtained from waste have been already up-dated (Rada, 2016). Nowadays, the targets that must be achieved for the waste management refer to the year 2020 and put the attention on the waste valorization through recycling, reuse and energy recovery.

The paper would describe the composition, collection and disposal of municipal solid wastes in various countries of South Eastern Mediterranean basin. In particular, the Italian and Southern Italian scenario is compared to other emergent countries bordering Mediterranean sea: Algeria, Lebanon, Egypt, Israel, Turkey.

The objective of the paper is to focus the trends on the MSW data in those Mediterranean countries and to suggest the best practices for collection and disposal of municipal solid wastes in emerging countries. An analysis of the energy from wastes and greenhouse gas of the MSW has been also performed in the paper.

2. Waste generation

Waste generation and composition is very variable as a consequence of income levels and the size of cities. In certain areas of Mediterranean basin such Palestina, it was found that, although MSW collection service was available for 98% of the residents in the areas surveyed, no proper treatment or landfill procedure was followed for the collected waste in most of these areas. Instead, waste burning in open dumpsites was the most common practice. Moreover, due to inefficient collection of waste disposal fees from the residents, municipalities were forced to sometimes cut the collection service and reduce its labor force, especially in villages. In most developed countries, workable legislation, regulations, and action plans are now in place. However, waste disposal in developing countries is still largely random and uncontrolled, and large quantities of waste go uncollected (Al-Khatib at al., 2007; Blight and Mbande, 1996).

Cointreau-Levine (1999) report some typical waste generation rates for low-income, middle-income and high income countries (table 1).

Table 1. Waste Generation Rate (Cointreau-Levine, 1999)

	Waste generation rates (in kg/capita/day)		
	Low-income country	Mid-income country	High-income Country
Mixed urban waste Large city (>500000)	0.50 - 0.75	0.55 – 1.1	0.75 – 2.2
Mixed urban waste Small to medium city (<500000)	0.35 - 0.65	0.45 – 0.75	0.65 – 1.5
Residential waste only	0.25 – 0.45	0.35 – 0.65	0.55 – 1.0

Table 2 demonstrates how waste composition varies by income levels. Because the solid waste of high-income countries contains a lower percentage of food material, yard wastes, and other putrescible organics, the resulting moisture content of the waste is lower and the resulting calorific value higher. The waste of developing countries does not have sufficient calorific value to self-sustain incineration; that is, it will not burn without the addition of fuel.

Table 2. Global Perspective on Urban Solid Waste Characteristics (Cointreau-Levine, 1999)

Composition of raw waste (by wet weight, %)	Low-income country	Middle-income country	High-income country
Vegetable/putrescible	40 to 85	20 to 65	20 to 50
Paper and carton	1 to 10	15 to 40	15 to 40
Plastic	1 to 5	2 to 6	2 to 10
Metal	1 to 5	1 to 5	3 to 13
Glass	1 to 10	1 to 10	4 to 10

Rubber, miscellaneous	1 to 5	1 to 5	2 to 10
Fines (sand, ash, broken glass)	15 to 50	15 to 40	5 to 20
Other characteristics:			
Moisture	40 to 80	40 to 60	20 to 30
Density in trucks (kg/cm)	250 to 500	170 to 330	100 to 1 70
Lower heating (kcal/kg)	800 to 1,100	1,000 to 1,300	1,500 to 2,700

As shown in table 3 the waste generation per capita per year (2010) varies from 192 kg (Algeria) to 523 kg (Italy) whit a percent increase variable from 8% (Lebanon) to 48% (Apulia, South Italy). Italy has a waste generation quite higher than the other Mediterranean countries. South Italy (Apulia) has an intermediate generation between Italy and the other Mediterranean countries.

Table 3. Waste Generation in South Italy and in South and East Mediterranean countries (World Bank/METAP, 2000)

	Lebanon	Syria	Jordan	West Bank Gaza	Egypt	Tunisia	Algeria	Morocco	Total South-East Mediterranean Region	South Italy (Apulia)	Italy
Estimated Solid Waste Generation 1998 (106 tonnes)	1.4	3.4	1.3	0.9	14.5	1.8	5.2	6.0	34.5	1.4	28.1
Projected Solid Waste Generation 2010 (106 tonnes)	1.8	5.7	2.0	1.7	20.1	2.3	7.4	8.8	49.8	2.1	31.5
Percent Increase In Waste Generation	28	69	57	83	39	26	41	47	44	50	12
Estimated Annual Per Capita Waste Generation 1998 (kg)	337	203	284	321	219	193	173	206	242	354	470
Projected Annual Per Capita Waste Generation, 2010 (kg)	363	243	349	362	247	211	192	246	277	523	520
Percent Increase In Per Capita Waste Generation	8	20	23	13	13	9	11	19	15	48	10

In the Mediterranean region the vegetable/putrescible fraction of the MSW tends to be higher than the Northern European countries (World Bank, 2012). Table 4 shows the composition of the range of the urban waste in the Mediterranean area and the countries outside typical range.

Table 4. Generalized Solid Waste Composition for South and East Mediterranean countries (World Bank, 2012)

	Typical of Region (%)	Countries Outside Typical range
Paper/cardboard	11 – 14	Lebanon (17%)
		Israel (22%)
Glass	2–7	Lebanon (9%)
Plastic	7 – 10	Jordan (16%)
		Israel (14%)
Metal	2–6	
Putrescible	55 – 70	Israel (43%)
Fabric/textiles	3-5	
Unespecified	2–5	Egypt (13%)
		Israel (8%)

Fig. 1 shows a comparison between waste composition in six different Mediterranean countries, including Italy and South Italy. Organic matter of MSW (OFMSW) is ever the highest fraction ranging from 28% of Italy to 60% of Egypt and 63% of Lebanon. Italy and South Italy shows the highest percentage of paper and cardboard, respectively 24% and 18%.

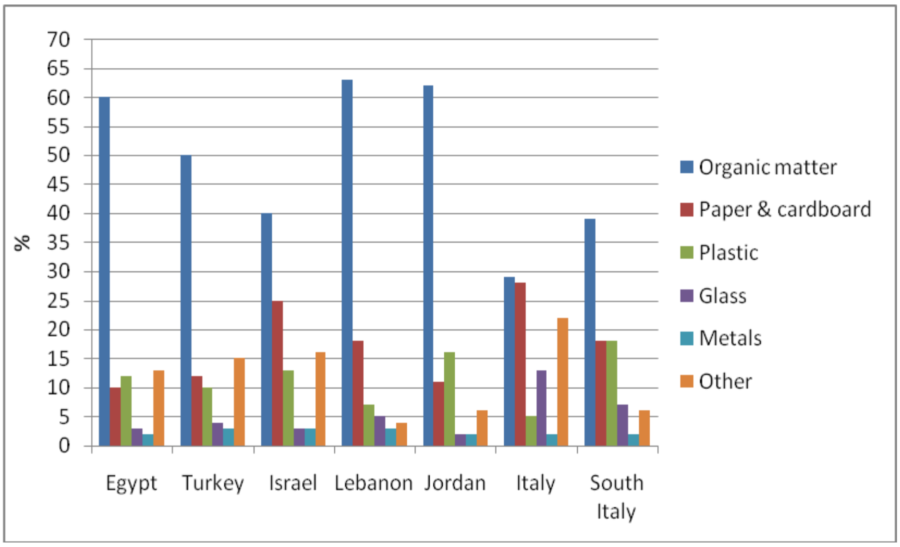

Fig. 1. Waste composition in six different Mediterranean countries

As shown in Fig. 1, for the various countries higher is the income level, lower is the percentage of organic fraction. Differently in Central America - Mexico - where high socio-economic status results in the highest organic fraction, as shown in table 5 (Aguilar-Virgen et al., 2013).

In Latin America, environmental regulations regarding solid waste management have traditionally focused on final disposal on the land (landfilling) rather than on minimization, treatment, recycling, materials recovery, or energy recovery. Even though during the last decade important improvement shave taken place in some countries in terms of evolving from disposal practices relying on open dumps to the use of sanitary landfilling, many of these countries have neglected a comprehensive strategy based on the waste hierarchy (by focusing only in landfilling).

Consequently, in order to attain sustainable solid waste management in developing countries, it is suggested to implement a waste hierarchy which aims at, on the one hand, reducing the amount of waste to be landfilled, and on the other hand, limiting the quality of the waste that is landfilled (Gandini and Diaz, 2013; Rada et al., 2014).

Table 5. HSW composition in Mexico by socioeconomic status (Aguilar-Virgen et al., 2013)

	Low (%)	Median (%)	High (%)
Organic matter	36	40	41
Textiles	10	6	3
Paper and cardboard	23	22	23
Plastics	12	12	12
Glass	4	5	6
Tin cans	1	1	2
Metals	<1	<1	<1
Disposable diapers	6	8	4
Inert waste	2	2	2
Other non-organics	<1	<1	<1
Miscellaneous	4	3	4

3. Separate collection

Particularly significative in the Mediterranean area is the growing of separate collection in Italy and South Italy. While from 2001 to 2010, the MSW generation per capita was quite constant ranging from 510 to 540 kg per capita the percentage of separate collection tends to increase in the last decade from 27% to 35% (Fig. 2a) for Italy and from 12% to 16% for Apulia (Fig. 2b).

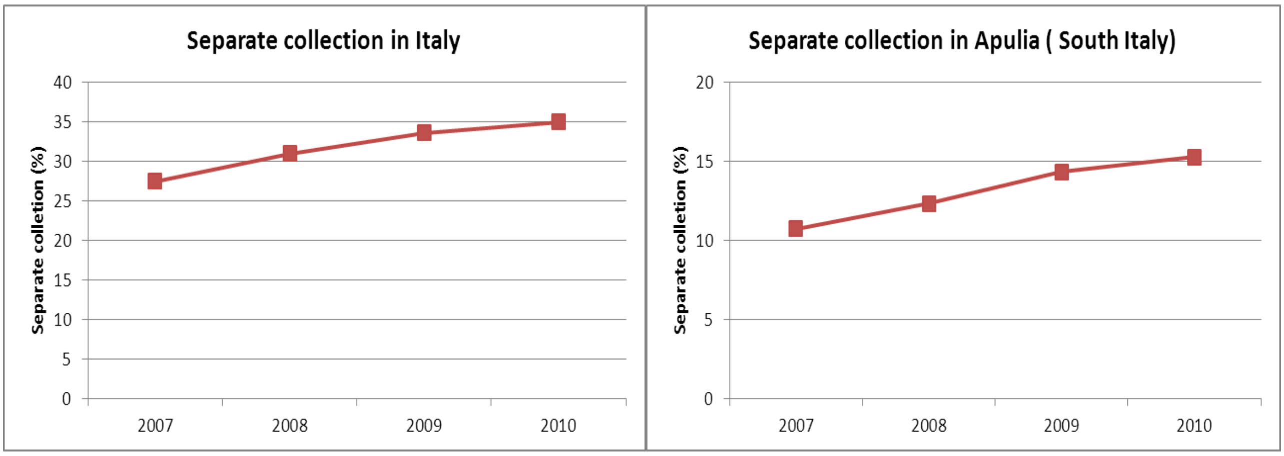

Fig. 2. (a) Trend of separate collection in Italy; (b) Trend of separate collection in South Italy (Apulia)

Figs. 2a, 2b shows the trend of separate collection in Italy (2a) and in South Italy (2b) from 2007 to 2010. Separate collection (SC) in all South-East Mediterranean countries is always lower than 5% and the trend of increase is lower than 10%. Apulia (South Italy) seems to have an intermediate behavior between Italy and the other Mediterranean countries in term of increase of separate collection.

Table 6 shows a comparison between MSW disposal methods in six different Mediterranean countries.

Table 6. MSW disposal methods in five different Mediterranean countries (World Bank, 2012)

	Turkey (%)	Israel (%)	Lebanon (%)	Jordan (%)	Italy (%)
Dumps	66	-	37	-	-
Landfills	30	90	46	85	54
Compost	1	-	8	-	33
Recycled	-	10	8	-	-
WTE	0	-	-	-	12
Other	3	-	1	15	-

Many differences are present for the MSW disposal methods; particularly in Italy, where the composting plays an important role for the treatment disposal of the organic fraction of municipal solid waste.

The trend of separate collection is shown in Fig. 3 where is reported the amount of separate collection of different waste fractions in Italy from 2007 to 2010 (ISPRA, 2012; ETC/RWM, 2008). Organic fraction has the highest fraction followed from glass and paper, but the percentage is quite lower. The same trend is expected in the next years in the emerging South-East Mediterranean countries.

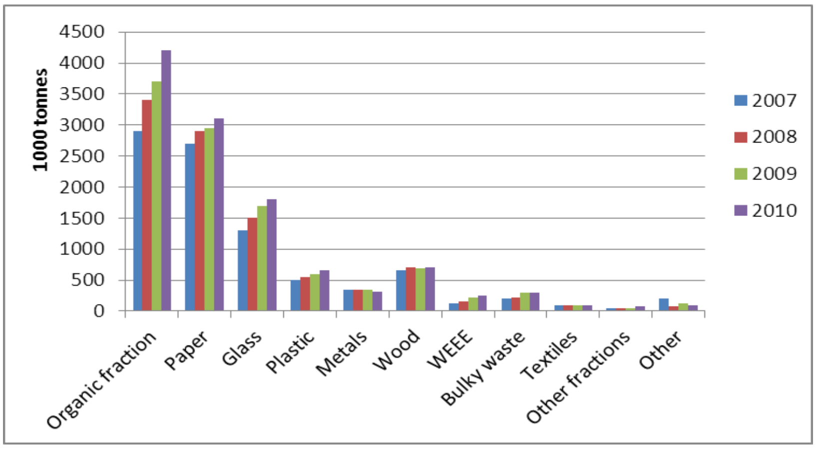

Fig. 3. Separate collection of different waste fractions in Italy, 2001-2007

4. Waste to energy

Treatments available for the conversion of solid waste into energy include incineration, sanitary landfill biogas, gasification, pyrolysis, and anaerobic digestion, among others (Torretta et al., 2014; Rada, 2014; Singh and Sharma, 2015; Yechiel and Shevah, 2016; Passamani et al., 2016; Collivignarelli et al., 2016). The selection of the treatment method should be based on local socio-economic conditions as well as on the quantity and quality of the MSW generated (Dolgen et al., 2005).

Because the most common practice for managing municipal solid waste in developing countries, is through disposal in sanitary landfills, it should be focused on the benefits that these disposal sites could potentially offer. The main product that can be obtained from the landfill is biogas, produced through natural anaerobic processes in the decomposition of the organic matter from the SW in the SL. Biogas is composed mainly of methane (CH_4) and carbon dioxide (CO_2), organic compounds that are responsible for greenhouse gas emissions (Hilger and Humer, 2003; Chiemchaisri and Visvanathan, 2008; Machado et al., 2009; Rada et al., 2015; Chai et al., 2016).

The experience of many countries, and particularly in Italy, shows that biogas can be used successfully for different purposes such as power generation, direct use, heating, and as an alternative transportation fuel, among other applications (EPA 1996, 2008; Christophersen et al., 2001; Martin et al., 2001; Kumar et al., 2004; Dolgen et al., 2005; Garg et al., 2006; Giugliano et al., 2008; Machado et al., 2009). Biogas recovery encourages sustainable waste treatment (Greben and Oelofse, 2009), but moreover knowledge of waste composition is required for the prediction of the quality and quantity of biogas.

With the global urban population now exceeding 50%, the inhabitants of cities are recognized as the major drivers of global greenhouse gas (GHG) emissions, particularly in Italy. For instance, the EU energy and climate package has set goals to reduce these GHG emissions by 20% by 2020, with an option to increase the reduction target to 30% if a comprehensive international agreement is reached, and the results of an analysis of several options have been recently published (European Commission, 2012). Some countries already begin to study and implement different solution for GHG emission decrease (Cioca et al., 2015; Zaman and Swapan, 2016). This is an important issue for Mediterranean European countries (Spain, Italy, Greece and Slovenia), where the implementation of GHG emissions default values from landfills has been performed (Sevignè et al., 2013).

Therefore, it can be stated that there is high potential for climate change mitigation at the European level through the complementary solutions of incineration, biological treatments and the increase of selective fractions, along with diminishing levels of landfills, especially for countries in the second and third groups, which are mainly the East and Southern European countries.

5. Conclusive remarks

The paper shows the differences in the composition between a high level income country like Italy with other South Eastern Mediterranean countries, where the organic fraction represents more than 40% as average of the waste composition.

The separate waste collection is quite high in Italy and South Italy. This trend is expected to be performed on the basis of the increasing of the average of income level. On the basis of the positive Italian experience composting represents a stringent target for the South-East Mediterranean countries where the organic fraction represents considerably the highest percentage. Moreover attention should be paid, in the same countries, to benefits of wastes to energy and to fix limits for greenhouse gas emissions.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH"

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Numerical modelling of fires in road tunnels with longitudinal ventilation system

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Abstract

This article discusses the issue of road tunnel safety in case of 5 to 30 MW-magnitude fires, as required by the normative and legislative documents of the European Union. Through numerical modelling, the article explores the dynamics of distribution of main damaging factors (temperature, concentration of toxic gases, visibility) caused by highly flammable fuels (petrol, diesel and others). The modelling is carried out in the environment of the Pyrosim 2015 software programme which is based on the flow dynamics method (FDS), where it is possible to create a dynamic 3D map of magnitudes that characterise the damaging factors. Based on the analysis of existing calculations, it is possible to measure the spatial scale and time of distribution of damaging factors in hypothetical scenarios of fire development, as well as determine the critical time for evacuation for each damaging factor, which is essential for conducting an effective rescue process.

Keywords: Pyrosim 2015; software programme,;flow dynamics; damaging factors; effective rescue process.

1. Introduction

Three types of artificial ventilation systems are normally used in modern road tunnels – longitudinal, transverse, and combined. This article discusses safety issues related to dangerous situations caused by fires of various magnitudes in road tunnels equipped with a longitudinal ventilation system. Transverse ventilation systems are mainly used in road tunnels that are between 400 and 1500 m in length, and constitute a widely used mechanical ventilation system. A longitudinal ventilation system is designed and installed in a manner that allows the removal of exhaust air and gases through mechanical ventilation flow from one portal to the next across the tunnel. The research presented in this article concerns the study and analysis of dangerous situations caused by fires of various magnitudes in road tunnels equipped with a longitudinal ventilation system. One ought to bear in mind the difficulty of the task, which lies in the large variety of scenarios in which tunnel fires are started and developed. This leads to the need of presenting the task in multi-parameter form, for which it is necessary to introduce simplifying assumptions for the modelled task. On the one hand, such an approach will allow us to discuss the issue within the scope of existing safety norms, and on the other hand, it will simplify the task of adequately describing tunnel fires in order to plan preventive and/or rescue measures accordingly.

In order to be able to conduct comparative analysis of dangerous situations caused by tunnel fires, a reasonable starting point would be a scenario where, on the one hand, we have the most dangerous situation possible in terms of damaging factors (temperature, concentration of toxic gases, visibility, etc.), and on the other hand, we can achieve maximum abstraction to reveal the characteristic tendencies of the dynamics of distribution of those damaging factors, which will then help us adequately describe the ongoing processes and conduct comparative analysis.

Thus, in order to model fires in tunnels equipped with a longitudinal ventilation system, we have established an abstract starting model of the origin and development of the fire, with the following initial conditions and limits:

- Tunnel geometry – length: $400 \le L \le 2000$ m; cross-sectional area: $50 \le S \le 70$ m^2
- Geometric location of fire localisation – centre of the tunnel L/2;
- Fires, with magnitudes of HRR 5, 10, 20, 30, 50 MW;

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- Highly flammable fuels – meaning that the fire develops maximum magnitude in the shortest possible period of time;
- Normal atmospheric conditions are maintained with regards to tunnel portals - P_0=101325 Pa. T_0=20ºC;
- Difference in pressures between portals – no natural ventilation available ΔP=0.

It should be noted that the presented starting model is universal, and can be used for any road tunnel ventilation scheme. The task has been modelled and solved by using *Pyrosim 2015* software, which allows us to obtain a spatial and temporal picture of damaging factors (temperature and concentration of toxic gases) at any location point inside the tunnel. The modelling of the task at hand has been conducted using the example of a 670 m long road tunnel equipped with a longitudinal ventilation system. In accordance with modern European norms, the tunnel ventilation system ought to be able to neutralise damaging factors caused by fires of magnitudes of up to 30 MW (UN, 2001, 2002).

Due to the multitude of results of numerical modelling, we will limit ourselves to presenting those results that apply to fires of borderline magnitude as determined by European norms (30 MW).

2. Results and discussion

As a result of numerical modelling, we present the results of solution for the initial task, in the form of isolines showing stratigraphic distribution of two major damaging factors (carbon monoxide and temperature) for a 30 MW-magnitude fire. The images illustrate the dynamics of distribution of damaging factors in one half of the tunnel, which applies symmetrically to the second half of the tunnel (see figures 1 and 2).

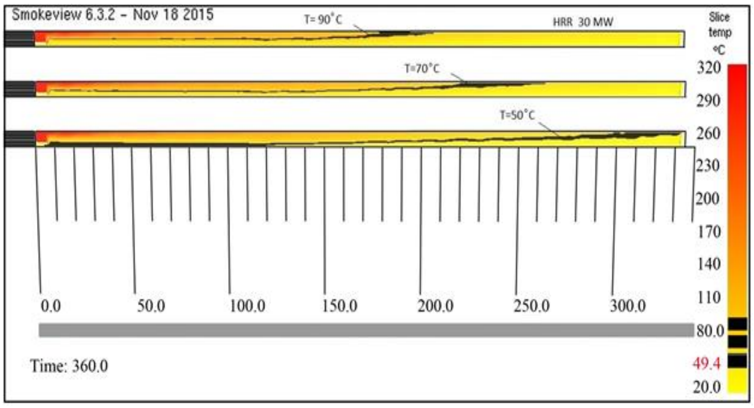

Fig. 1. Illustration of stratigraphic distribution of the temperature field for a 30 MW-magnitude fire. Modelling time: 360 seconds (starting model)

From the results of this research we can see that within 5 minutes from the start of a 30 MW-magnitude fire, the temperature field reaches the 50 Cº figure that is hazardous for humans all across the tunnel, effectively from the bed level to the portal. Within 150 m of the fire source, the temperature field reaches the 70 Cº mark from the tunnel bed level to the 2-3 m point, which in combination with the other damaging factors is usually lethal for humans.

The dynamics of growth of carbon monoxide concentration towards dangerous levels is equally fast, as seen clearly from Image 2. The starting model of the fire has shown that within 5 minutes from the start, carbon monoxide concentration levels reach 0.15 g/m^3 across the whole tunnel, while within the radius of 150 m from the fire source, the figure increases six fold and reaches 0.9 g/m^3 from the tunnel bed level to the 2-3 m point. Bearing in mind that the damaging factors in the starting model have accumulative effect, it becomes clear that the situation can become highly difficult within several tens of minutes from the start of the fire, and have catastrophic consequences. It is also clear that the intensity of the damaging factors increases parallel to the increase in the magnitude of the fire (accumulative effect).

To illustrate these facts, it is sufficient to present the results of the numerical modelling of carbon monoxide concentration levels in the starting model of a 50 MW-magnitude fire, as seen in figure 3. As seen from the presented modelling results, in case of powerful V-C fires, the situation can sharply worsen to such an extent that rescue activities may become fruitless in terms of saving lives. There are different fires in according Beard and Carvel (2012) V-C fire – ventilation controlled fire, that is, the HRR of the fire is limited by the amount of available oxygen in the locality of the fire. F-C – fuel controlled fire, that is, the HRR of the fire is limited by the arrangement and the chemical nature of the fuel, not by the amount of available oxygen. It should also be noted that the mechanical system of longitudinal road tunnel ventilation is characterised by a kind of anisotropy with regards to spatial distribution of damaging factors towards the fire source, which is demonstrated by the fact that in the direction of the ventilation flow from the fire source, the situation can become more critical proportionally to the speed of the flow.

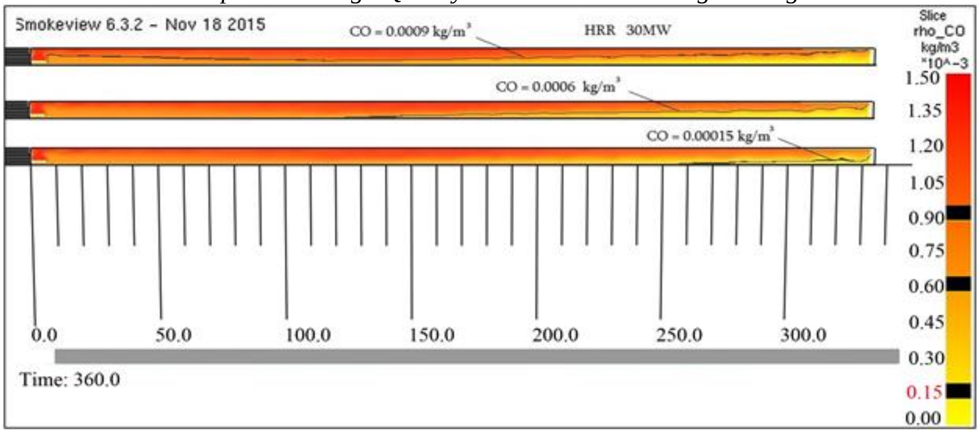

Fig. 2. Illustration of stratigraphic distribution of carbon monoxide concentrations for a 30 MW-magnitude fire. Modelling time: 360 seconds (starting model)

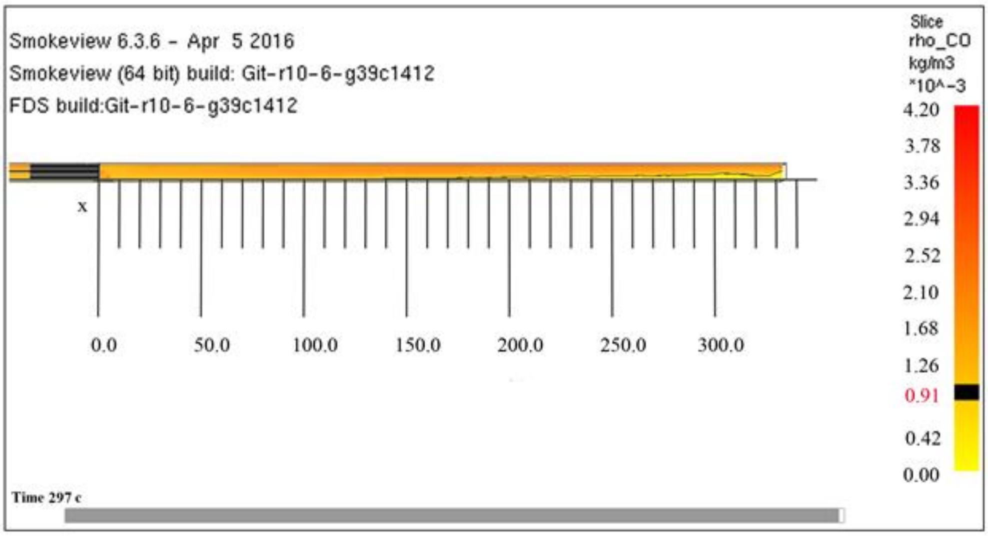

Fig. 3. Isoline showing carbon monoxide concentration level of 0.9 g/m^3 across the tunnel. Modelling time: 720 seconds, HRR=50 MW (starting model)

Below are the results of numerical modelling of several difficult varieties of the original task, as expressed by the addition of the condition of natural ventilation of the tunnel to the original task. The condition of natural ventilation is discussed, whereby we have a difference in pressures between portals of ΔP=0.15 Pa (see Images 4 and 5).

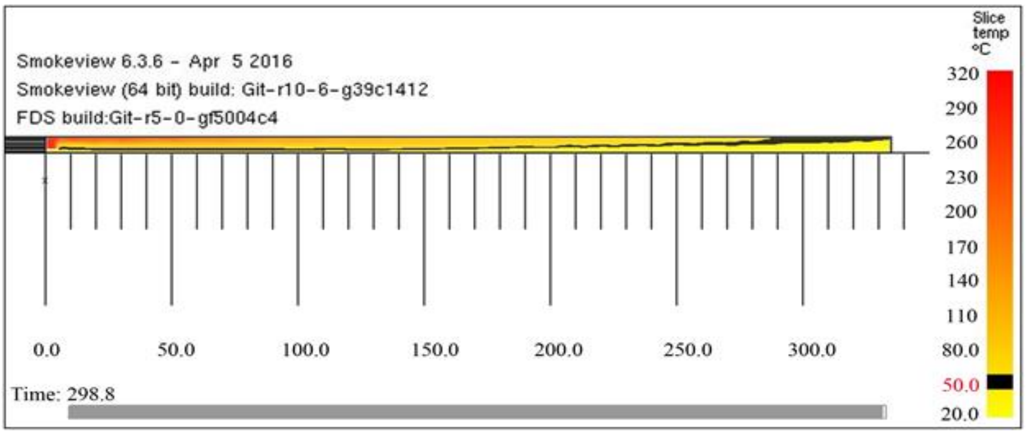

Fig. 4. Illustration of stratigraphic distribution of the temperature field for a 30 MW-magnitude fire. Modelling time: 300 seconds (starting model + natural ventilation ΔP=0.15 Pa)

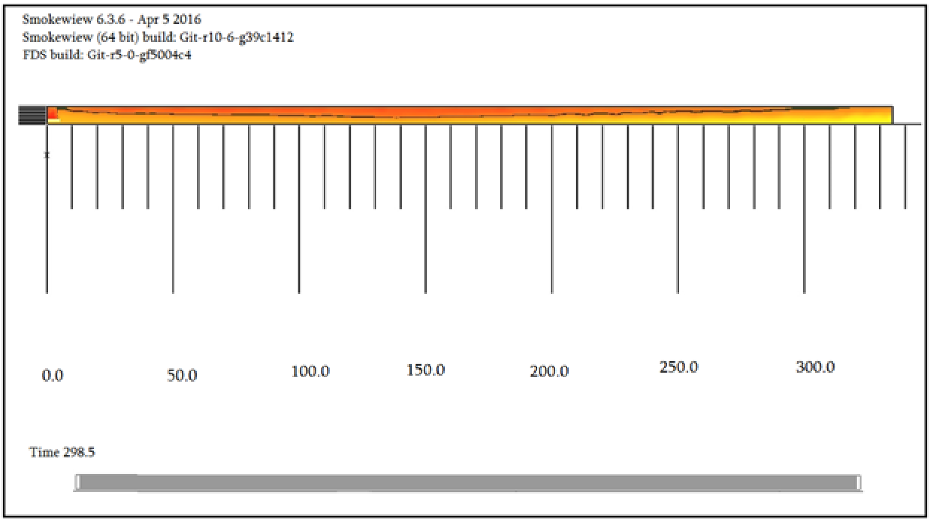

Fig. 5. Illustration of stratigraphic distribution of carbon monoxide concentrations for a 30 MW-magnitude fire. Modelling time: 300 seconds (starting model + natural ventilation ΔP=0.15 Pa)

As seen from the results of the calculations, the distribution of damaging factors (temperature, carbon monoxide concentrations) towards the fire source is asymmetrical. Clearly, the magnitude of this effect will significantly increase together with an increase in the intensity of mechanical ventilation.

3. Conclusions

1. In case of V-C fires with a magnitude of 30 MW or more, under the conditions of a standard longitudinal ventilation system, and within the scope of the starting model, damaging factors may develop to dangerous levels within 5 to 10 minutes at a distance of up to 300 m from the fire source.
2. In case of V-C fires, and under the conditions of a standard longitudinal ventilation system, the situation may worsen from the fire source in the direction towards the ventilation flow in accordance with spatial distribution of the intensity of the damaging factors.
3. It is advisable to conduct advance numerical modelling for fires with a magnitude of 30 MW or more inside road tunnels equipped with a longitudinal ventilation system. Specifics of each tunnel will be taken into account in the numerical modelling process, in order to obtain the most adequate picture possible of the spatial and temporal distribution of damaging factors, and to compile a preliminary fire safety ‘passport’ for the tunnel in question.

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Training methods for intervention and rescue personnel in confined spaces depending on their physiological parameter changes

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Abstract

Working in confined (limited) spaces represents a risk factor generating accidents or undesirable events, having an impact on human health. Applying the rules of good practice in these situations is a mandatory preventive measure. A confined space is any place that is not currently designated for work. It has entry or exit restrictions, a normal atmospheric pressure, inadequate ventilation and danger of drowning or suffocation, contaminated air or oxygen deficiency. The decisive factor in ensuring success of the intervention and rescue operations in toxic or chemical aggressive environments resides in optimal and efficient design of a training process for rescue personnel comprising inclusively intervention in confined spaces. Identifying an optimum training route for intervention and rescue personnel in confined spaces, enables simulation of intervention activities in horizontal and vertical limited spaces, low visibility, high temperature and humidity environments, etc., having as a purpose the preparation of intervention and rescue teams for situations close to reality. This paper was developed within the Nucleu-Programme, carried out with the support of ANCSI, project no. PN-16-43-02-18.

Keywords: intervention and rescue personnel; confined spaces; breathing apparatus; toxic /explosive /flammable environments.

1. Introduction

The activity in special conditions created as a result of underground or surface damage, threatening staff or property and requiring the use of respiratory protective equipment because the concentrations of gases, vapours, toxic or asphyxiating dust exceeds the limits established by norms, is ensured by rescue stations. (Gaman, 1997, Gaman et al., 2003)

Direct executor of the difficult and dangerous work to save people and protect industrial objective is the rescue taskforce. The success of the rescue operation depends primarily on their intervention, courage and confidence in the protective insulation device. (Gaman et al., 2005)

2. NRDI INSEMEX Petrosani training facility description

NRDI INSEMEX Petrosani has a training facility that has a unique character at national level and is similar to those in countries with a tradition in the field of rescue, including training areas where rescuers carry out practical exercises, installations, equipment and operations executed during training being designed to be close to actual conditions encountered in situations of various types of damage.(Gaman, 2007)

Equipments that are part of the confined spaces training facility within NRDI INSEMEX Petrosani, are fitted with the following gear. (Gaman et al., 2009):

- Ergometer;
- Ergometer treadmill;
- Metal ladders;
- Gaps (low profiles);
- Vertical route;
- Labyrinths;

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• Confined spaces modular circuit.

During training under the protection of insulating apparatus in the training facility, trainees are submitted to great efforts, under the assistance of a health professional to monitor changes in physiological parameters during interventions. (Gaman et al., 2012)

To monitor real time blood oxygen saturation levels for rescuers training in the confined spaces training facility multiple WK 50 D type oximeters are used, needed for appropriate management and dosing of the amount of work carried out by rescuers. (Pupăzan et al., 2012)

To measure rescuer's pulse in the confined spaces training facility, a telemetric measuring system type HRT-SYS is being used, this being the only device that allows continuous monitoring of this parameter. The device uses specialized software that allows continuous recording of rescuer's pulse via wireless technology to a distance of approx. 100 meters from the central unit.

3. Calculation of work consumption in rescuers training

When working with insulating devices there are a number of factors contributing to work becoming more stressful. Typically, those working under the protection of insulating devices, besides back wearing a device that weighs 14 to 18 kg are also subject to actions of great difficulty, involving ensuring their own security, saving human lives, performing some urgent and high qualification works (isolation damaged areas, working in flooded areas, and transportation of materials or injured through confined spaces etc.) in rough microclimate conditions (high heat and humidity), toxic and smoke environments. Hence rescuer's physical effort is intense because of the conditions mentioned above. (Gaman, 2014 Pupăzan 2013)

Body adaptation is provided on the one hand by nervous control and secondly by neuro-hormonal control. A series of changes to body's organs and systems occur, as an expression of the tendency to functionally adapt, changes that are most visible in cardiovascular activity. The way this system adapts, which is the most visible, is accelerating the heart rate, increased heart rate frequency reflecting it's growing pace. Starting from 60-70 beats per minute Heart rate can reach 120-150 or even 200 beats per minute in exceptional cases, at great efforts. (Gaman et al., 2014)

To cope with such an overload, proper training of rescuers and periodical evaluation of degree and ability to effort are requested, tests that are easily applied by the rescue station's doctor. (Pupăzan, 2010, Elijah, 2012)

Effort put into training by rescuers is expressed in **Kgm** and, depending on the equipment they work on, is calculated in relations that use certain notations. The amount of work put into training should be equivalent to:

• 15,000 Kgm for rescuers in training, at first-time training;

• 20,000 Kgm for rescuers older having more than 2 years experience, at retraining.

In the course of practical training, intervention and rescue personnel were divided according to industry: personnel working in the underground mining industry and surface industry rescue personnel. For each activity were selected three teams of 3 training rescuers and 3 teams of retraining rescuers.

Rescue teams conducted several exercises with varying degrees of difficulty for each being calculated the work consumption.

Testing was carried out for 6 activities:

• Confined spaces circuit;

• Tractions on ergometer;

• Moving on the treadmill ergometer;

• Moving up and down on a metal ladder;

•Moving up and down the pit stairs;

• Completing the modular circuit.

For the training of surface industry rescue personnel, the most challenging route, where the amount of work consumption is 15,200 Kgm was chosen as the optimum workout route (depending on measurements of blood oxygen saturation and pulse of each rescuer). Within this workout route the following activities are conducted:

• 2 confined spaces circuits;

• 3 series of 80 tractions on ergometer;

• 5 minutes of moving on the treadmill ergometer;

• Moving up and down on a metal ladder 50 times;

• Moving up and down the pit stairs;

• Completing 2 modular circuits.

Blood oxygen saturation and pulse measurements were taken for each rescuer (Fig. 1), these being repeated after each of the six activities tested.

Fig. 1 – Measuring rescuer's blood oxygen saturation and pulse

For this route, measurements of blood oxygen saturation and pulse for the team of surface rescuers in training are shown in Table 1 and graphically illustrated in Figures 2 and 3.

Table no. 1

No.	**TRAINING**	**Subject 1**		**Subject 2**		**Subject 3**	
		Pulse	**SpO_2**	**Pulse**	**SpO_2**	**Pulse**	**SpO_2**
1	Confined spaces	135	99	147	98	127	98
2	Ergometer	161	98	128	97	116	97
3	Treadmill	124	97	113	97	129	96
4	Metallic ladder	138	96	117	97	111	97
5	Pit	111	97	126	96	119	97
6	Modular Circuit	129	97	131	99	131	96

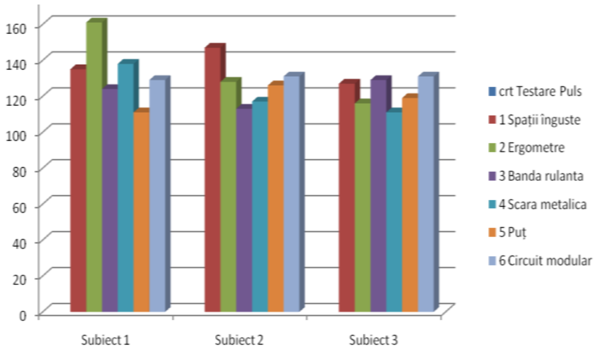

Figure 2 – Pulse variation in training

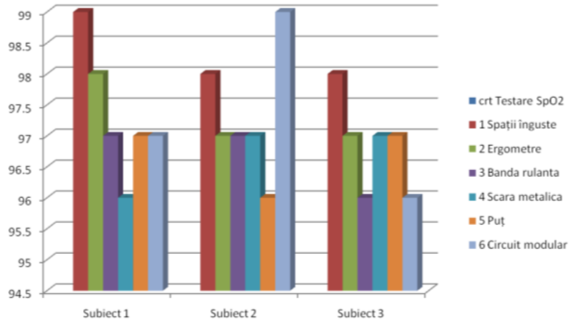

Figure 3 –SpO_2 variation in training

For the re-training of surface industry rescue personnel, the most challenging route, where the amount of work consumption is 20,100 Kgm was chosen as the optimum workout route (depending on measurements of blood oxygen saturation and pulse of each rescuer). Within this workout route the following activities are conducted:

- 2 confined spaces circuits;
- 4 series of 80 tractions on ergometer;
- 10 minutes of moving on the treadmill ergometer;
- Moving up and down on a metal ladder 100 times;
- Moving up and down the pit stairs;
- Completing 2 modular circuits.

For this route, measurements of blood oxygen saturation and pulse for the team of surface rescuers in re-training are shown in Table 2 and graphically illustrated in Figures 4 and 5.

Table no. 2

No.	**RE- TRAINING**	**Subject 1**		**Subject 2**		**Subject 3**	
		Pulse	**SpO_2**	**Pulse**	**SpO_2**	**Pulse**	**SpO_2**
1	Confined spaces	145	99	147	98	137	98
2	Ergometer	159	98	138	97	126	97
3	Treadmill	132	97	123	97	129	96
4	Metallic ladder	139	96	127	97	121	97
5	Pit	121	97	126	96	129	97
6	Modular Circuit	126	97	131	99	133	96

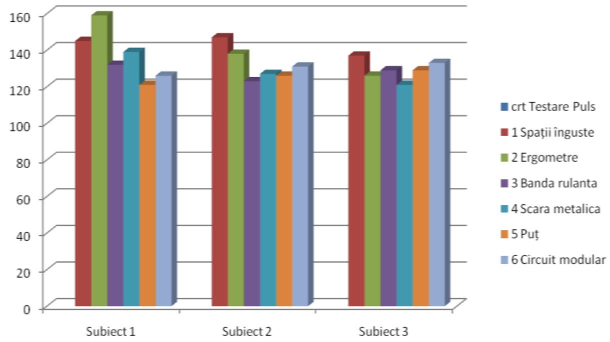

Figure 4 – Pulse variation in training

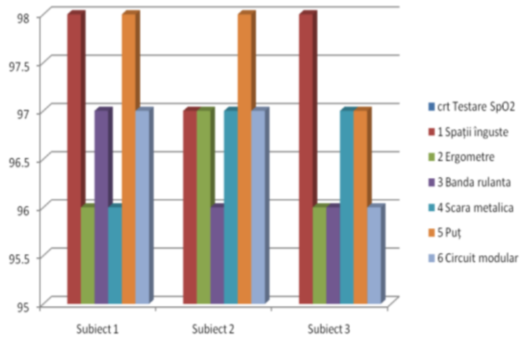

Figure 5 –SpO_2 variation in training

For the training of underground industry rescue personnel, the most challenging route, where the amount of work consumption is 15,200 Kgm was chosen as the optimum workout route (depending on measurements of blood oxygen saturation and pulse of each rescuer). Within this workout route the following activities are conducted:

• 2 confined spaces circuits;
• 3 series of 80 tractions on ergometer;
• 5 minutes of moving on the treadmill ergometer;
• Moving up and down on a metal ladder 50 times;
• Moving up and down the pit stairs;
• Completing 2 modular circuits.

For this route, measurements of blood oxygen saturation and pulse for the team of underground rescuers in training are shown in Table 3 and graphically illustrated in Figures 6 and 7.

Table no. 3

No.	TRAINING	Subject 1		Subject 2		Subject 3	
		Pulse	SpO_2	Pulse	Pulse	SpO_2	Pulse
1	Confined spaces	134	98	135	98	127	98
2	Ergometer	161	98	137	97	118	96
3	Treadmill	125	96	105	97	124	96
4	Metallic ladder	145	98	102	97	115	98
5	Pit	103	96	117	96	117	97
6	Modular Circuit	125	97	124	99	132	98

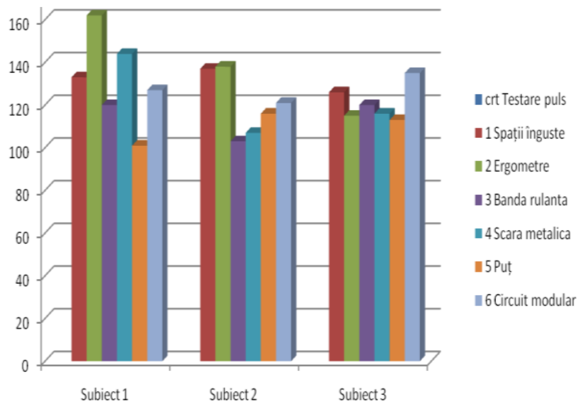

Figure 6 – Pulse variation in training

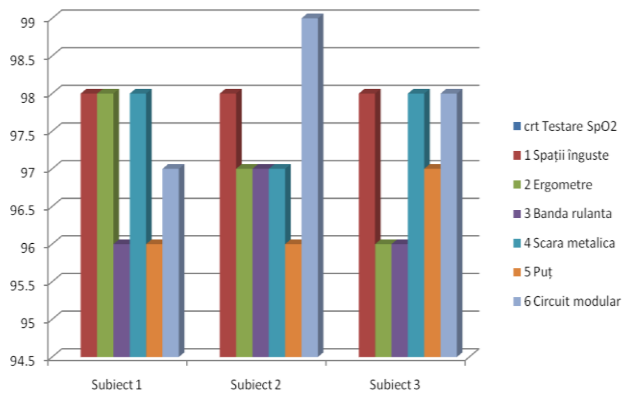

Figure 7 –SpO_2 variation in training

For the re-training of underground industry rescue personnel, the most challenging route, where the amount of work consumption is 20,200 Kgm was chosen as the optimum workout route (depending on measurements of blood oxygen saturation and pulse of each rescuer). Within this workout route the following activities are conducted:

• 2 confined spaces circuits;
• 4 series of 80 tractions on ergometer;
• 10 minutes of moving on the treadmill ergometer;
• Moving up and down on a metal ladder 100 times;
• Moving up and down the pit stairs;
• Completing 2 modular circuits.

For this route, measurements of blood oxygen saturation and pulse for the team of underground rescuers in re-training are shown in Table 4 and graphically illustrated in Figures 8 and 9.

Table no. 4

No.	RE- TRAINING	Subject 1		Subject 2		Subject 3	
		Pulse	**SpO_2**	**Pulse**	**Pulse**	**SpO_2**	**Pulse**
1	Confined spaces	148	99	145	98	139	98
2	Ergometer	158	98	139	97	127	97
3	Treadmill	135	97	124	97	125	96
4	Metallic ladder	135	96	128	97	131	97
5	Pit	128	97	128	96	139	97
6	Modular Circuit	127	97	135	99	131	96

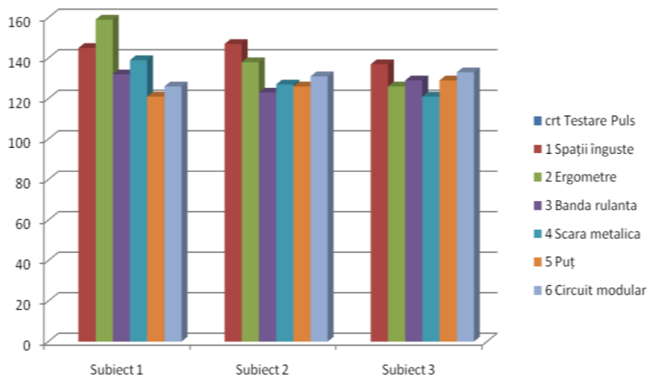

Figure 8 – Pulse variation in training

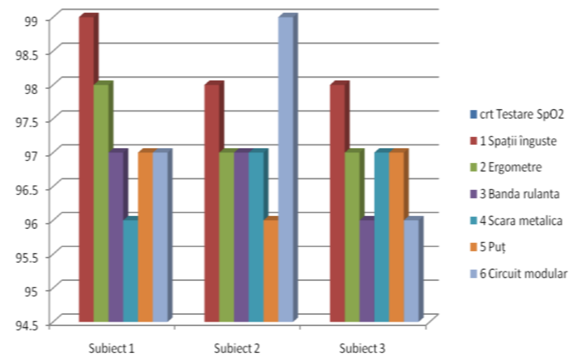

Figure 9 – SpO_2 variations in training

4. Conclusions

In the course of practical training, intervention and rescue personnel were divided according to industry: personnel working in the underground mining industry and surface industry rescue personnel. For each activity were selected three teams of 3 training rescuers and 3 teams of retraining rescuers.

Rescue teams conducted several exercises with varying degrees of difficulty for each being calculated the work consumption.

Blood oxygen saturation and pulse measurements were taken for each rescuer, these being performed after each activity within the training route.

Three types of training routes were analyzed for underground / surface rescuers, found in the process of training / retraining. Each workout route took 2 hours to complete.

For the training of underground / surface industry rescue personnel, the most challenging route was chosen as the optimum workout route (depending on measurements of blood oxygen saturation and pulse of each rescuer). Each workout route took 2 hours to complete.

For the re - training of underground / surface industry rescue personnel, the most challenging route, was chosen as the optimum workout route (depending on measurements of blood oxygen saturation and pulse of each rescuer).

Training rescuers in the confined spaces training facility leads to higher levels of health and safety at work, by enhancing high safety interventions in case of emergencies, accidents, disasters, etc.

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Improving safety in the workplace using checklists legal requirements

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Abstract

For carrying out an assessment of compliance with existing legislation (in this case - from health and safety at work) having as object check how it applies the laws in force at the work place, including how activity it's organized and drawing up the documents, which seeks a qualitative assessment by transposing into indicators with the same importance, legal requirements verification sheets were made. The effects of achieving an objective assessment process and especially finding optimal solutions for irregularities or non-conformities found will increase the efficiency of preventive activities, lowering final costs through a coherent in the security at work domain, increasing the partners level of trust and improving the company's market image.

Keywords: assessment; legal provisions; work safety.

1. Introduction

Due to the large number of legal requirements minimum security and health content contained in the current legal provisions, the legislation distinct from other fields that contribute to creating a safe organizational framework, the issue of implicit information and information selection. In addition, most employers concerning the application of legal requirements only in terms of drafting documents, a briefing formal or partial application with the target of reducing the training time/selfinstruction, reduce costs or, in this case the application checklists is beneficial, lack the necessary knowledge, documenting effective, experience in the practical application of legal requirements and interpretation. Regardless of what it wants to check, assess and methodological choices need arises knowledge of the auditor of the conditions imposed rules that must be met by the employer, system, process or content of documents drawn up, in which case, the necessary data will be obtained from the persons directly involved in the labor process. Thus, for compliance with the legislation in force (in this case - the Safety and Health at Work), concerning verify the applicable legal provisions in force at work, including the organization of work and preparing documents, which seeks a qualitative assessment by transposing the indicators with equal importance (Yes, No or Not applicable) verification sheets were made legal requirements for each legal provision transposing EU directives into Romanian legislation.

The document thus produced can be one tool available to anyone (employee , employer , specialist OSH auditor) who, without knowing the content of the legal requirement can identify/verify the application, fulfilling its requirements and how to make the documents , content their correctness and the fulfillment of legal obligations transposed levels forecast in the law. Implementation of the minimum requirements of prevention in health and safety at work required by applicable law, that address the non will lead to an improvement of the security and decrease the risk level of the labor system analyzed. (Darabont, Al., et al., 2001) The goal is straightforward compliance assessment, verification of awareness and compliance with legal requirements and other requirements to the job or organization, but also indirect, assessment of the effectiveness and safety management system health. (Darabont, D., 2010)

An audit/verification process does not always lead to a formal request for corrective action. Audit/verification is directed towards gathering evidence for the beneficiary based on facts, this is the one to decide on the position to be adopted. Therefore there are two separate processes related to the audit:

- audit / verification itself - gathering information for the beneficiary;
- corrective action process - which is led by the beneficiary. (Moraru, R.I, et al., 2002)

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- For the first trial, the audit/verification actual setting is required in the first phase of the object or what will check:
- compliance with the requirements of the Safety and Health at Work job stipulated by relevant regulations (Law no. 319/2006 , Decision no. 1425/2006, Government decisions - sites of the Safety and Health at Work, own instructions);
- conformity of the whole organization with the requirements of Safety and Health at Work (Law no. 319/2006 , Decision no. 1425/2006) ;
- compliance processes, equipment technical Safety and Health requirements stipulated in legislation (Law no. 319/2006, Government decisions - Safety and Health at Work, related sites, occupational safety standards) and other services (technical books , guides to good practice , projects etc.);
- products comply with the requirements Safety and Health stipulated in standards, regulations, followed by a selection of the applicable legal provisions.
- For the second trial, the practical realization of corrective actions , we consider a number of factors that , even if the initial check was carried out objective , systematic, properly , the effect of reducing the risk of injury to a job analyzed will not be realized. In practice were highlighted two main reasons:
- ack of a coherent security and health in an organization
- tendency to reduce spending in non -productive ways such as the safety and health at work.

The two cases cited above have a beneficial effect in the short term by simplifying the management process, saving time and improving the expenditures but long-term labor system will present a lower level of security, a misperception on the need for action prevention and protection and thus the lack of a safety culture at the level of the employer and workers. (Darabont, D., 2005)

Table 1. *Checking list for highlighting the applicable legal provisions at the audited workplace (example)*

Decision no. 1028 of 9 August 2006 on the minimum safety and health on the use of display screen equipment (Annex)

Crt. No.	**Pointer**	**Legal provision (article, paragraph, letter)**	**YES**	**NO**	**It's not necessary**
		1. Equipment			
1.	Using the equipment poses risks to workers ?	section 1, lett. a, annex			
2.	The characters on the screen are clearly separated and distinct , appropriately sized and with enough space between characters and lines ?	section 1, lett. b, alin 1, annex			
3.	The screen image is stable without scintillation events or other forms of instability?	section 1, lett. b, alin 2, anexa			
4.	The brightness and / or contrast between the characters and the background screen is easily adjustable by the operator and easy to adapt to environmental conditions ?	section 1, lett. b, alin 3, annex			
5.	The screen can be easily tilted and oriented to suit the needs of the operator ?	section 1, lett. b, alin 4, annex			
6.	It is possible to use a separate base or adjustable tables for the screen ?	section 1, lett. b, alin 5, anexa			
7.	The screen shows the glare or reflections that may disturb user ?	section 1, lett. b, alin 6, annex			
8.	The keyboard is separated from the screen ?	section 1, lett. c, alin. 1, annex			
9.	Keyboard tilt can be adjusted to find a comfortable working position to avoid fatigue arms and hands ?	section 1, lett. c, alin. 1, annex			
10.	There is room for helping hands and/or forearms on the table in front of the keyboard ?	section 1, lett. c, alin. 2, annex			
11.	Keyboard surface is matt ?	section 1, lett. c, alin. 3, annex			
12.	The key features and position the keyboard facilitates its use ?	section 1, lett. c, alin. 4, annex			
13.	Key symbols shows high contrast and be legible in normal working position ?	section 1, lett. c, alin. 5, annex			
14.	Table or work surface has a less reflective surface ?	section 1, lett. d, alin. 1, annex			

15.	Table or work surface is sufficiently large and allows for flexible placement of the screen, keyboard, documents and auxiliary equipment ?	section 1, lett. d, alin. 1, annex	
16.	Document holder is stable and easily adjusted and positioned so as to diminish the uncomfortable movements of the head and eyes ?	section 1, lett. d, alin. 2, annex	
17.	There is enough space to allow workers a comfortable position ?	section 1, lett. d, paragraph 3, annex	
18.	Chair is stable and gives the operator freedom of movement and a comfortable position ?	section 1, lett. e, alin. 1, annex	
19.	The seat can be adjusted vertically ?	section 1, lett. e, alin. 2, annex	
20.	Seat backrest can be tilted and adjusted vertically ?	section 1, lett. e, alin. 3, annex	
21.	It provided a footrest ones I want ?	section 1, lett. e, alin. 4, annex	
	2. Work environment		
22.	User workstations provide sufficient space to enable it to change its position and vary movements ?	section. 2, lett. a, annex	
23.	General and local lighting (lamps work) ensure satisfactory lighting conditions and an appropriate contrast between the screen and the environment, taking into account the type of activity and visual needs of the user ?	section 2, lett. b, alin. 1, annex	
24.	Annoying glare and reflections on the screen or other equipment are avoided by arranging workplace and workstation depending on the location and technical characteristics of the artificial light sources ?	section 2, lett. b, alin. 2, annex	
25.	Workstations are arranged as light sources, walls and equipment do not cause direct glare and reflections lead as possible on the little screen ?	section 2, lett. c, alin. 1, annex	
26.	The windows are provided with appropriate coverage , with adjustment to mitigate natural light at the workstation ?	section 2, lett. c, alin. 2, annex	
27.	The arrangement of job / work stations take into account the noise emitted by equipment belonging job / work stations , particularly to avoid distraction or disruption verbal communication ?	section 2, lett. d, annex	
28.	Devices that belong to the post / workstation creates discomfort to workers by producing excess heat ?	section 2, lett. e, annex	
29.	All radiation with the exception of the visible part of the electromagnetic spectrum , are reduced to negligible levels in terms of health and safety of workers ?	section 2, lett. f, annex	
30.	At the workstation / workplace is achieved and maintained an appropriate humidity ?	section 2, lett. f, annex	
	3. Interface operator/computer		
	The development, selection, acquisition and modification programs and to define tasks involving the use of display screen equipment with employer shall take into account the following principles:		
31.	a) program is tailored workload ?	section 3, lett. a, annex	
32.	b) program is easy to use and, if necessary, be adapted to the knowledge or experience of the operator and no qualitative or quantitative testing device can not be used without the knowledge	section 3, lett. b, annex	

	workers?	
33.	c) systems provide workers information about developments in the operations ?	section 3, lett. c, annex
34.	d) system displays information in a format and at a pace adapted operators ?	section 3, lett. d, annex
35.	e) ergonomic principles are applied informatics, particularly where data processing operations by the operator ?	section 3, lett. e, annex

2. Conclusions

A detailed analysis before the beginning of the activity allows the implicated parts a correct understanding of measures that must be taken, the risk that may appear, the simple awareness of these factors being a precursor of the increasing of the security level and decreasing of the level of risk. The Use of checking files of the legal requirements the comply with the provisions of a legislative measure allows:

- highlighting the main legal provisions that can be applied to the workplace/audited unit;
- checking the way legal requirements are applied and respected even if the person does not have knowledge in the security and health at workplace domain;
- checking the application of the imposed measures by the legal provisions, if they are not applied or partly accomplished, the requirements for a certain aspect, activity or specific requirement of a performed activity;
- highlighting the way that the editing of the content of some documents has been respected, who must execute them, keep them or fill them in;
- respecting the tasks and obligations that come by law to some persons and the way they accomplish them;
- highlighting and respecting the accomplishing terms and depositing of some documents, as much internally as at various units of the states.

Even when using these check- lists in a way as objective and customized within a unit this does not guarantee obtaining benefits for workers.This is conditioned by the practical application of the minimum requirements of managerial vision , policy and management in health and safety at work at the unit plus the specific activity, the average age of workers and their skill level.

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Occupational health and safety management in construction sector - the cost of work accidents

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Abstract

The cost analysis of accidents and safety measures, in order to establish a value dimension of prevention and benefits, is a scientific objective background, to manage the health and safety management in an organization. Work accidents cost analysis is an indicator for increasing the awareness of managers in order to adopt prevention and safety measures required to reduce and / or to manage the events that resulted in individual or collective work accidents. The aim of this paper is to analyze the costs of a collective work accident occurred in civil construction sector and to establish the necessary safety measures to the organization level in order to prevent such events.

Keywords: risk; safety; work accident; cost; construction

1. Introduction

The construction sector is a continuing growing sector and has as specific the development of industrial activity in different places and work environments in permanent changing, causes that determine permanent modification of work places configurations, power supply installations, types of work equipment, and safety systems against the risk of accidents and occupational diseases.

In all of construction activities, whether they are of industrial or civil engineering activities, there are risks of injury and occupational disease caused by all four components of the work system: mechanical risks (falls from the height, tripping, slipping, land subsidence, burial, hitting by materials), electrical risks (electrocutions and burns), thermal risks, physical risks (noise, work in extreme temperatures), chemical risks (contact with hazardous substances such as acute poisoning, chemical burns), danger of explosion, fire, physical overload (manual handling and musculoskeletal disorders) and mental stress.

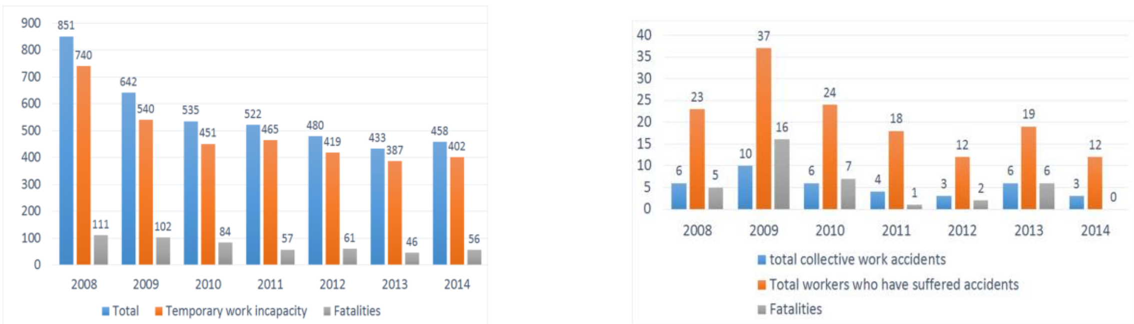

Fig. 1.(a) Accidents at work in construction sector; (b) collective work accidents in c**on**struction sector

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Nationally, in the construction sector the biggest share of work accidents is the risk generated by work task, through lack of documents related to safety and health (OSH) and risks generated by workers by wrong actions and omissions.

The statistics on accidents at work nationally produced, processed in research studies, have revealed that there is a decrease in the number of work accidents produced in this sector, according to records of Statistics National Institute (SNI) for construction sector presented in Fig. 1 a and b (Antonov A., et al., 2014).

There is a very small decrease not only in the number of workers involved in work accidents, but also, in recent years, in the number of collective work accidents in construction sector, mainly due to lower working volume and industrial activity in this sector.

Most collective work accidents in construction sector were due to land subsidence as a result of failing to support the earth banks with specific means of protection.

A large percentage of employers, especially small and medium enterprises in construction sector, believes that the prevention and protection against work accidents and professional diseases, is a resource consuming activity, particularly from financial point of view and should be treated in terms of its efficiency. (Dobra R., 2013)

Accidents at work, besides the victims, also means stopping economic activity, and engaging some of the state structures as a result of interventions after the event (SMURD emergency and first - aid teams, emergency room doctors, Prosecution, Labour Inspection, etc.) which implies charges in society, at the employer and the person and / or caregivers of victim / injured. (Buică G., 2010), (OSHA, 2002)

Such an event adversely affects every element of work system, interruption of economic activity because of an accident at work, has negative effects on productivity due to reduced working time, workers involved in the accident (victims, colleagues of the victim / victims, top management), changing the personnel structure and working conditions (work equipment, environment etc.). (Dascalescu A., 2003).

Working time is the element which can highlight the losses and expenses that arise from a work accident.

2. Case Study

To highlight the expenses that incur for employers, it was chosen as a case study of an collective work accident resulted in the death of two workers and the injury of two other workers during welding to the water suply system and sewerage system of a rural community.

The collective accident was caused by the collapse of a bank of earth that has not been properly supported.

Preliminary data on collective work accidents is given in Table. 1.

Table 1. Preliminary data on collective work accidents

Preliminary data	Notation	Measurement unit	Type of the consequences of the collective work accident for			
			Victim no. 1	Victim no. 2	Victim nr. 3	Victim nr. 4
			Death	Death	TWI	TWI
Net wage in the accident time	$\overline{S_0}$	lei /month	1807	2580	2210	1750
Duration of temporary incapacity of work	Z_{ITM}	days	-	-	5	120
Financial support for illness	I_B	lei /month	-	-	2210	1750
Duration of the vacancy of working place (only if is different from disability period)	D_n	days	-	-	5	120
The remaining average number of years for occupation of the same working place	A_{LM}	years	19	9	-	-
Transformation coefficient from monthly income in daily income	β	days/month	-	-	110,5	87,5
Supplementary payment for the persons who take the working tasks of the victim	S_h	lei /hours	7,4	-	8	10,6
Number of overtime	$\sum h_s$	hours	24	-	-	-
The number of people that perform overtime	$\sum n_s$	person	4	-	-	-
The coefficient of transformation hourly in daily income	β_2	hours/zi	8	8	8	8
Updated rate	φ	-	1	1	1	1
Hourly production whack programmed at the old working place, respectively on at new working place	n_{p0} n_{p1}	m/ hours	0,8	-	-	-
Hourly production made by the victim at old working place or new working place after coming back, respectively by the makeshift	q_v q_i	m/ hours	0,7 0,8	-	-	-

Price per production unit	p	lei	9	-	-	-
Duration of adaptation after coming back to work by the victim or by the makeshift	T_{Av} T_{Ai}	hours	16	-	32	16
Number of effective working hours per month	$\tilde{N}_h$	hours /month	170	170	170	170
Net monthly salary of the worker who replaces the victim	S_T	lei/month	1680	2410	-	-
The average duration of implementation	$\bar{D}_P$	years	0,5	0,5	0,5	0,5
Transformation coefficient from monthly income in hourly income	β_1	hours /month	170	170	170	170
The number of persons involved in actions and activities regarding the accident (without production)	ΣN	person	5	5	5	5
The number of persons involved in actions and activities regarding the accident (without production)	Σt_i	hours	80	80	80	80
The average monthly net salary of persons engaged in actions and activities related to accident	$\sum \bar{S}_{hi}$	lei/month	1450	1450	1450	1450

The total cost of the collective work accident, Ct, is the sum of the costs of losses generated by each victim individually, plus the costs of loss and / or damage of work equipment costs, of consumption of consumables, fines and penalties, if necessary, the funeral benefits and not least cost necessary for taking work safety measures. The equation is given in (1).

$$C_t = C_{t-victim\_1} + C_{t-victim\_2} + C_{t-victim\_3} + C_{t-victim\_4} + C_{Demage\_we} + C_{Consumable} + C_{Fines} + C_{Penalities} + C_{Funeral\_benefits} + C_{Safety} \quad (1)$$

2.1. Costs generated by the first victim ($C_{t\_Victim\ 1}$)

The first victim, who performed diggings, died immediately during crumbling earth bank. Top management staff is obliged, due to the deadline, to hire a new worker. The working time lost by the first victim is partially recovered from other workers who were paid overtime to complete the work.

Top management staff, besides the cost of lost working time lost due to the second victim and overtime pay, also record losses and low efficiency of the new worker in the period in which he is accommodated with the new job. The total cost due to death of the first victim is indicated in (2) (Dascalescu A., 2003)

$$\begin{aligned} C_{t\_v1} = \Delta V_{expl\_v1} = \frac{I_B \times Z_{ITM}}{\beta} - 12 \cdot A_{LM} \cdot \bar{S}_o \cdot \phi + 12 \cdot A_{LM} \cdot S_T \cdot \phi + \sum n_s \cdot \sum h_s \cdot S_h + D_n \times n_{p0} \times p \times \tilde{N}_h \cdot \beta_1 + \\ \sum N \times \sum t_i \times \sum \bar{S}_{hi} + T_{Ai} \times \frac{q_i}{n_{p0}} \times \frac{S_T}{\tilde{N}_h} = 1142{,}92\, lei \end{aligned} \quad (2)$$

2.2. Costs generated by the second victim ($C_{t\_Victim\ 2}$)

The second victim, who performed welding operations at sewer pipes, died two days after the event. The working time loss of the second victim was not recovered due to the fact that other welders were engaged in other activities. A new welder was hired after 7 days.

Top management staff, besides the cost of lost working time due to the second victim, recorded losses and low efficiency of the new welder in the period in which the worker is accommodated with the new job. The total cost due to death of the second victim is indicated in (3) (Dascalescu A., 2003)

$$\begin{aligned} C_{t-v2} = \Delta V_{expl\_v2} = \frac{I_B \times Z_{ITM}}{\beta} - 12 \cdot A_{LM} \cdot \bar{S}_o \cdot \phi + 12 \cdot A_{LM} \cdot S_T \cdot \phi + D_n \times n_{p0} \times p \times \tilde{N}_h + \\ + \sum N \times \sum t_i \times \sum \bar{S}_{hi} + T_{Ai} \times \frac{q_i}{n_{p0}} \times \frac{S_T}{\tilde{N}_h} = 812{,}17\, lei \end{aligned} \quad (3)$$

The victim’s loss working time was not recovered by colleges’ overtime. Top management in addition to losses due to loss of working time of the third victim, records and low yield losses of the victim to return to work.

2.3. Costs generated by the third victim ($C_{t\_Victim\ 3}$)

The third victim who performed activities of supporting the banks, suffered minor injuries, being in temporary disability for 5 days.

The victim lost work time was not recovered colleagues' overtime. Top management in addition to losses due to lost work time of the third victim, records losses due to low efficiency of the victim to returning to work.

The total cost due to the third victim is indicated in (4) (Dascalescu A., 2003)

$$C_{t\_v3} = \frac{I_B \times Z_{ITM}}{\beta} + D_n \times n_{p0} \times p \times \tilde{N}_h + \cdot S_T \cdot D_i + \sum N \times \sum t_i \times \sum \overline{S}_{hi} + T_{Ai} \times \frac{q_i}{n_{p0}} \times \frac{S_T}{\tilde{N}_h} + T_{Av} \times \frac{q_v}{n_{p0}} \times \frac{\overline{S}_0}{\tilde{N}_h} = 818{,}16\,lei \qquad (4)$$

According to art. 35 of Law no.346 / 2002 on insurance for work accidents and occupational diseases, the allowance for temporary disability in the case of work accident or occupational disease is borne in the first 3 days of incapacity by the employer, and from the 4th day of incapacity, from the insurance contribution for work accidents and occupational diseases.

Loss of revenue for the company are estimated as follows (5) (Dascalescu A., 2003):

$$\Delta V_{expl\_V3.} = \frac{I_B \times Z_{ITM}}{\beta} + D_n \times n_{p0} \times p \times \tilde{N}_h + \cdot S_T \cdot D_i + \sum N \times \sum t_i \times \sum \overline{S}_{hi} + T_{Ai} \times \frac{q_i}{n_{p0}} \times \frac{S_T}{\tilde{N}_h} + T_{Av} \times \frac{q_v}{n_{p0}} \times \frac{\overline{S}_0}{\tilde{N}_h} - \cdot I_{B1} \frac{\overline{S}_o}{\beta} \times Z_{ITM} = 778{,}6\ lei \qquad (5)$$

where I_{B1} - TWI number of days of paid insurance contribution for work accidents and occupational diseases.

2.4. Costs generated by the fourth victim ($C_{t\text{-}victim\_4}$)

The fourth victim suffered leg fractures, being in temporary disability for 120 days.

The loss of working time due to this victim wasn't recovered by colleague's overtime. Being the third similar case as the victim, it is used the same formula for calculating the cost generated by the fourth victim ($C_{t\text{-}v4}$))6) (Dascalescu A., 2003):.

$$\Delta V_{expl\_V3.} = \frac{I_B \times Z_{ITM}}{\beta} + D_n \times n_{p0} \times p \times \tilde{N}_h + \cdot S_T \cdot D_i + \sum N \times \sum t_i \times \sum \overline{S}_{hi} + T_{Ai} \times \frac{q_i}{n_{p0}} \times \frac{S_T}{\tilde{N}_h} + \\ + T_{Av} \times \frac{q_v}{n_{p0}} \times \frac{\overline{S}_0}{\tilde{N}_h} - \cdot I_{B1} \frac{\overline{S}_o}{\beta} \times Z_{ITM} = 3\ 254{,}21\ lei \qquad (6)$$

Loss of revenue for the company are $\Delta V_{expl\_v4} = 914{,}51\ lei$

2.5. Costs related to the loss of fixed assets (work) (C_{WE_fault})

Following the crumbling earth bank the electrofusion welding machine was damaged, requiring repairs, carried out by a maintenance company. The cost of repair was 2215 lei.

In this case, the non-use device not influence the costs of losses of fixed assets because the company had in administration yet another electrofusion welding machine which at the time of the accident was not used in other activities and in this respect have not recorded additional costs that would be generated by purchasing or renting a new working equipment.

2.6. Costs related to fines (C_{fines}) and the purchase of work equipment and personal protective equipment (Csafety)

For breaching the law the firm, through its representatives, was sanctioned with a fine in value of 10 000 lei, according to art. 39, paragraph (9) of Law no. 319/2006 and received three written warnings.

Safety measures taken to prevent similar events are technical and organizational. Ito continue the task, within 30 days the company must be equipped with systems to support the earth banks, work equipment which are designed to ensure both the safety of workers and the safety of work executed as means of specific protection and to supply appropriate personal protective for workers adequate to risks identified in the workplace for works to be executed.

The firm also have to review the safety and health plan within 30 days after receiving the investigation report issued by the Labour Inspectorate who recorded the event, including the evaluation of the foreseeable risks related to the materials, work equipment and to complete the register of coordination which during inxeatigation it was found that it was not completed.

The investigation report has established that within 5 days to take action informing the workers on the causes of accidents and health and safety measures to be taken in order to prevent other casualties.

As a result of the measures carried out, it was purchased two supporting systems of 4x1m for 3 533.26 Euro / pcs each and personal protective equipment for 1 230.8 lei.

2.7. Penalties arising from failure to comply contractual deadline ($C_{penalties}$)

Activities for restoration of the area where the accident at work took place and lost time as a result of carrying out investigations led to exceeding deadlines.

To comply with contractual terms and avoid paying penalties of 1 000 lei / day of delay, top management of the company decided to outsource part of the work of a third company. The cost of works carried out by third company was 4000 lei.

Apart from the above calculated costs, employers borne the funeral expenses ($C_{funeral\_expenses}$) for deceased victims in the amount of 8000 lei.

The cost of the collective work accident for the company and the total losses are recorded to 57 617,33lei.

The company recovers from injuries and occupational diseases Fund 2 379 006 lei, the financial losses due to collective work accident recorded are 55 238 324 lei.

Analysing the percentage of cost categories of work accident that the company incur, it was found that the highest percentage is occupied by insurance of safety measures, an investment that if it had been made before starting the work would not be recorded injuries and casualties and financial losses.

Analysing the percentage of categories of expenditure that the company recorded as losses is established the penalties as fines, received due to failure of the work safety measures has the highest share of 36%, followed by the burial aid of the two victims and the cost of subcontracting a part of work to avoid payment of very high penalties due to delay of final term. In fig. 2 is shown this analysis.

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In calculating the above mentioned cost of work accident it did not consider the influence of entry of new fixed assets, the two systems that support banks, being in an aid for company in order to reduce the “non-safety”.

In terms of OSH and the role of safety for supporting systems for earth banks and personal protective equipment, this cost can be considered cost of safety, as the company purchased from its own initiative, in terms of complying with legislative provisions established by Law nr.319 / 2006 on safety and health at work.

From a financial point of view, because of “appreciation”, usually as practices observed in the economy, that investment in occupational safety by purchasing support systems for earth banks “is not advisable” and efficient, the company lost 55 238 324 lei, which would be covered the budget for safety at work and would not have led to the death of two workers and injured other two workers and potential present and future economic losses.

Although investment in safety at work is analysed, usually managers, as any investment in the light mainly of costs and profits, this must be also analysed as cost of the possible occurrence of events that resulted in accidents at work and technical losses estimated based on the history of their occurrence

Fig. 2.(a) Share of expenditure categories as a result of collective work accident (b) Share of expenses in collective work accident that will not be recovered

Awareness and involvement of top management is essential in the development of organizational risk management and to increase the risk awareness at different levels of the organization (G. Babut, R. Moraru, 2006).

Conclusion

The main problem for them is the amount of money to be allocated to Prevent work accidents and occupational diseases and the profit that they could bring.

Although it is difficult for top management of the company to calculate the profit that it brings an investment in the safety of workers, the estimation and cost analysis of a work accident is an indicator for their awareness in order to adopt specific measures of prevention and protection as the result of identification and occupational risk assessment for the four components of the work system.

The estimation of profit decrease of a company as a result of expenses related to an accident at work whether it is individually or collective, allow measurement of qualitative and quantitative of how actions to improve working conditions and the actions to improve the safety and health of workers are effective

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Analysis of pollutant imissions generated by bone meal production

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Abstract

In urban areas, air pollution represents one of the biggest problems concerning protection of human health and natural environment. This leads to the fact that local authorities of each area set as priority objective a management system of air quality. Moreover, given the fact that environmental pollution is the consequence of the economic situation of a country or region, it is necessary that actions of prevention and protection of environment and human health to be an important issue for any company. But all this requires an assessment of possibilities for inspection and monitoring of disturbances and propagation of air pollutants in each region depending on the level of industrial development and specific topographic and climatic conditions.

The paper presents monitoring of air quality in the area of a bone meal factory, it being a source of pollution for surrounding areas, as well as the impact on the environment and human health.

The purpose of the paper is to highlight the importance of monitoring air pollutants, given that the breathable air pollution is a problem that concerns not only organizations and specialized agencies in this area, but also base citizens.

Importance of the paper comes from the fact that prolonged exposure of population to pollution caused by dust and gas emissions leads to alterations of population health, also significantly contributing to climate change.

Keywords: pollution; immisions; atmosphere; health; environment.

1. Introduction

Air pollutants come from a variety of sources but mainly from combustion processes. In this regard, evaluation methods, air quality standards and limit values for pollutants emitted into the atmosphere were established by laws. Law 104/2011 on ambient air quality creates a legal framework for measures designed to maintain and improve air quality, based on objectives for air quality, ensuring alignment of national legislation with European standards and fulfilment of Romania’s obligations as an EU member state. This law transposes Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (*Călămar, 2015), (Law, 2011).*

The problem of air pollution can be considered a system with three components: the emission source, the atmosphere and receptors. Total elimination of pollution is an impossible goal, so it is better to target decreases in emissions to a level at which adverse effects associated with the presence of pollutants in the air are eliminated. To achieve this goal we must find an answer to the question: "What is the best way to combat air pollution?”. Social and political factors play an important role in achieving this goal because the necessary investments come at a high level (*S. K. Friedlander, 1973)*.

Air pollutants considered in assessing ambient air quality are *(Law 104/2011)*: sulphur dioxide, nitrogen oxides, ozone, carbon monoxide, benzene, particulate matter, lead and other toxic metals, polycyclic aromatic hydrocarbons. Values of maximum permissible concentrations of air pollutants are also regulated by STAS 12574/1987 and represent the average concentrations in various measuring ranges (averaging periods): 30 min., 24 hours, monthly, yearly. Usually short time averaging periods are used (30 min.); fixed measuring stations of environmental agencies use long duration averaged measurements (24 hours).

2. Description of bone meal production

The bone meal factory is located in a town in Hunedoara County, in an area where there is no significant sources of

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air pollution except traffic. The chosen site is sufficiently remote from human settlements - the nearby villages seat at about 1,100 m northeast at about 1,000 m northwest, thus meeting the requirements of MS Order no. 536/1997, which makes provisions for location of economic units producing atmospheric emissions that can cause discomfort at distances that do not affect the population in the area. *(ECOARTECH, 2011).*

For the manufacturing of bone meal and technical fats, 3rd category material of animal origin is used as raw material, stated by (EC) Regulation no. 1069/2009 of the European Parliament and of the Council laying down health rules concerning animal by-products and derived products not intended for human consumption and repealing (EC) Regulation no. 1069/2009 and Order no. 16/2010 of the ANSVSA President amended and supplemented *(ECOARTECH, 2011)*.

The raw material (3rd category material of animal origin) is usually obtained from slaughterhouses. Essentially, bone meal and technical fat manufacturing consists of melting the raw material in controlled conditions, by indirect heating with steam (maximum temperature of 115°C), separation of protein material from fat and their processing through to finished products, namely boner meal and technical fats. Bone meal is delivered to factories that produce food for pets (dogs, cats) and animal fat is used mainly as fuel for the steam power plant's boiler to produce steam required by production process.

3. Inventory of air pollution sources

Activities that constitute sources of air pollution are related to:
- Combustion in the steam power plant;
- Inside traffic (entrance and exit of vehicles transporting raw materials, equipment and products,);
- Discharge gas purge recovery system;
- Composting platform.

Manufacture of bone meal and technical fats results in volatile organic compounds falling under the heading of group of saturated, unsaturated and aromatic hydrocarbons, aldehydes, ketones, alcohols, fatty acids, amines etc., and also in inorganic compounds such as hydrogen sulphide, ammonia, etc. The issue of risk at work was studied by numerous researchers worldwide (*Băbuț et al., 2009, Băbuț et al., 2015, Simion et al., 2016, Pupăzan et al., 2012*), studying each chemical element and risks associated to it, upon workers and environment.

Unpleasant odour volatile organic compounds include acetaldehyde, ammonia, butylamine, butyric acid, dimethylamine, dimethyl sulphide and disulfide, ethylamine, ethyl and methyl mercaptan, triethylamine, trimethylamine, hydrogen sulphide, indole, methylamine.

In the manufacturing of bone meal results a discharge gas consisting of water vapour having some content of volatile organic compounds, some of which have unpleasant odour, effluent that undergoes a treatment process in a plant consisting of a cyclone, a heat exchanger, a condenser, fan and a bio-filter. At the same time, the production hall is under some depression being connected to an absorbent ventilation system that captures fugitive emissions from the process and puts them into the bio-filter treatment plant.

Gas discharge purge recovery system is a reliable and proven technology for odour control in a wide range of industrial activities and especially in treatment of gas containing volatile organic compounds resulted from processing animal waste. Bio-filtration technology is considered BAT according to BREF "Waste Water and Waste Gas Treatment" and BREF "Slaughterhouses and Animal By-products Industries".

4. Materials and Methods

Our study included quantities of pollutants emitted into the atmosphere during 2015-2016, from the sources listed above belonging to this bone meal company. In this regard, the staff of the Laboratory of Environmental Protection of NRDI INSEMEX Petrosani performed measurements of gases and dusts emissions from the steam power plant as well as measurements of gas imissions on the company's platform, especially volatile organic compounds (VOCs) and hydrogen sulphide (H_2S) with unpleasant odour disturbing for the local population or household settlements.

The basic motivation for the study is to implement air pollution control and reduction. Specifically, the objective is to control pollution sources so that the concentration of pollutants in the environment is reduced to levels considered safe in terms of undesirable effects. To quantify the objectives it is advisable to know the volume of damage caused by each of the pollutants (for all environment aspects) as a function of exposure to various levels of pollutant concentration *(Gavrilescu M., 2007).*

Primary standards for ambient air quality are those necessary to protect public health with an adequate safety threshold. Secondary standards for ambient air quality list levels of pollutant concentrations necessary to protect public welfare against known or anticipated adverse effects associated with the presence of such pollutants in the air. Secondary standards are based on damage to crops, vegetation, wildlife, visibility, climate and adverse effects on the economy. Thus, an air quality standard is a level to which the concentration of a pollutant should be reduced, to avoid unwanted effects *(Kovacs M., ș.a., 2014)*.

To determine the emission and imission concentrations of pollutants discharged into the atmosphere from sources related to target's functioning, the environmental permit was taken into consideration, for it requires the monitoring of indicators both in emission and imission. Thus, emission gases were sampled such as SO_2, CO, NOx and dust, as well as imission gases, namely hydrogen sulphide, ammonia, methyl mercaptan.

Emissions of pollutants in the atmosphere consist of acid gases (NOx, SO_2), particulates, carbon monoxide and volatile organic compounds. All these pollutants affect to a certain measure air quality. Qualitative changes depend on the amount of pollutants discharged and pollutant properties, especially their stability in the atmosphere, their or the compounds that they develop into aggressiveness on atmosphere components.

4.1. The equipment used and the results of dust and gas emissions measurements

The sampling equipment (endowment of NRDI INSEMEX) used to measure emissions of dust and gas is state of the art, having heated sampling lines to avoid condensation.

Measurements of dust and gas emissions were performed gravimetrically (for dusts) using the ISOSTACK BASIC automatic isokinetic sampling system and instrumentally (for gases) using the TESTO 350 XL multigas analyzer.

The ISOSTACK BASIC automatic sampling system allows and sampling particulate and gases at exhaust chimneys under isocinetism conditions; this means that the sampling rate must be set so that the speed of effluent entering the sampling nozzle is equal to the speed of the gas in the chimney. When choosing the location and distribution of sampling points, the facts that gas flow isn't always laminar and particle size distribution is not uniform were considered. Automatic manual dust sampling systems perform continuous measurements of flow rate or pressure ratios at probe and automatically adjust suction speed.

TESTO 350 XL multigas analyzer (fig. 1) is composed of the sampling probe, the analysis unit and control unit. For sampling gaseous effluents (fig. 2) a stainless steel metal probe is used, provided with an inside thermocouple for measuring effluent temperature. The device is intended for measuring concentration of nitrogen dioxide, nitrous oxide, sulphur dioxide, carbon dioxide, carbon monoxide and oxygen in emissions of stationary sources.

Figure 1. TESTO 350 XL multigas analyzer

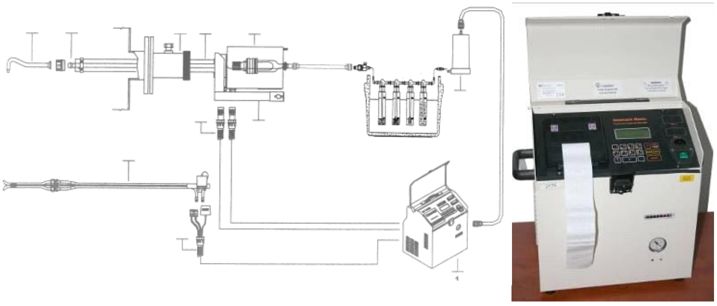

Figure 2. ISOSTACK BASIC system

Concentration s of dust and gases released into the atmosphere while performing the test are summarized in Table. 1.

Table no. 1

No.	Sampling date	Measurement place	Measured marker	Concentration [mg/m³]		C.M.A[mg/m³] according to conform Law 278/2013 Order 462 / 1993
				Average value	Maximum value	
1.	December 2015	Discharge chimney no. 1 of the galvanizing plant	CO	0,197	3,70	100
			SO_2	0	0	35
			NO_x	329,6	1340	350
2	2015	Discharge chimney Buderius plant	Dusts	0,81		5

When measuring particulate emissions the following additional parameters were considered:

H- Source height [m];

D / L x W –Source diameter for circular source or the length and width for rectangular sources [m];

T_s - Source air temperature [^{0}C];

T_a - Ambient temperature [^{0}C];

V_a - Air source speed [m / s];

P_a - Atmospheric pressure [mbar];
O_2 - Oxygen concentration in the source [%];
CO_2 - carbon dioxide concentration in the source [%]

The nitrogen oxides in exhaust gas are formed due to combustion with an excess of air. The largest amounts are represented by nitrogen monoxide (NO) and nitrogen dioxide (NO_2). The amount of nitrogen monoxide formed increases with temperature, while the nitrogen dioxide decreases (Rojanschi, 2002).

Nitrogen monoxide is oxidized in the atmosphere becoming nitrogen dioxide. This, in turn, along with water, can form nitric acid, thereby increasing the acidity of the atmosphere and soil.

Analyzing the measured values (Table 1) we note that the measured concentrations of total particulate limit does not exceed the emission limit value set by Order 462/1993 and Law 278/2013, respectively 5 mg/m^{3}N, gases concentrations (CO, SO_2) do not exceed the emission limit values for SO_2 = 35 mg / m^3 N, CO = 100 mg / m^3 N and NO_2 concentrations, if we average minimum and maximum values, exceed the allowed limit of 350 mg/m^{3}N.

Thus, application of techniques to prevent the formation of NOx should be taken into consideration, one of the methods currently used (figure 3) is installing burners in outbreak corners so that secondary combustion air and fuel are not contained in the same jet, forming a circular burning zone.

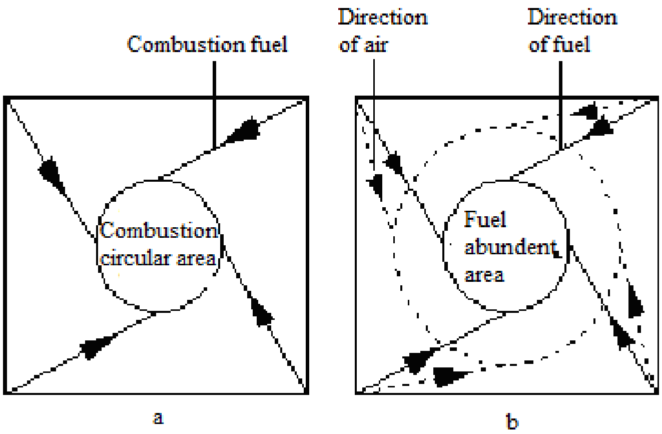

Fig. 3 Assembly of burners having reduced NOx burning points (*Rojanschi, 2002*)
a - traditional assembly b – assembly for reduced NOx built-up

4.2. Equipment used and results of the gas imissions measurements

The equipment used for measuring gas imissions is the PhoCheck 5000 Ex portable gas analyzer (Figure 4) and MSA Orion Plus portable gas analyzer (Figure 5), used measuring volatile organic compounds (VOCs) from ambient air, using a PID analyzer (Detection by photo ionization).

Fig.4. PhoCheck 5000 Ex portable gas analyzer

Fig. 5. MSA Orion Plus portable gas analyzer

Impact assessment upon environmental factor air is made in terms of concentrations in imissions (pollutants concentration at respiratory level). We are interested only in short-term mediation concentrations (30 minutes) which represent the highest expected concentrations at respiratory level due to sources simultaneously running in the same area.

The results of imissions measurements are summarized in Table 2.

Table 2

No.	Sampling date	Place of measurement	Measured marker	Concentration [mg/m^3]	C.M.A according to STAS 12574/87
1.	December 2015	S - E from location	Hydrogen sulphide (H_2S)	0	0,015 mg/m^3
		N - V from location		0	
2.	January 2016	S - E from location	Hydrogen sulphide (H_2S)	0	
		N - V from location		0	
3.	July 2015	S - E from location	Ammoniac	6,361	0,3 mg/m^3
			Methyl mercaptan	0,909	0,00001 mg/m^3
		N - V from location	Ammoniac	2,418	0,3 mg/m^3
			Methyl mercaptan	0,579	0,00001 mg/m^3
4.	December 2015	S - E from location	Ammoniac	1,361	0,3 mg/m^3
			Methyl mercaptan	0,0002	0,00001 mg/m^3
		N - V from location	Ammoniac	0,418	0,3 mg/m^3
			Methyl mercaptan	0,0001	0,00001 mg/m^3
5.	January 2016	S - E from location	Ammoniac	1,185	0,3 mg/m^3
			Methyl mercaptan	0	0,00001 mg/m^3
		N - V from location	Ammoniac	0	0,3 mg/m^3
			Methyl mercaptan	0	0,00001 mg/m^3
6.	July 2016	S - E from location	Ammoniac	0,575	0,3 mg/m^3
			Methyl mercaptan	0	0,00001 mg/m^3
		N - V from location	Ammoniac	0,2375	0,3 mg/m^3
			Methyl mercaptan	0	0,00001 mg/m^3
7.	July 2016	S - E from location	Hydrogen sulphide (H_2S)	0	0,015 mg/m^3
		N - V from location		0	

After analyzing the concentrations measured over the entire monitoring period (table 2) the following were noted:

- H_2S concentrations measured *do not* exceed the limit established by STAS 12574/87 in any of measurement campaigns;
- Concentrations of methyl mercaptan *exceed* the limit established by STAS 12574/87 and environmental permit by 10 ÷ 90 times within measuring campaigns in July and December 2015, while in 2016 measured values fall within allowed limits;
- Ammonia concentrations measured *exceed* the limit established by Law 104/2011 on ambient air and STAS 12574/87 by 1 ÷ 21 times in most measurement campaigns, values recorded in 2016 being smaller or even zero.

It is noted that on the day of measurements prevailing wind direction was from NW to SE.

5. Effects of air pollution on human health

Over the years, concentrations of air pollutants have occasionally reached, in some areas, excessive levels for a period ranging from several hours to several days. Although the effects of one episode of air pollution can be devastating, an equal or even grater concern is represented by the chronic effects on people living in polluted air.

Air pollution affects health of humans and animals, causes damage to vegetation, soil and materials, affecting climate, reducing visibility and sunlight. Some of these effects are specific and measurable, such as damage to vegetation and materials and reduced visibility others are difficult to measure, such as effects on human and animal health.

In the advanced situation, local population may be affected in time in terms of health because of excessive concentrations of the two indicators, namely methyl mercaptan and ammonia. In 2016, the operator was able to significantly reduce concentrations emitted into the atmosphere, so, if they will maintain this course of producing bone meal at current standards, the local population will be less and less affected.

6. Conclusions

To assess the environmental impact of the bone meal factory, pollution in the area was quantified by measurements in both emissions and the imissions, having as reference the indicators required for monitoring by the Territorial Agency for Environment and effective standards.

Results of measurements performed in the monitoring points reflect a momentary situation, being influenced by a number of factors of random evolution over time. Thus, prevailing wind direction during the months of sampling was from NW to SE, direction in which is also positioned a landfill that can make a significant contribution to measured concentrations. Comparing the values obtained with the maximum allowed by current legislation for particulate and gas emissions as well as imissions gases, shows that the environment is affected by the activity.

Maximum concentrations of NOx emission do not fall within the permissible limits set by law 278/2013 and maximum concentrations of imission exceed by far the maximum permissible limits on ammonia and methyl mercaptan during 2015, being lower in 2016.

Human settlements, even if at a distance from the site taken into consideration, may be affected over time, especially due to odour originated from volatile organic compounds. The presence of odor in the atmosphere, developed pursuant to bone meal production has led to questions and comments from local residents up to making certain complaints to competent bodies. Bio-filtration technology is considered BAT according to BREF "Waste Water and Waste Gas Treatment" and BREF "Slaughterhouses and Animal By-products Industries" and studies in the literature show that the bio-filter treatment efficiency is very high , approaching 100%. Resulting from the research conducted it can be said that there is a problem in meeting the technology proposed by the project, and for normal functioning of the factory top management must remedy this issue. It is recommends that the company management takes up measures and practices to control the combustion process in the steam power plant to prevent formation of NOx in large amounts by burning with very low air excess coefficient (low NOx burners) and remediation of work technology issues.

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Measures for restricting corrosion of a motor drive subjected to atmospheric corrosion in the plant for wastewater treatment

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Abstract

The paper presents a case with a motor drive, installed above the pool containing ammonium nitrogen (NH4-N), organic carbon, sulfates, chloride, oxygen and depolarizers from the air. We analyze these environmental conditions that accelerate the processes of oxidation and recommend protective measures. The measures consist of treatment with inhibitors, selection of suitable alloyed metal, surface's treatment with thermal and ultrasonic methods. Unfortunately they are applicable only for new devices. In this case, it was implemented an unconventional method by covering with a box from suitable insulating material.

Keywords: motor drive; corrosion; prevention, materials.

1. Introduction

Corrosion is a serious problem for society, causing damages to economy and conditions of live of people. From economic point of view the loss from corrosion in industrialized countries amounts to 4-5% of their national products.

Corrosive destruction of the metals is a consequence of destructive changes in their structure, provoked by the influence of aggressive environments. Aggressive environment interacts with materials and destroys them as a result of physical, chemical and physico-chemical processes, of presence of large temperature variations, welding, forces of tension and compression, stray currents, microorganisms etc. The basic facilities that are subject to corrosion are pipelines, tanks and other metal structures, which are in contact with aggressive fluids.

Besides them, to corrosion are exposed metal constructions near to aggressive fluids and under the influence of atmospheric fluctuations.

2. Subject of study

In particular, it is considered a motor drive, which is subject of atmospheric corrosion in "Municipal plant for waste treatment" in the area "Sadina". The motor drive is installed above the pool containing ammonium nitrogen (NH4-N), organic carbon, sulfates, chloride and oxygen, which in combination with the presence of depolarizers from the air create conditions accelerating the processes of oxidation and arising oxide cover (layer) with weak protective properties. The main obstacle to predict the type of corrosion destruction is the change in the composition of infiltrate during the year and last but not least the variable weather conditions. In dependence on the environmental factors and considering the potential corrosion damages, the article proposes a set of measures to reduce and control the status of the motor drive.

3. Reasons for corrosion

The prevention of corrosion process begins with exploration of the "Corrosive" environment. The term "atmospheric corrosion" includes corrosion of the material in contact with air and is the most common type of corrosion of the metals.

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Atmospheric corrosion is a problem of global concern, having in mind that it shortens the operational life of equipment and reduces the durability of structural materials. Although there is a common classification system for causes of corrosion, it is far from universal. Conventional atmospheric parameters, which can lead to corrosion of the metal consist of weather factors such as temperature, humidity, precipitation, solar radiation, wind speed and the like. Additional factor are the air pollutants such as sulfur dioxide, hydrogen sulfide, nitrogen oxides, chlorides, which due to its diversity and the complex interaction reduces the predictability of the velocity of development of processes (Syed, 2006). In the considered specific case it was modeled the determination of synergistic interaction of environmental factors, where the most aggressive industrial environments are sulfur (SO_X) and nitrogen oxides (NH_4). The rate of oxidation increases with increasing the humidity (at 60% is the limit value, which in this case has not been reached), because the airborne pollutants are precipitated on the metal surface, especially in environments containing chlorides, phosphates, hydrogen, sulfate, ammonia and its salts.

3.1. Composition of environment

The chemical analysis of the infiltrate (fig 1a) shows the content of chloride ions, which concentration is sufficient to destroy the passivating layer. The ions of a chloride react with the steel and form an intermediate iron chloride ($FeCl_2$). On these places the steel is activated as a strong anode, but the near located, still passive, surface forms cathode. The hydrolysis of the ferric chloride produces hydrochloric acid (HCl) and the result is corrosion in form of localized perforation (pitting). After appearance of holes in the steel, the acidic environment sustains the process, supports the corrosion and increases its depth. In the places with welds, stress corrosion is likely to occur.

a. Composition of filtrate

Name of the substance	Unit of measurement	Results test
1. Nitrogen ammonium (NH4-N)	mg/dm^3	233
2. Azot nitrate (NO3-N)	mg/dm^3	0.16
3. Nitrogen nitrite (NO2-N)	mg/dm^3	< 0.02
4. Arsenic	mg/dm^3	0.031
5. Barium	mg/dm^3	0.25
6. Iron	mg/dm^3	0.86
7. Mercury	mg/dm^3	<0.50
8. Cadmium	mg/dm^3	<0.0010
9. Copper	mg/dm^3	0.38
10. Molibden	mg/dm^3	<0.0050
11. Nickel	mg/dm^3	0.077
12. Common procurement organic . carbon	mg/dm^3	264
13. lead	mg/dm^3	0.018
14. Selenium	mg/dm^3	<0.010
15. Culfati	mg/dm^3	114.2
16. Fluoride	mg/dm^3	0.59
17. Phosphates	mg/dm^3	6.3
18. Chloride	mg/dm^3	863
19. Chrome	mg/dm^3	0.17
20. Zinc	mg/dm^3	0.078

b. Steel parts

Fig. 1. (a)Composition of filtrate processed by the water treatment plant "Municipal enterprise for waste treatment" in the area "Sadina".; (b) steel parts affected by the aggressive environment of infiltrate waters

Due to the proximity of the motor drive to infiltrate water and the presence of chloride ions observed trans-crystal local destruction by corrosion crack spread through the metal grains. The presence of bacteria in the medium does not exclude the possibility of microbiological corrosion.

3.2. Effect of pH

The corrosion of metals, which are predominantly made by stainless steel, can be induced and sustained mainly by two mechanisms: the first one is a reduction the alkalinity of the surrounding environment, and the second is the

presence of chlorides, which cause an electrochemical process. Both mechanisms destroy the passive layer on the surface of the metal details. Passive layer can not exist, when the pH has a value below 11.5, and as in this case its destruction causes corrosion. The research findings and measurements prove that the machinery and equipment influenced by both, evaporation from the infiltrate and the atmospheric conditions, have the most corrosive damage over the area of the plant (Figure 1.). The average value of pH for one year of infiltration of water in depot is pH 7,9, and of mixed flow of infiltrated water is an average pH 7,73.
The heterogeneous infiltrate mixture together with the impact of variable weather conditions change the acidity over the year. Although the change is not greater, it is a good reason for defining of protection measures. In that case, at slightly acidic and neutral aqueous solutions, a layer is formed from insoluble by-products of corrosion (complex hydrated oxides - t. Pomegranate. "Rust"). However, its protective properties are weak.

3.3. Difference in concentrations of depolarizing or passivating substance

In the presence of uneven on thickness electrolyte layer on the metal surface form a galvanic cell of a differential aeration. The region, where the concentration of oxygen (resp. aeration) is greater, is converted to a cathode. The section, to which access is with limited oxygen, becomes anode.
In this case the differences in the electrochemical potential of the metal parts are a consequence of different aeration and are caused by inhomogeneities at the surface. This may be due to the specific composition of the metal, the contacting between the different types of metal parts; contacting between surface protected steel and unprotected steel; defects in the surface of the metallic element, welding, wire link or other active points, which are so many for the motor drive.

4. Protection measures

Given changing environmental conditions during the year (temperature and humidity) and observed corrosion damage, the main measures that can be taken to protect the facilities are the application of inhibitors, choice of suitable material, placing insulation or protective equipment and continuous inspection.

4.1. Processing of the corrosive environment

The processing of the corrosive environment with the aim to reduce its aggressive action on metals has received wide spread in the industry as a method of corrosion protection.
Lowering of the corrosive aggressively of the environment at electrochemical corrosion can be achieved by:
- Reducing the content of depolarizing substance;
- Introduction of the corrosion inhibitors (inhibitor protection).

In the case presented by a suitable inhibitor, which changes the pH of environment, may be shifted the places of the anode in the environments with high chloride content. The implementation of this measure is threatened by the rotation of wet and dry cycles at the change of the seasons. However, it has been found that the appropriate compound is 0.5 mM SnCl2 (Kamimura, 2012). In the present environment, however, there are ammonium ions, so we need to do further studies to determine whether the substance and concentration are appropriate. This is a task for future work.

4.2. Choice of an appropriate metal

The choice of sustainable construction material requires an establishment of the reasons for corrosion of metals, determination of the nature of corrosion environment and the kind of depolarisation, evaluation of the impact of the main factors of corrosion. Currently the facility is already installed and operating, therefore is inefficient to replace it. The recommendation is that, after its operational life, it to be replaced with another one, produced by more resistant material.
It has been found that the loss of corrosion of weathering steels, which contain a small amount of Cu, Cr and Ni ions, is correlated with the amount of chloride ions in the atmosphere. It is known that chloride ions leads to formation of (β-FeOOH), which prevents the formation of the protective rust layer and it is synthesized only under acidic conditions (Kamimura, 2012). Therefore, in slightly acidic environments is recommended alloying the steel with Sn, Cu and Ni, elements contained in chrome-nickel steel. Since the motor drive has many places with welds, but the molybdenum prevents corrosion spotted, the most appropriate steel is the chrome-nickel-molybdenum one.
The development of intergranular and stress corrosion is prevented by nitrogen ligation - N, thus distinguishing high and low alloyed steels, but is possible at a sufficient nitrogen concentration. It has been found, however, that at the presence of Cl^- and other harmful ions in the contact zone, negatively charged nitrogen ions would not be added in the oxide coating layer on the steel, as they begin the process of new passivation. The latest survey shows that for the conditions in the treatment plant the nitrogen-alloyed steel is appropriate, but not the oxide coating containing nitrogen.

On the other hand, the high levels of N in the stainless steel makes them susceptible to MIC, especially in the presence of nitrifying bacteria. The addition of Si, and Ag imparted antibacterial properties of materials. It is recommended again to use alloying of Ag, instead of coating, which is appropriate in inhibitory processing but in this case is absent.
The corrosion damages to the considered motor drive begin with pitting corrosion and one of the main reason for this undesirable process is the presence of impurities. Generally, the presence of manganese sulfide (MnS) in stainless steel is undesirable (Lim, Kim, 2001), as it forms cracks and ulcers even for classes that are heavily alloyed (Lo at all, 2009). Alloying with rare earth elements in appropriate amounts and the application of high-temperature annealing significantly suppressed the formation of MnS (Yang at all, 2007), by conversion in $(Cr, Mn)_2$ (O,S) (Hiroshi Y.,1986). Besides the Cr, it would be possible to add appropriate quantities of a titanium carbon in ferritic stainless steels, which form $Ti_4C_2S_2$ and suppress the formation of MnS (Lo at all, 2009). Therefore, this component has to present in the motor's drive steel.
To prevent the formation of cracks it should be avoided the deformation of martensitic structures. When the size of the grains in martensite is less than a critical value, the fatigue is delayed and the crack propagation in the material also. An advantage of austenitic steels is that they are not influenced by environmental factors (such as temperature, humidity, presence of ions) that lead to a change of the compositions of the steel (dislocation of the crystal structure and deformation). To prevent the process it is recommended the use of the austenitic steel or miniaturization of a microelectromechanical system (MEMS), i.e., the structure of the metal for the manufacturing of motor drive must have a fine grain structure.
Stainless steels have very good resistance to oxidation at high temperature in a dry oxidizing environments as they have Cr-rich surface. However, the chromium oxide gradually loses its protective ability, especially in a moist environment, such as the operating environment of the motor drive. Because of the moving parts there are places where the temperature rises, that's why to prevent the destruction of the structure it is recommended alloying with silicon (Si) and aluminum, which improve the surface properties and oxidation stability.
Summarizing the analysis of the necessary impurities in the steel, we could recommend the following brands steel: 10H14G14N4T; 10H14AG15; and 07H13AG20 which are substitutes for steel type H18N10T in environments with relatively low aggressiveness.

4.3. Additional techniques for processing metal

For strengthening of anticorrosion properties of the steel surfaces, a pre-treatment at a high temperature or high pressure, which contributes to the stability of micro-grain structure of the steel, can be applied. In most cases, the damage or the maximum loads occur near to the surface layers of the material and the vast majority of the practices are focused on improving the surface properties of metals, especially to stainless steel. Such practices are blasting of metal surfaces, applied successfully for increasing of the of operation life of welded components, elimination of alterations caused by welding and other technological processes, stress relief, increasing the hardness of the material. In dependence on technology it was distinguished Laser Peening (Hackel, Rankin) suitable for processing blades of fans, motors and other moving parts, as in the present case. The ultrasonic peening (Kudryavtsev, Kleiman) is based on the combined effects of high-impact impulses and it is widely accepted as the most effective technology. High-energy shot increases the hardness of the surface layer and reduces the influence of dislocations (Hou, 2008) and the ultrasound shot Peening (USP) reduces a stress corrosion in low alloy steels (Prevéy). It is important to note that these surface techniques for nano-construction prevent distortions induced by martensitic structures. They form a fine grained surface which prevents dislocation under pressure and slows down the formation of cracks. High-energy sources such as lasers and electron beam perform a phase transformation in the surface of the material and it is used to improve the corrosion performance for a long time.

In the practice, to reduce corrosion damage is modified the structure of finished parts and surfaces by laser processing. Depending on the strength of the beam, duration of action, temperature and other factors are distinguished several different methods. The laser cladding (Weng, 2014, Candel-Ruiz, 2012) is applied to the chromium-nickel and titanium alloys for the cutting tools rotating parts, as well as in medicine. Laser surface melting (Conde, 2000; Schleifenbaum, 2010) allows the deposition of new material by laser annealing. This operation removes cracks and defects of small and inaccessible locations of the parts (Negro, Huet, 2012) in the same manner as the motor drive. Laser alloying introduces new elements in the metal structure for increasing of the rigidity and corrosion resistance (Yu, 2011). Laser cleaning is intense laser radiation to selectively remove the contaminants from the solid support, leaving the basic substrate to largely unaffected. Laser beating (Peyre, 2000) increases resistance to pitting corrosion. Laser transformation hardening is used for small parts for improving the wear resistance with respect to friction (Brown, 2010). In the case of a running motor drive, it is recommended that the affected areas to be cleaned and be subjected to induration and then laser annealing. These measures will slow the progress of the ongoing corrosion processes.

When inserting the new motor drive is provided the parts to be subjected to a laser melting (LSM), in which a thin surface layer is melted by a laser beam and then a shallow layer that is cooled more quickly in comparison with the bulk of the matrix. Through these measures is reduced the speed of intergranular corrosion and stress that is an appropriate procedure for surface working machines, the same as the motor drive. The advantage of the application of these technologies is the ability to accurately control the energy i.e. achieve the desired modification of the material.

For reduction of local destruction a formation of the passive layer under the influence of the dynamic polarization between hydrogen and oxygen, an exposure to UV light or electropolished are recommended. As materials used in this practice are argon, sodium nitrate or phosphate. The processing of steel includes formation of oxide coatings by application of various technologies. In the choice of protective measures it is important to note that the oxide layer must not have an excessive thickness, because of the opportunity to unpeel, especially in high-temperature on rolled ferritic structures. The reason is the high hardness of chromium oxides.

All these measures have to be taken into account at the development of new facilities.

4.4. Unconventional measures to protect

The motor drive are still working and it is necessary to recommend measures which can slow down the started corrosion processes and extend their operating life. Reduction of corrosion rate in this case can be achieved through the use of inhibitor, laying of protective coating, application of modification methods or designing of box. At this stage it is impossible to put a new coating of the motor drive because there is no access to all its parts, and there are moving parts with complex shape. Even the factory-fitted protective layer wears out over time. Therefore it is recommended to clean motor drive by laser method and to cover it with a box from insulating material, which is equipped with a fan for introducing of fresh air and discharging the contaminated air. So, the steam from the infiltrate will not reach to the motor drive. As for the material for manufacturing, having in mind the composition of the corrosive environment, there are offered polystyrene, fiberglass, epoxy polymers, laminated, PVC and the like.The box was placed corrosion-resistant fan flow 5 m3/h and power 50 W**.**

Advantage of the proposed box is the low cost, universality and the opportunity to be produced from the team working in the enterprise. Furthermore, it can be used after the replacement of the motor drive.

4.5. Inspection

Based on the analysis, for avoidance of emergency situations, monitoring of the level of corrosion during the operation is recommended. The fatigue of material and the registration of cracks at a very early stage can be measured through magnetic and acoustic methods. The latter give a good correlation between the signal change and the growth of the numbers of cracks. For measurement of their length and distribution, the magnetic method is preferable. Such measurements, which are very specific and made early in the exploitation period, permit to change the remedies. In the research object corrosion has progressed and the use of these methods is not economically feasible. Therefore it is proposed an inspection for cracks through application of penetrants, which is sufficiently effective method.

Besides these resources, the progresses of general corrosion can be monitored by calipers. The presence of cracks in the motor drive was found with ultrasound caliper 45 MG of the company OLYMPUS. It is possible to use 27 MG also, but it does not offer data recording. While 45MG model provides options for recording previous measurements through additional software applications. On the basis of the saved data, and depending on the software applications, analyses of the presence of corrosion and the depth of the cracks are done. The results show that the corrosion increases by 1 mm/year and the cracks almost completely has covered surface parts of the motor drive.

5. Conclusions

Featured are unconventional methods of protection such as making a box of insulating material and processing of corroded surface ultrasonic methods.

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Use of IT equipment and specialized programs for solving ventilation networks

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Abstract

Simulation of mining networks became widespread in mining. There are several number of computer programs to analyze ventilation networks that are currently used to design, analyze, and operate of ventilation systems. Most of these ventilation programs have a graphical representation of ventilation network and the parameters involved, such as the loss in ramifications head, fan characteristics, heat transfer calculations, natural ventilation, etc. In addition, most of them include gas motion simulation, and simulations to changed conditions, such as being cases of fire, etc., although they are usually stable models. In our work are summarized the ventilation simulation programs available today such as VentSim, MVS, Vuma 3D, VentGraph, VenPri, and 3D Canvent.

Keywords: ventilation networks, IT, specialised programs, solving, modeling, simulation.

1. Introduction

Simulation mining networks became widespread in mining. There are a number of specialized programs ventilation network analysis that are currently used to design, analyze, and operate ventilation systems (Morar et al., 2014).

Most of these programs have a graphical representation of the network of ventilation and the quantities involved, such as the loss of head ramifications, features fan, heat transfer calculations, natural ventilation, etc. In addition, most of them include gas motion simulation, and simulations to changed conditions, such as being cases of fire, etc., although they are usually stable models.

2. Presentation of the simulation programs available

IT programs currently used for simulating and solving ventilation networks are (Morar Marius at al., 2016):

- VentSim;
- MVS – Services for mine ventilation;
- VnetPC;
- MineFire;
- DuctSIM;
- CLIMSIM;
- Vuma-3D;
- VentGraph;
- VenPri;
- 3D–Canvent.

VentSim - It is one of the leading software used for ventilation. It was originally developed in 1993 and since then

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the software has been used by more than 400 mines, universities, consultants and research organizations worldwide.

VentSim is described as a simulation package designed to simulate flow rates, pressures and heating to a network modeled lodging ventilation. VentSim is the first integrated package with easy to use graphical design for Windows with a graphical 3D.

An example of 3D graphics capabilities of the vents is shown in Figure 1.

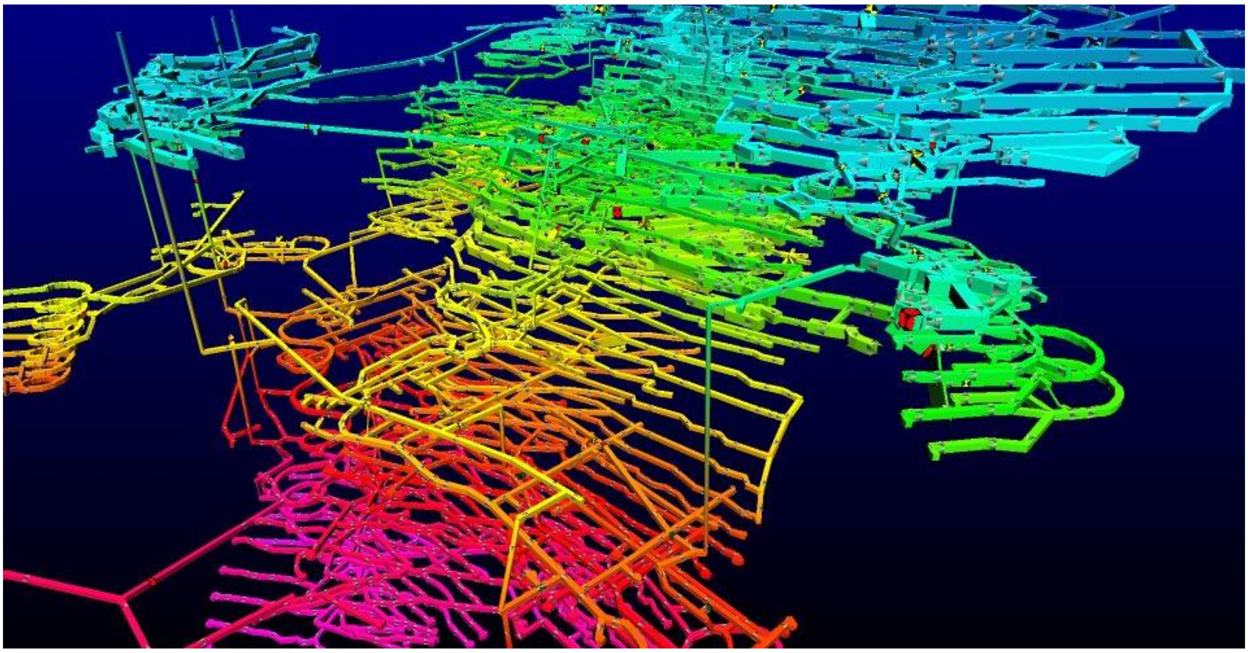

Fig. 1: An example of 3D network in VentSim.

The program offers a complete toolkit utility tightly integrated to analyze air flow, the heat, contaminants and financial aspects of mining ventilation.

Ventilation was a primary concern in underground mines for centuries, but until the introduction of computerized analysis of network ventilation in the last 40 years, projections and modeling of ventilation was largely difficult, relying on experience, conjecture and extended calculations.

Program enables 3D visualization of airway ventilation that allows rapid assessment to verify whether their size or position mining are correct.

The program also allows for animation drafts, the fans that sources of heating / cooling.

MVS - Services for mine ventilation, an engineering firm that since 1983 has developed a suite of software for underground ventilation: VnetPC, MineFire, DuctSIM, CLIMSIM.

- **VnetPC** - It provides a deeper and graphical representations of network parameters that characterized ventilation.
- **MineFire** - Performs calculations normal ventilation network planning and simulation static, dynamic and transient ventilation networks under a variety of conditions. The program simulates the ventilation system response parameters change, external influences such as temperature and internal influences, such as fires.
- **DuctSIM** - It is a simulation program designed for both mining and digging tunnels to assist engineers and designers with design and modeling ventilation and piping.
- **CLIMSIM** - It is designed to help environmental engineers in predicting thermodynamic properties and related psychrometers networks ventilation air flowing through underground workings.

Vuma-3D – It was developed by the company Bluhm Burton Engineering (BBE) released a three-dimensional (3D) network of underground mine ventilation own (Vuma). The program is used to calculate heat loads and air flow distribution in underground mines and to simulate underground mining environments.

VentGraph – It is developed by Strata Mechanics Research Institute of the Polish Academy of Sciences in Krakow. VentGraph is an integrated set of software that provides a ventilation engineer miner effective tools for solving complex problems of ventilation for underground networks. Outside capabilities static analysis conventional balance, the package also contains a simulator fire, conducting case studies of phenomena ventilation unstable, to prepare the evacuation of personnel from the nearby fire hazard and gas and weather ventilation different process variants. (Cioclea D at al., 2012, Moraru, R.I at al., 2014).

An example of a network visual representation hand is shown in Figure 2.

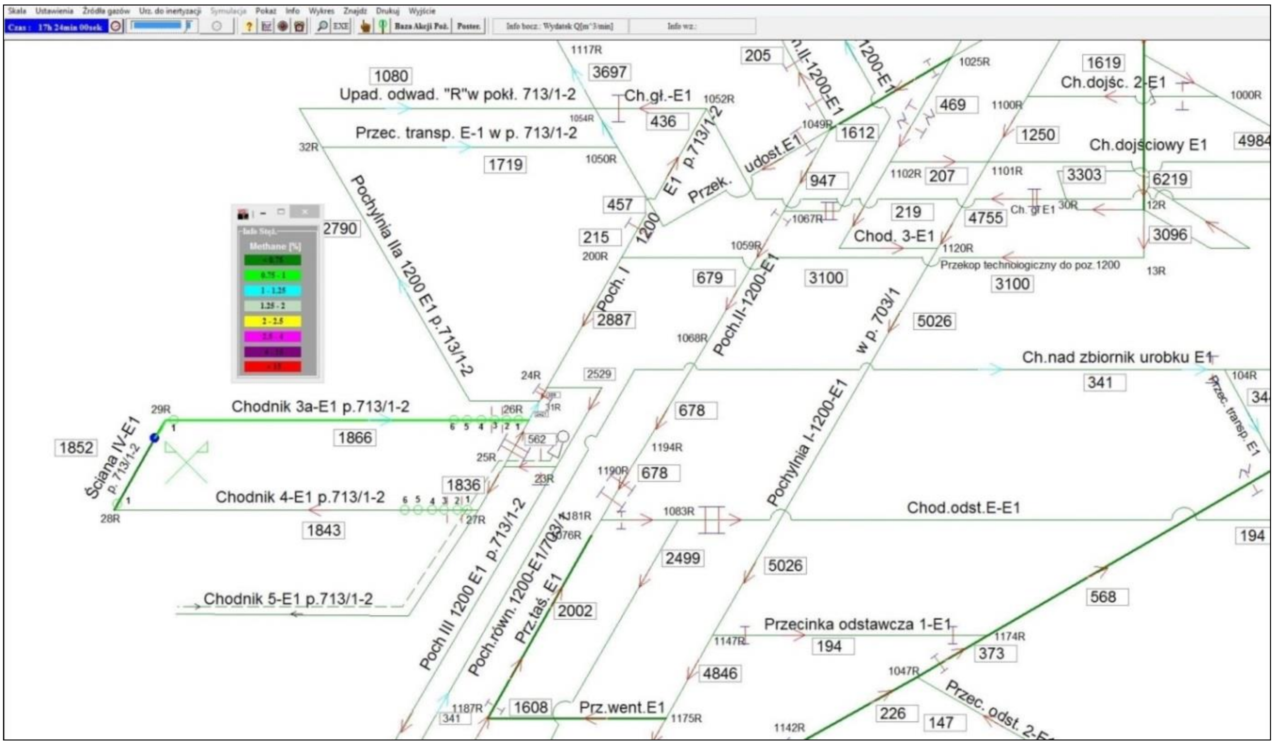

Fig. 2: A network of ventilation in VentGraph

VentGraph program is used by mine rescue stations in Poland, Czech Republic and Slovakia.

This system has the following characteristics:

- Distinct program blocks for the job in terms of performance safe ventilation;
- Graphical display of the results of calculations;
- Simulating the propagation of methane in equilibrium and unstable situations;
- The unique fire simulation;
- Cooperation optional real-time monitoring systems;
- Simulating the optional flow filtration exploited space.

VentGraph program comprises four groups of program that performs the following tasks:

- Preparation of database entry (EDTXT modules, EDRYS, EDESC);
- Calculation of the equilibrium state and Analysis (module GRAS);
- Simulating the unsteady conditions;
- Management of evacuation routes, operating in real time.

Some comparison capabilities for modeling the network above codes flow transient with Transnet, it was concluded that a modified form of code VentGraph provide more accurate and efficient simulations of flow transient dimensional network.

VentGraph simulation models provide the engineer mine ventilation with efficient tools for solving complex problems of transitional ventilation network.

An example of visual representation of a transient flow of gas in a mine network is shown in Figure 3.

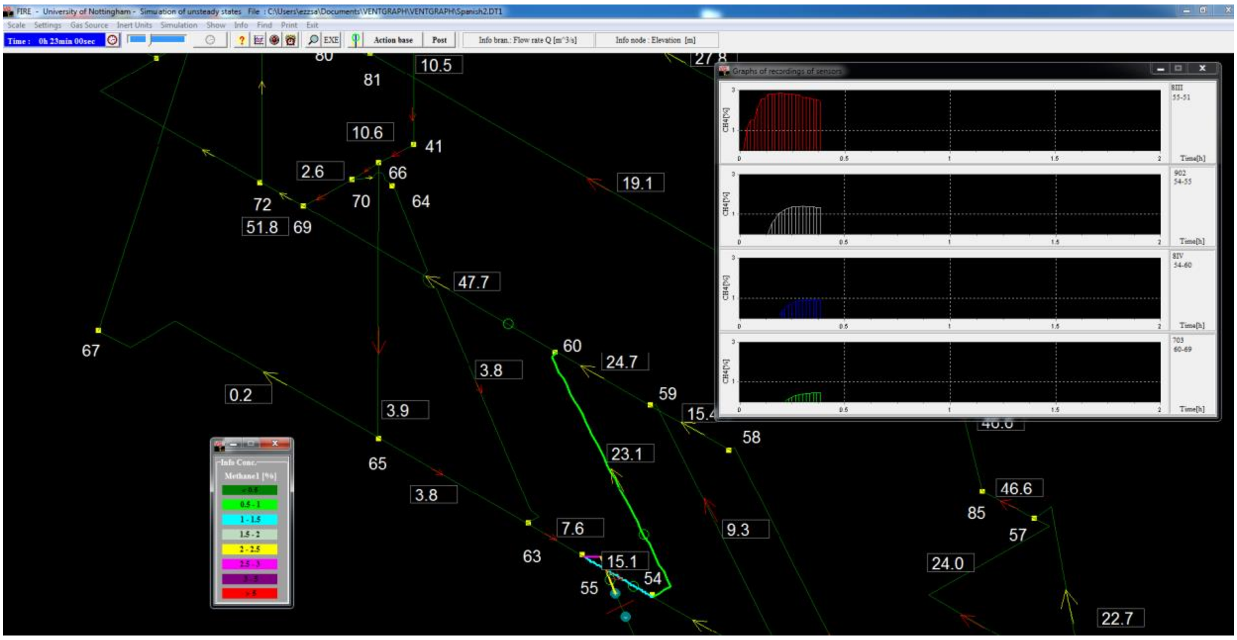

Fig. 3: A transitory flow of methane in VentGraph.

VenPri – is a program to aid ventilation circuit design and calculation of the main underground mines and tunnels, which was widely used and validated. Aitemin tried to do a program without errors and has implemented a rigorous quality control both on the editing and interface presentation and methods of computation.

The basic characteristics of the program are:

- Simply placing significant data about ventilation and graphical network;
- Carrying out complex calculations to obtain the distribution of the air flow in the ventilation network, depending on the network structure, the resistance branches, the characteristic curves of the fans and other factors;
- May consider the influence of natural ventilation;
- It allows monitoring of gas circulating through the network of ventilation and estimated gas concentrations at any point in the network, both in stationary and transient conditions;
- It can be used as a simulation tool for studies of ventilation, testing different versions and can even be used to make contingency plans in case of damage or fire. In case of fire may be made to the affected branch, the proper temperature, thereby altering natural ventilation, plus you can follow the evolution of gas.

It can be also used for real-time control of ventilation, and is designed to easily communicate with other programs.

Presentation of the program is shown in Figure 4.

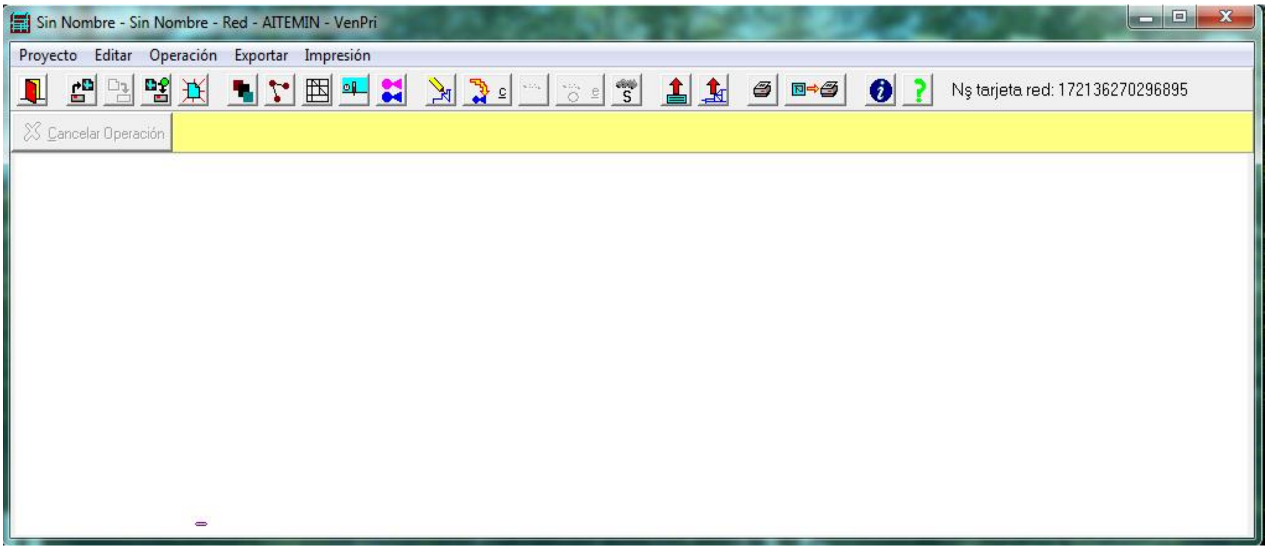

Fig. 4. Program VenPri

3D-Canvent – was manufactured by the Canadian CANMET and can simulate the ventilation systems in use, including parameters such as flow rates of air and their distribution in the system, the pressure losses by friction, the performance of the fans, energy requirements of the air and operating costs mining both taken separately for each work and the entire network (3D-Canvent - User manual). These simulations are performed to develop models of ventilation based on physical input data mining projects resulting from conception and design ventilation parameters used in determining the estimated strength of the mining network. Providing information that characterizes the network of ventilation (resistance or geometry) and location and the main fans, 3D Canvent will provide listings and dimensional drawings of the following parameters for ventilation (Morar et al., 2015):

- The distribution of air flow in ventilation system;
- Friction pressure losses for each mining job in hand;
- Resistance mining works;
- Parameters main fans;
- Air energy losses in mining;
- The running costs of the ventilation system (lei / year - based on energy costs and yields of the main fans).

3D-Canvent is based on Kirchhoff's laws, using the Hardy-Cross iterative technique in the convergence towards a solution.

3D-Canvent is a Windows application and was designed to support the planning, design and analysis of mine ventilation systems. 3D-Canvent combines ease of use the graphical representation of the ability of designing networks in 3D, which allows the option of viewing the network as a server-dimensional (X-Y, X-Z, Y-Z) and / or three-dimensional pattern (X-Y-Z).

Any fan can be placed either in the form of pressure by either a pressure characteristic curve (P) - Flow (Q).

3D-Canvent program has the opportunity to present the operating point of any ventilation fan model by tracing the characteristic curve of the mine and the characteristic curve of the fan in the same drawing.

A network of ventilation must be solved properly resolved through a number not exceeding 30 iterations. However, insufficiently developed models will require more time to be balanced and resolved.

Figure 5 presents a network of ventilation solved by 3D-Canvent program.

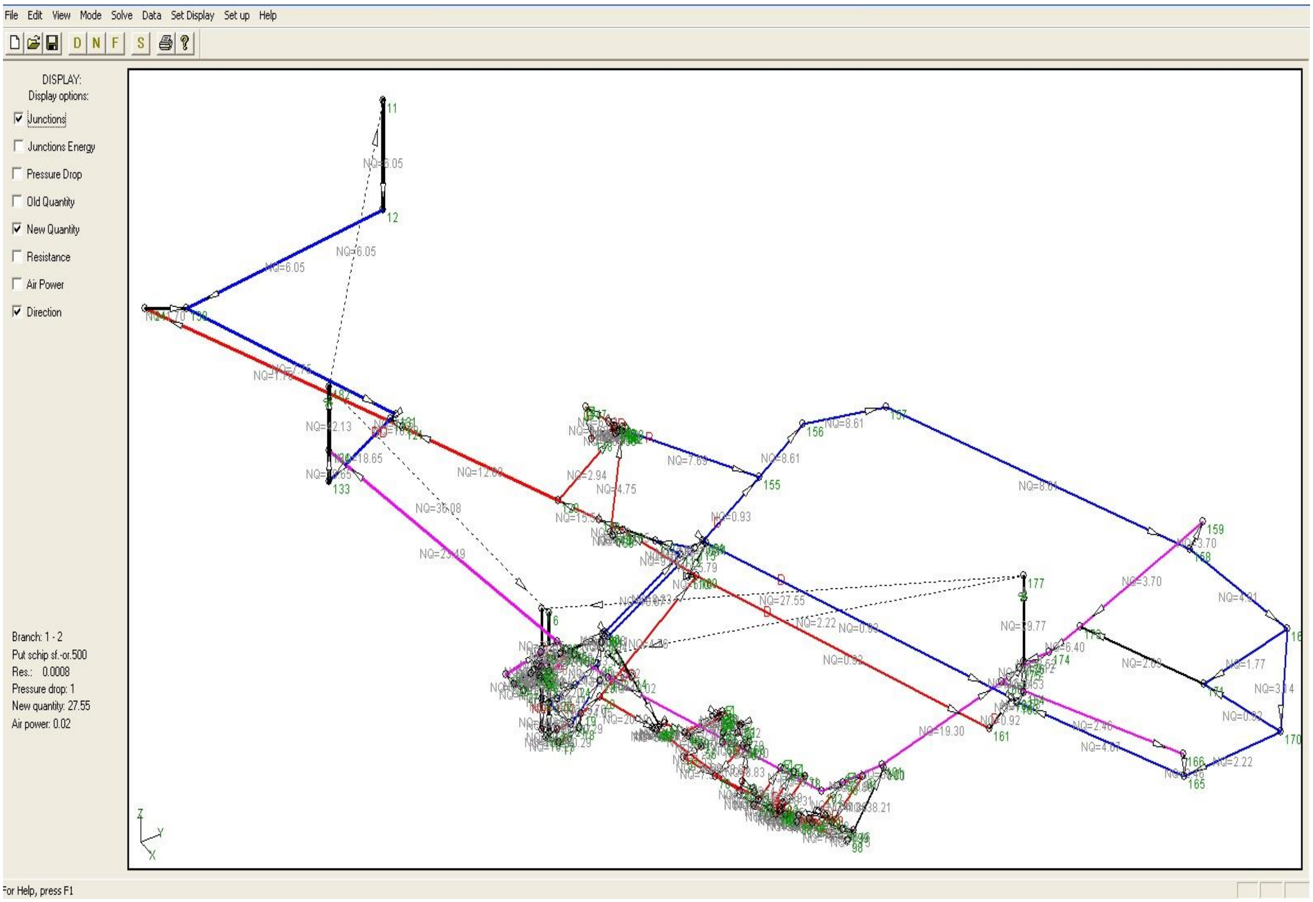

Figure 5 - Network solved in 3D-Canvent program

3. Conclusion

The ventilation mine is an extremely sensitive and complex, that encompasses many disciplines in the service of achieving and maintaining health and safety conditions underground. Solving ventilation networks using computers is a huge step forward to help optimize ventilation management and visualization of real-time network changes.

Specialized IT software application allows for efficient distribution of air flow rates in each branch and thus a better distribution of air in workplaces and reducing costs (with electricity) through effective distribution of circulated air. Network engineering ventilation solving using computers, programs specialist IT, networking solves regardless of its complexity.

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3D Canvent - User Manual

Identifying vulnerabilities/risk factors of the critical infrastructure in the power installations of ultra high and high voltage from the national power system with international connections

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Abstract

The power safety together with food safety, financial safety, commercial safety, etc. is part of a broader concept of national and individual safety, known as economical safety. Power safety involves the generation of reliable electrical energy, control of the main electrical overhead lines (OHL) and control of the power substations. The present paper is aimed at highlighting the basic elements and systems within the national power system as possible vulnerabilities in case of terrorist threats, natural disasters or man-made destructions, together with the risk assessment methods for power substations of 750 kV and 400 kV, OHL 750 kV and 400 kV and main hydro, thermal and nuclear power plants.

Keywords: power safety, critical infrastructures, vulnerabilities, overhead linea OHL, power substations, power plants

1. Introduction

The power safety together with food safety, financial safety, commercial safety, etc. is included in a broader concept of national and individual safety, known as economical safety (Moraru et al, 2014). Reaching a certain level of security depends on the state's ability to aggregate resources internally and to gain or maintain access to external economic resources (Băhnăreanu, 2008).

Power safety is to be ensured in terms of:

- energy sources in the production of electricity;
- control of the overhead lines OHL for transport electricity (power grid);
- control of the overhead lines OHL for electricity distribution;
- control on the conversion of alternative energy into electricity.

In general, the concept of electricity defined as "secure resource at a reasonable price", encompasses a much broader issue than the triangle of *power supply - sustainability - competitiveness.*

So the existence of sufficient and available resources (energy and alternative energy sources) is an imperative prerequisite in ensuring power safety (Cioca and Cioca, 2005). Any prolonged interruption of power does a significant harm on: the national power system stability, the power quality circulating in the power system, the economic growth by disconnecting the substantial industrial consumers, political stability, citizens' safety, etc.

Therefore, power safety concerns, mainly the following dimensions:

- ensuring primary energy sources or alternative energies;
- identification of highly reliable alternative overhead lines OHL to transport electricity (power grid)
- securing existing overhead lines OHL.

The vision of power safety depends largely on the regional and global context and position in the economic cycle, thus, consumers and energy intensive industries want reasonable prices and fear of unexpected interruptions or desired power supply. Developing countries are vitally interested in the ability to pay for resources for economic development and shocks balance of payments.

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Strong power companies are concerned about the integrity of the entire network of transport and distribution of electricity. Attention of policy makers is drawn to the risk of undermining the safety of supply and safety of the power infrastructure due to terrorism, conflicts or natural disasters (Cioca et al, 2010).

Also, the political and economic factors are very attentive to increasing the size of overcapacity, strategic reserves and surplus power infrastructure. Therefore, throughout the economic circuit, prices and diversity of electricity supply overhead lines OHL are critical components of power security.

A distinct place in the relationship between the electricity producer and the consumer of electricity begins to be occupied by an intermediary party, e.g. the state (public company) through which the electricity transits. The intermediate party (public company) aims to strengthen the economic advantages offered by the power transit, but at the same time it aims to strengthen the advantages in the political system of international relations. It may be that in the future that administrative units of transit states would play the role of an intermediate party (Moraru and Băbuţ, 2010).

On an optimistic outlook, relations between *manufacturer - intermediate - consumer* could generate interdependencies which would provide a solid support to enhance power safety solutions. Each "link" in the chain *owner - operator - producer - carrier - retailer - consumer* is interested to defend and promote their interests, to maximize its results. Power security is often perceived as an "umbrella" that covers many concerns of electricity, economic growth and political power.

2. Power safety. Dimensions and current challenges

Power safety dimensions:

1. *Domestic policy*:
   - investment in infrastructure maintenance and development of power infrastructures (power substations and overhead lines OHL);
   - intervention in case of emergency power (blackout, incidents and/or accidents at work);
   - increasing the power efficiency;
   - orientation of the electricity mix to alternative energies.
2. *Economic policy:*
   - clear rules for the operation of electricity markets;
   - plans to develop electricity transmission networks - ETN;
   - long-term contracts;
   - diversification of power sources and main overhead lines OHL;
   - technological innovation in the field of power.
3. *Geopolitics:*
   - concerted action to secure international trade with power supply;
   - adopting a global legal framework in the field of transnational power services;
   - tendency to renationalizing of infrastructure and power companies;
   - the need for strategic concepts and an overall approach, particularly in relation with fragile states.
4. *Security policy:*
   - close cooperation with the states vulnerable to terrorist attacks on power infrastructure (power substations or overhead lines OHL) or piracy, including through exchange of information, training and discussion on best practices;
   - the industrialized states which are major consumers electricity, either directly or through the EU and NATO should extend their commitment and capabilities in the field of risk management, crisis response and preparedness of military, police and emergency situations.
5. *Military Policy:*
   - manifests itself internally through the defense policies of the most important actors in the electricity market, aiming ultimately, the use of military means to maintain advantageous positions.

Power safety is threatened not only by:
- terrorism;
- political unrest;
- armed conflicts;
- piracy.

but it is vulnerable at:
- hurricanes;
- floods;
- earthquakes;
- or manmade disasters.

Power safety is endangered by six major challenges of the XXI century:
- short circuits of power supply overhead lines OHL;
- the finite nature of energy resources;
- using electricity as a tool to pressure (power weapon);

- the use of revenues from electricity to support undemocratic regimes;
- global climate changes;
- the high cost of electricity for developing countries.

Therefore, power safety must take into account the challenges that globalization brings, any failure or vulnerability on the EU's or NATO's part (power source) affecting consumers across the whole EU or NATO.

3. The concept of critical infrastructure

A whole range of facilities or infrastructure can be considered critical due to:
- unique condition, and complementarity within the infrastructure of a system or process;
- the vital importance they have as material support or virtual support (network), in the systems operation and in the economic, social, political, informational, military, etc. workflows;
- the important role that they meet in the stability, reliability, security, functionality and especially in the security of systems;
- increased vulnerability to direct threats, as well as those targeting systems to which they belong to;
- Particular sensitivity to changing conditions, and especially sudden changes of situation.

The "family" of critical infrastructure includes:
- telecommunications facilities;
- plants and supply systems of electricity and water;
- installations of oil and gas deposits;
- financial services and banks;
- emergency services (medical units, police stations and public order, emergency inspectorates, etc.);
- continuity of Government (Government of Romania, the Romanian Intelligence Service, Foreign Intelligence Service, etc.).

On 8 December 2008 it has been issued Directive 2008/114 / EC of the European Union which stipulates the responsibility of member states to identify critical infrastructures within national borders and to establish and manage protection measures with the purpose of contributing to the protection of individuals.

"Critical Infrastructure" means an asset, system or part of a system, in member states which is essential for the maintenance of vital societal functions, health, safety, security, social welfare or economic people, and the disruption or destruction would have a significant impact on a member state as a result of the failure to maintain those functions;

DIRECTIVE 2008/114 / EC of the European Union Council represents a first step in a step by step approach towards the identification and designation of European critical infrastructure - ICE and of the need to improve their protection. And the final primary responsibility for the protection of the critical infrastructure lies with the Member States, the owners / operators of such infrastructures.

The European Commission suggests three essential criteria for identifying potential critical infrastructure:
1. *length or surface* - damage to critical infrastructure is assessed by geographic region likely to be affected; international, national, provincial / territorial or local;
2. *degree of seriousness* - the impact or degradation may be minimal, moderate or high. Criteria for assessing the gravity are: the economic impact; the effect on the public; the impact on the environment; the dependency; the political scope;
3. *effect over time* - the length of time after which there are major or severe consequences, this criterion indicates when that infrastructure degradation can have a major incident or a serious effect (immediately after 24-48 hours a week or in the longer term).

Critical infrastructures in the field of power include: *electricity generation plants, electricity transmission facilities, electricity distribution and nuclear plants facilities.*

4. Vulnerabilities/risk faktor of critical infrastructure from national power system with international connection

In Romania the activity of electricity transmission (transport) is done through the National Power Grid Company - TRANSELECTRICA SA, which is the system operator.

The activity of electricity transmission (transport) is carried out through Power Grid, consisting of power substations and overhead lines OHL. Power Grid (Electricity Transmission Network - ETN) is the electrical grid of national and strategic interest with voltage values greater than 110 kV. In the international context marked by the intensification of terrorist actions, especially the democratic states that are part of the European Union and NATO, should be considered Romania's country risk - from the perspective of national security - as a possible target of terrorist organizations. By the effects a terrorist attack may have on TRANSELECTRICA SA, from interrupting the supply of electricity to small areas (isolated city) to disruption of the entire power system, effects both disastrous for the population and the economy as a whole; the transmission grid installations operated by TRANSELECTRICA SA (see fig. 1.1.) are a favorite target for possible terrorist actions.

Also in the Romanian society there is increased crime manifested itself through theft and the unauthorized intrusion into computer networks.

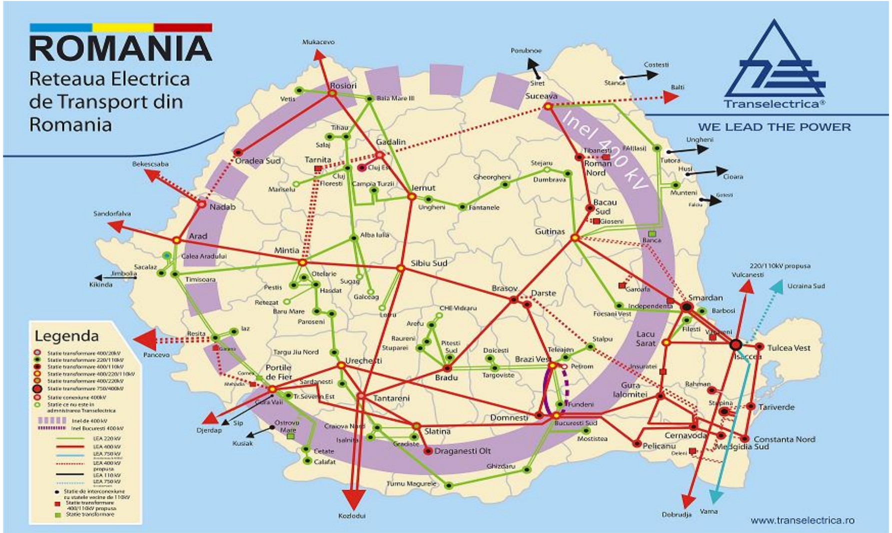

Fig. 1.1. The scheme of the electricity transmission network from Romania

Vulnerability/risk factors of critical infrastructure within the national power system with international connection in case of a terrorist attack, natural disaster or man-made destruction, are summarized below:

Power substation 750/400 kV Isaccea:

- *OHL 750 kV Isaccea – Pivdennoukrainska NPP (South Ukraina)*
- *OHL 400 kV Isaccea – Vulcănești (Moldova Republic)*
- *OHL 400 kV Isaccea – Rahman – Dodrudja (Bulgaria)*
- *OHL 400 kV Isaccea – Stupina – Varna (Bulgaria) – arhitecture 750 kV*
- *OHL* 400 kV Isaccea – Lacu Sărat (injection from Thermal Plant Brăila)
- *OHL* 400 kV Isaccea – Smârdan (double circuit)
- *OHL* 400 kV Isaccea – Tulcea West

Power substation 400 kV Țânțăreni:

- *OHL 400 kV Țânțăreni – Kosloduy (Bulgaria) – double circuit*
- *OHL* 400 kV Țânțăreni – Turceni (injection from Thermal Plant Turceni) – double circuit
- *OHL* 400 kV Țânțăreni – Slatina
- *OHL* 400 kV Țânțăreni – Sibiu
- *OHL* 400 kV Țânțăreni – Urechești (injection from Thermal Plant Rovinari and Hydro Plant Porțile de Fier 1)
- *OHL* 400 kV Țânțăreni – Bradu

Power substation 400/220 kV Porțile de Fier 1:

- *OHL 400 kV Porțile de Fier 1 – Djerdap 1 (Serbia)*
- *OHL* 400 kV Porțile de Fier 1 – Urechești (injection from Thermal Plant Rovinari)
- *OHL* 400 kV Porțile de Fier 1 – Slatina
- *OHL* 220 kV Porțile de Fier 1 – Reșița (double circuit) – vulnerability, 220 kV → 400 kV, ring closure at 400 kV from the west zone)
- *OHL* 220 kV Porțile de Fier 1 – Cetate
- *OHL* 220 kV Porțile de Fier 1 – Calafat
- *OHL* 220 kV Porțile de Fier 1 – Turnu Severin

Power substation 400/220 kV Reșița:

- *OHL 400 kV Reșița – Pancevo (Serbia)* – double circuit
- *OHL* 220 kV Reșița – Porțile de Fier 1 (double circuit) (injection from Hydro Plant Porțile de Fier 1) – vulnerability, 220 kV → 400 kV, ring closure at 400 kV from the west zone)
- *OHL* 220 kV Reșița – Timișoara – double circuit – vulnerability 220 kV → 400 kV, ring closure at 400 kV from the west zone)
- *OHL* 220 kV Reșița – Iaz (double circuit)

Power substation 400/220 kV Arad:

- *OHL 400 kV Arad – Sandorfalva (Hungary)* – connection to UCTE (european power system)
- *OHL* 400 kV Arad – Mintia (injection from Thermal Plant Mintia)
- *OHL* 400 kV Arad – Nădab
- *OHL* 220 kV Arad – Timișoara (double circuit) – vulnerability 220 kV → 400 kV, ring closure at 400 kV from west zone)

Power substation 400 kV Nădab:
- *OHL 400 kV Nădab – Bekescsaba (Hungary)* – connection to UCTE (european power system)
- *OHL* 400 kV Nădab – Arad
- *OHL* 400 kV Nădab – Oradea (under construction) – vulnerability, ring closure at 400 kV from the west zone

Power substation 400/220 kV Roșiori:
- *OHL 400 kV Roșiori – Mukacevo (Ukraina)* – connection to UCTE (european power system)
- *OHL* 400 kV Roșiori – Oradea
- *OHL* 400 kV Roșiori – Gădălin (injection from Thermal Plant Iernut)
- *OHL* 220 kV Roșiori – Vetiș
- *OHL* 220 kV Roșiori – Baia Mare (double circuit)

OHL 400 kV Gădălin – Suceava (under construction) - vulnerability, ring closure at 400 kV from the north zone)

OHL 400 kV Suceava – Bălți (Moldova Republic) (under construction) – missing interconnection to 400 kV in the north-east zone)

Thermal Plant Brăila, injection in:
- Power substation 400 kV Lacu Sărat → *power substation 750/400 kV Isaccea*

Nuclear Plant Cernavodă (vulnerability – nuclear risk), injection in:
- Power substation 400 kV Gura Ialomiței → power substation 400 kV Lacu Sărat → *power substation 750/400 kV Isaccea*
- Power substation 400 kV Constanța North → power substation 400 kV Tulcea West → *power substation 750/400 kV Isaccea*
- Power substation 400 kV Pelicanu → power substation 400 kV South București
- Power substation 400 kV Gura Ialomiței → power substation 400 kV South București

Thermal Plant Turceni, injection in:
- Power substation *400 kV Țânțăreni:*
    - Power substation 400 kV Țânțăreni → *power substation 400 kV Kosloduy (Bulgaria)*
    - Power substation 400 kV Țânțăreni → power substation 400 kV Slatina
    - Power substation 400 kV Țânțăreni → power substation 400 kV Urechești
    - Power substation 400 kV Țânțăreni → power substation 400 kV Bradu

Thermal Plant Rovinari, injection in:
- *Power substation 400 kV Urechești (by two OHL):*
    - Power substation 400 kV Urechești → power substation 400 kV Porțile de Fier 1 (interconnection beetween 2 power plant)
    - Power substation 400 kV Urechești → *power substation 400 kV Țânțăreni*
    - Power substation 400 kV Urechești → *power substation 400 kV Domnești*

Thermal Plant Mintia, injection in:
- Power substation 400 kV Arad → *power substation 400 kV Sandorfalva (Hungary)* → UCTE
- Power substation 400 kV Sibiu → *power substation 400 kV Țânțăreni*
- Power substation 400 kV Sibiu → power substation 400 kV Iernut (interconnection between 2 power plant) → power substation 400 kV Gădălin → *power substation 400 kV Roșiori* → UCTE
- Power substation 400 kV Sibiu → power substation 400 kV Brașov

Thermal Plant Iernut, injection in:
- Power substation 400 kV Gădălin → *power substation 400 kV Roșiori* → UCTE
- Power substation 400 kV Sibiu → power substation 400 kV Brașov

- Power substation 400 kV Sibiu → power substation 400 kV Mintia (interconnection between 2 power plant)

5. Conclusions

In the increasing importance of power safety for national security, the safety of electrical installations must be a constant objective of interest for the transmission and system operator Transelectrica SA.

Developments in recent decades have shown increasing vulnerability caused by:

- damage, destruction and / or interruption of technological infrastructure (transport, power, IT, etc.) caused by acts of terrorism;
- natural disasters (earthquakes, floods, hurricanes, etc.);
- negligence (lack of staff competence, lack of regular training, omissions, etc.);
- technical work accidents;
- technical incidents;
- criminal activities.

To ensure safe and stable operation of the national power system, Transelectrica SA will consider increasing the security of its objectives, taking into account both objective's asset value and their functional importance. Transelectrica SA must have a strategy on ensuring adequate objectives security at minimum cost (not a requirement) and should include a set of its own activities carried out at the company level.

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The modelling of the improving environmental aspects process and of the associated impacts in industrial organizations

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Abstract

The proposed model aims is to optimize the related activities, such as: identification of environmental aspects arising from activities, products and services of the organization, which can be controlled and influenced under normal and abnormal operation and in emergency situations; assessing of the associated impacts in order to determine the aspects that have or may have significant environmental impacts; identification and evaluation the potential environmental aspects of new projects prior to approval and their financing; timely identification of improving measures and/or, if is applicable, control of environmental aspects generated by the new projects so that appropriate decision on necessary measures to comply with environmental requirements of the company and of the legal regulations in the field to be taken correctly and on the time; implementing a methodology for improving the environmental aspects with significant impact.

Keywords: process modelling, environmental aspects, associated impacts, improving process

1.Introduction

1.1. The environmental aspect

According to ISO 14001:

- The *environmental aspect* represents a part of the activities, products or services of an organization that can interact with the environment. And must be specified as a significant environmental aspect is that environmental aspect that has or can have a significant environmental impact;
- The *impact on the environment* means any change to the environment, harmful or beneficial, resulting in total or partial activities, products or services of an organization.

In order to identify the environmental aspects and impacts associated is necessary, in accordance with the reference mentioned above, that the organization to start a preliminary environmental analysis.

Table 1. Preliminary environmental analysis, Oprean et al., 2012.

What is around us?	What are the organization inputs?	What is the type of activities from organization?	What are the organization outputs and what impact have this to the environment?	How are considered the obtained data and how do we react?
The organizational external environment	• Energy and fuel • Air, water and soil • Materials	• Product • Process • Services	•Environmental impacts in normal operation conditions •Environmental impacts in abnormal operation conditions •Environmental impacts in accidental operation conditions	Environmental Management Program

Data collection for identification of environmental aspects is made, usually, using observation lists. But these data can be supplemented with information obtained from:

- The audit reports of the systems of management environment, quality and occupational health and safety (OHS);
- The reports resulting from checks carried out by authorities.

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One of the best sources of information can be, also, analysis of risk assessment reports of accidents and occupational diseases, Cioca et al., 2010 and Moraru et al., 2014.

It may take into account (where applicable) natural disasters or accidental situations (especially of the most common such as floods and fires) to obtain more objective data, Cioca et al., 2008.

1.2. The improving process methodology

Improvement methodology proposed by the authors is inspired from the DMAIC model used by organizations in the six-sigma projects.

Six Sigma started at Motorola in the 80s as a challenge to achieve a reduction in the number of defective products. To achieve this effect it took a thorough analysis of the causes and possible correction. Motorola has published the mid 90s detail its quality improvement framework, which have been adopted since then by numerous organizations. The term and innovative 6 Sigma program became recognized only in 1989, when Motorola announced it would get a fraction less than 3.4 defective product for a total of one million in less than five years. This statement radically changed vision of quality: from one where the quality is measured in percent (number of parts in a hundred), to a level that is referred to one million or one billion, Kifor et al., 2006.

The aim of this method is to obtain products and processes without defect. A six-sigma improvement process includes a series of steps, grouped by type of activity (Fig. 1).

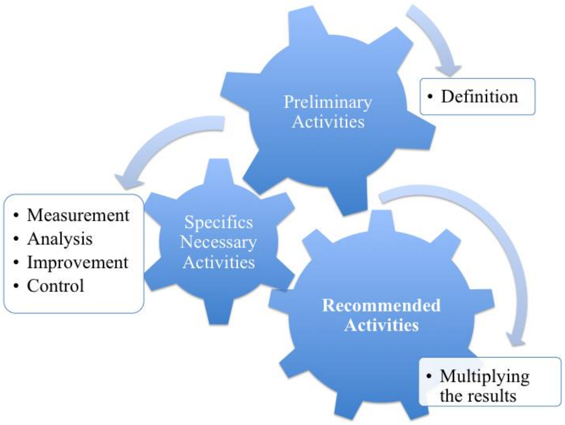

Fig. 1. DMAIC model, Oprean et al., 2012.

2.The proposed methodologies

2.1. Identification of environmental aspects and associated impacts

For identification of environmental aspects is used, as appropriate, one or more of the following methods:

- Interviews with staff having responsibility in the activities analyzed;
- Visiting the site, observing and noting all the elements that impact on the environment (loss of sawdust in silos, stains on the ground, leaks at the joints, the dust emissions and noise, air emissions from the chimneys of thermal power plants) or practices environment (the collection and storage of waste and chemicals, measures to avoid losses on the ground, labor protection measures, etc.);
- Analyze existing relevant records.

For each department that generates or has the potential to generate environmental aspects, is analyzed the specific processes and is identified all subordinate activities (if applicable). Is completed the box on the form named "List of environmental aspects and associated impacts generated by process" (Table 2).

It analyzes each process / activity and is identify all process input / output activity and all intentional and unintentional corresponding to each input, then are registered this data in "List of environmental aspects and associated impacts generated by the process."

It examines the outputs of each process and are identified environmental aspects due to:

- Unintended products that result or may result from the respective activity (Waste water, emissions of pollutants to air, waste, noise, etc.);
- Products intended, unless can generate changes on the environment;
- Use of natural resources (water, electricity, fuel, raw materials, etc.);
- On hazardous substances, etc.

To express environmental aspects are taken into account the following categories for them:

- Pollutants emitted into the air;

- Pollutants evacuated with waste water;
- Pollutants evacuated through waste generated from activities;
- Spillages of materials that can contaminate soil directly or indirectly from the inside or from the outside;
- Pollutants that can generate an impact on the community (noise, vibration, radiation);
- The use of raw materials and natural resources;
- Other environmental aspects.

Is fill in the form "List of environmental aspects and associated impacts generated by the process" the operating conditions for every environmental aspect identified, using following notations:

- **N** - for normal operating conditions;
- **A** - for abnormal operating conditions (planned turn on or off of equipment's, and periods of repairs);
- **Acc** - operation in accidental situations / emergency (failures arising from various causes, internal or external, which may lead to accidents with consequences on the environment).

It analyzes each environmental aspects highlighted in the form and is identify their associated impacts environmental completing the appropriate box on the form.

This methodology is applied both the current activities and the new projects.

Table 2. List of environmental aspects and associated impacts generated by the process

Process	Included activities	Input	Output	Environment aspect	Operating condition	Environment impact	Impact assessment					Impact clasification	
							L	F	N	C	Total score	Insignificant	Significant

2.2. Assessment of associated impacts with the identified environmental aspects

Criteria for assessing the impacts associated environmental aspects are given in the table 3, and refers to:

- Existing of the legal requirements and other environmental requirements regulating environmental impact (**L**);
- Frequency of occurring environmental impact (**F**);
- The nature of the natural resource/the pollutant /the waste to which it relates those impacts (**N**);
- Data on the amount of natural resource/pollutant /waste implied by those impacts (**Q**).

For each of the four criteria apply a scoring system between 1-5, according the table 3.

Impact assessment is calculated with following equation:

- **S = L x F x N x Q**, which represents total score of the impact. Then is fill in the form presented in table 2 the impacts in the corresponding box.

Minimum overall score that can be obtained for an impact is 1 and the maximum is 625. If overall impact score is greater than or equal to 75, then that becomes significant environmental impact (**S**). If the score is below 75 overall environmental impact is insignificant (**N**).If an environmental aspect generates at least a significant impact, the environmental aspect in turn is classified as significant.

Table 3. Rating scale for assessment impacts arising from environmental aspects

No.	Assessing criteria	Application field	Symbol	Score	Note meaning
1.	Existing of the **legal** requirements and other environmental requirements regulating environmental impact	Applicable to all environmental aspects	**L**	1	The impact is not limited / controlled by legislative or other environmental requirements
				3	The impact is limited / controlled only by stakeholder requirements (standards, authorities, clients and so on)
				5	The impact is limited / controlled by environmental permits and / or environmental legislation
2.	**Frequency** of occurring environmental impact	Applicable to all environmental aspects	**F**	1	The impact appears in: - Accidental/emergency situations which **generates major disruptions** functioning of the organization, with serious consequences on the environment and/or human health - Accidental situations and **not generate serious consequences** on the environment and/or human health
				3	The impact appears only in abnormal operating conditions: - Planned switches on or off of the facilities for inspections and repairs - As a result of activities / incidents that occur with low frequency (= / <2 times / month)
				5	The impact occur in normal operation (the current operation of the organization's activities)
3.	The **nature** of the natural resource/the pollutant /the waste to which it relates those impacts	Applicable to environmental aspects arising from the use of **natural resources** (water, air, soil, natural gas and so on)	**N**	1	The natural resource used is not legally regulated or by the organization's rules
				3	The natural resource affected is pursued only by the rules of the organization
				5	The natural resource affected is a part of the organization's priorities
		Applicable to environmental	**N**	1	The most significant pollutant which determining the impact is not

No.	Assessing criteria	Application field	Symbol	Score	Note meaning
		aspects arising from the **discharge of the pollutants** in air, water, soil			dangerous to humans and the environment
				3	The most significant pollutant which determining the impact is hazardous (flammable, corrosive, carcinogenic, oxidizing, etc.)
				5	The most significant pollutant which determining the impact is toxic/prohibited substance/pollutant that causes global environmental issues (e.g. CO^2 greenhouse-effect).
		Applicable to environmental aspects arising as **waste generation**	**N**	1	Household waste / waste recovered and capitalized (e.g. wood waste)
				3	Waste is treated like a household waste but not falling into this category/ Recovered waste for recycling but now is not recovered
				5	The waste is part of the toxic and dangerous category
4.	Data on the **amount** of natural resource/pollutant /waste implied by those impacts	Applicable to environmental aspects arising from the use of **natural resources** (water, air, soil, natural gas and so on)	**Q**	1	Consumption of natural resource is below the planned consumption by the organization
				3	Consumption of natural resource is located frequently at specific level of the planned consumption by the organization
				5	Consumption of natural resource exceeds the specific consumption planned by the organization
		Applicable to environmental aspects arising from the **discharge of the pollutants** in air (including noise), water, soil	**Q**	1	The emitted pollutant appears in effluents discharged from the site in concentrations lower than the regulated alert threshold/ Noise level is below the set point for the outer perimeter
				3	The emitted pollutant appears in effluents discharged from the site in concentrations located around the regulated alert threshold or is no information about existing level of pollution / Noise level is located at the outer perimeter set point
				5	The emitted pollutant appears in effluents discharged from the site in concentrations ranging alert threshold and the intervention threshold or the intervention threshold exceeds regulated / Noise level exceeds the set point for the outer perimeter
		Applicable to environmental aspects arising as **waste generation**	**Q**	1	Waste occurs in quantities below 0.5 ton / month
				3	Waste occurs in quantities at 0,5 - 1 tons / month
				5	Waste occurs in quantities above 1 tons / month

2.3. The DMAIC model

Models used in the automotive industry inspire the model proposed by the authors. The DMAIC model is briefly presented in tables 4, 5 and 6, Zerbes, 2015, as follow:

Table 4. Preliminary activities

Stage	Activity	Techniques and tools recommended
Definition	Identifying the types of problems of the organization	• Brainstorming • Records from monitoring and control processes • Audit reports • Statistical records • Cause-Effect Diagram
	Evaluating existing problems in organization	
	Developing the criteria for selection	
	Drawing up the assessment matrix	
	Identifying the priority problem	
	Defining the problem	
	Establishing the mission	

Table 5. Specifics necessary activities

Stage	Activity	Techniques and tools recommended
Measurement and Analysis	Defining the limits	• Flow chart or • Tabular flow chart • Brainstorming • Process model diagram (PMD)
	Identifying the causes	• Cause-Effect Diagram • Brainstorming
	Weighting the causes	• Pareto chart
Improvement	Identifying the alternatives	• Cause-Effect Diagram • Brainstorming
	Evaluating the alternatives	• QFD • Selection matrix of alternatives
	Designing and planning the improvements (Establishing the human resources, material and financial resources, timing, corrective actions and so on)	• 8D • Tabular • Graph
	Culture change (creation of human models, possibly using the principle of win-win, presentation and awareness of the benefits)	• 5S • The use of Poka-Yoke strategies
	Implementation of improving	• 5S • 8D • Poka-Yoke

Stage	Activity	Techniques and tools recommended
Control	Designing and implementing the controls	• QFD • Gantt diagram • Brainstorming • Control matrix
	Verification of the performance of improvement project	• Tabular • Graph • Statistical control

Table 6. Recommended activities

Stage	Activity	Techniques and tools recommended
Multiplying the results	Supporting other employees in the organization who are facing similar problems in order to apply what he learned the team from the improving project;	• Documentation of all the improvement projects and sharing of accumulated experience through training and/or brainstorming • Development of a database that containing information on the results and experience gained from carrying out improvement projects. Facilitating access to this information and their use as decision support can be a real benefit within the organization.
	Nomination of other projects for solving. At the correcting a deficiency, often we discover new ones that may have been hidden for years. These should be distributed to other teams to be resolved. These teams can use the results and experience from previous projects.	

3.The proposed model

Starting methodologies specified above we propose the following DMAIC model (Model for Improving the Environmental Aspects) whose phases are summarized in Table 7.

Table 7. Phases of the propose DMAIC model

Phase	Stage	Activity	Recommendations
Preliminary activities	Definition	Identifying of workplaces	Use the list of the working places identified in the Service for Prevention and Protection in OHS used to assess risks for accidents and occupational disease
		Develop the data collection sheets	Use the observation forms models used in QMS
		Identification of environmental aspects (EA) for every workplace	Work in team. The team should be made from: Environmental Responsible, the operator of that workplace, the coordinator of the structure and, if possible and appropriate, call at an expert in the field
		Centralization of data	
		Setting the impacts associated with EA	
		Developing the methodology for assessment	
		Evaluating the impacts	
		Identifying the significant EA	
		Defining the priority aspects	
		Establishing the mission	Besides the above mentioned team here should be involve the top management
		Establishing the team	
Specifics necessary activities	Measurement and Analysis	Mapping the EA in the workplace targeted	Use photos or drawings of the workplaces on which to marks the EA and highlight the significant aspects
		Identifying the causes of occurrence of priority aspects	Use the techniques and instruments enshrined in the processes of improvement of the quality management system (brainstorming, Cause-Effect diagram, Pareto chart and so on)
		Analysis of the causes	
		Evaluating the causes	
		Identifying the root cause/causes	
		Identifying the measures for improving	Get inspired by: safety data sheets of products used as raw materials and supplies, technical data sheets of equipment and so on.
		Developing the methodology for evaluating the measures for improving	Get inspired from recordings, techniques and tools to improving processes enshrined in the Quality Management System and / or the Manager of Occupational Health and Safety and production system management Cioca et al., 2005 and Cioca et al., 2007
		Assessment of the measures for improving	
		Identifying the optimal improvement measures in that moment	
	Improvement and control	Planning the implementation of the chosen improvement measures	
		Implement the chosen measures for improving	
		Developing the control diagram	
		Planning the monitoring and control	
		Implementation of the monitoring and control	
		Getting the results	
		Validation of results	
		Celebrating the team	

Phase	Stage	Activity	Recommendations
Recommended activities	Multiplying the results	Development of a database that containing information on the results and experience gained from carrying out improvement projects.	Facilitate the access to this information and their use as decision support can be a real benefit within the organization.

If you assign for each activity objectives and for each objective some KPIs we can calculate the performance of the proposed model with the following mathematical express, Zerbes, 2011:

$$M_P = \sum_{i=1}^{4} E_i r_i \tag{1}$$

Were:

$$\sum_{i=1}^{4} E_i = \sum_{j=1}^{10} I_j p_j + \sum_{k=1}^{6} I_k p_k + \sum_{l=1}^{9} I_l p_l + \sum_{m=1}^{12} I_m p_m \tag{2}$$

$$=> M_P = \left(\sum_{j=1}^{10} I_j p_j\right) r_1 + \left(\sum_{k=1}^{6} I_k p_k\right) r_2 + \left(\sum_{l=1}^{9} I_l p_l\right) r_3 + \left(\sum_{m=1}^{12} I_m p_m\right) r_4 \tag{3}$$

Were: $\mathbf{M_p}$ – the proposed model; $\mathbf{E_i}$ –model stage; $\mathbf{r_i}$ – risk factor; $\mathbf{I_{j,k,l,m}}$ – performance index; $\mathbf{pj_{,k,l,m}}$ – weighting coefficient.

It should be noted that $\mathbf{r_i}$ - risk factors may vary from one organization to another depending on several factors such as experience, time priorities, organizational politics, etc.

4.Conclusion

The ideal of improving organization performance should improve in all priority issues for the stakeholders. For an organization to survive in the today's international competitive environment it must strive to improve learning, and innovation. Management should make decisions so that appropriate products are available when required, building the most efforts of all. There should be close cooperation between government, organizations, unions and universities. Everyone has to improve the products or services, as customers perceive her. This means that all departments in all organizations should use the most appropriate technology to improve efficiency, effectiveness and adaptability.

In fact, all organizations must have a known plan and accepted by all, a plan to combine various methodologies to improve in order to ensure maximum value for the stakeholders.

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7th International Multidisciplinary Symposium

„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

UNIVERSITARIA SIMPRO 2016

Renewable energy in the Alps: a case study

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Abstract

The present paper concerns the role of the hydropower sector in an Italian area characterized by a multi-year tradition of water exploitation for energy purposes. The presence of Alps still makes it available a significant potential of energy from the rivers, as demonstrated by the local balances of energy sources. Other sectors evolving quickly thanks to the recent developed strategies (in particular the biomass one) are growing their relative importance but cannot reach the local contribution of the hydropower sector. Considerations on the role of plant upgrades, new authorizations and climate changes can be found in this paper.

Keywords: alpine; biomass; hydropower; MSW; renewable resource; water.

1. Introduction

In accordance with the scientific community indications and trends, and in compliance with the European Union perspectives, the Autonomous Province of Trento (Italy) has proposed to reach the energy self-sufficiency status by 2050, focusing only on the renewable resources exploitation.

In the last years many researches were done regarding the increase of renewable resources usage regarding, under a local or global perspective: Municipal Solid Waste (Rada 2014; Ionescu R.D et al., 2013; Ionescu et al., 2013; Cucchiella et al., 2012), biodegradable waste (Rada et al., 2014; Malakahmad et al., 2013) biomass (Girelli et al., 2012; Patrascu et al., 2014) hydropower, wind and solar power (Gaudard and Romerio, 2014; Spanhoff 2014; Christopher and Christopher, 2014).

Moreover, the Autonomous Province of Trento aims to achieve the "Trentino Zero Emission" goal by reducing the carbon dioxide emissions and other greenhouse gases with 50% respect to 1990 levels by the year 2030 and 90% by 2050. In order to reach the above mentioned targets, the provincial strategy is focusing on the implementation of more stringent energy efficiency policies in terms of renewable energy sources usage, with special attention on the hydropower sector due to its mature technological grade.

In this context, this paper aims to highlight the role of hydropower production in Trentino, in order to clarify if the growing interest towards sources not related to water could modify the role of the hydropower sector.

2. The global context

An overview regarding the present European Union (EU) and Italian energy situation and respective trends is reported in this section.

The last EU commitments on energy consumption from renewable resources have led to a rapid growth of green energy perspectives across the continent. All member states have to achieve a 20% saving of primary energy by 2020. However, necessarily, EU policies must have a long-term horizon. The Commission has therefore set up in 2011 two

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documents, which indicate possible paths to a low-carbon economy, providing useful information for the elaboration of national and regional strategies (EC 2011a,b).

The EU has foreseen a scenario that should lead to a low-carbon economy considering the greenhouses emissions reduction with 40% respect to 1990 level by 2030 and 80% by 2050. Figure 1 shows (EC 2011a), the overall scheme for the total decarbonisation from electricity generation, as well as drastic GHG reductions in other sectors. It is clear that the hydropower path can have a central role in this strategy.

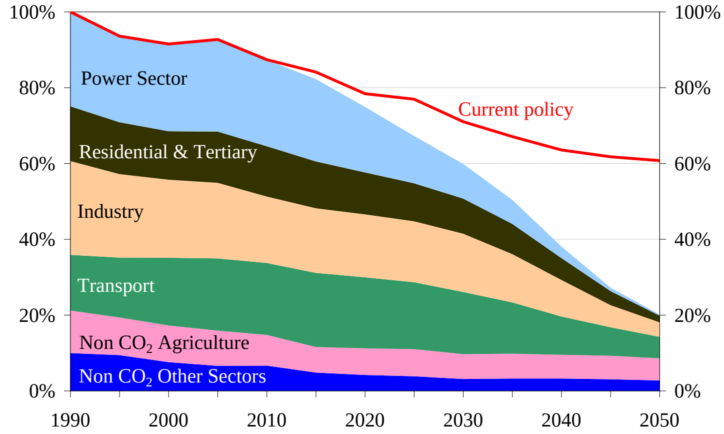

Fig. 1. EU GHG emissions towards an 80% domestic reduction (100%=1990)

The exploitation of renewable sources in Italy has experienced a rapid growth, with an increase of 50% in recent years, as reported in Figure 2 (GSE, 2012). Most evident growth was registrated in the photovoltaic sector.

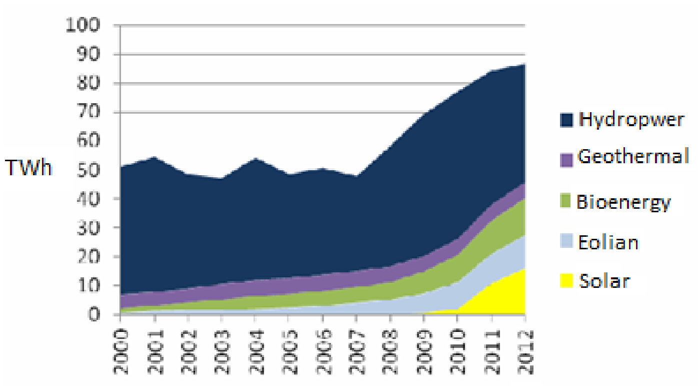

Fig. 2. Electricity production in Italy, by type of renewable source (14)

Overmore, the National Action Plan for renewable energy presents a substantial maintenance of the existing hydropower production on the Italian territory for the 2010-2020 decade, as shown in Figure 3 (PNA, 2010).

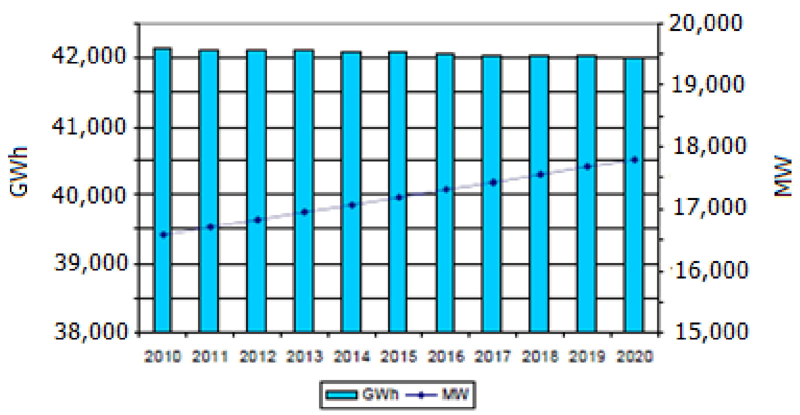

Fig. 3. Power and energy production, trends in Italy presented in the National Action Plan Italy (15)

At national level, the future development of hydro generation from natural flows is affected by two factors acting in opposite ways:

a. a reduction in the productivity of the existing plants, due to the impact of climate change on precipitation and application of environmental constraints on the use of water (Minimum Vital Flow - MVF) and water multiple use;
b. increased production due to the repowering of the existing industrial park, which will be achieved through the installation of new small scale plants with a capacity <10 MW, while for the large-sized plants it is assessed that there will be no possibility of new installations.

3. The local context

The Province of Trento has a remarkable hydropower plants capacity. According to the Terna statistics (TERNA 2014), in this province 152 plants are in operation, with a gross installed capacity of 1,560 MW. Considering the procedures established by the European Directive 2009/28/EC the gross generation was approximately 3,600 GWh (TERNA 2014; APE 2009). In Italy there are 2,184 plants in operation, with a gross installed capacity of 17,628 MW and gross generation amounted to be 41,623 GWh. Thus the hydropower sector in the Autonomous Province of Trento territory has the following characteristics:

- Its power is about 8.8 % of the total Italian capacity
- The yearly generation of electricity is about 8.6% of the Italian one (for this sector)
- The number of plants is about 7.0 % of the Italian hydropower park, thus the local sector show a plant capacity and operativity slightly higher than the national one
- The local per-capita generation is remarkable at national level, taking into account that the Province has about 1% of the population of Italy; that can be explained by the presence of the Alps chain.

The normalized electricity generation from hydropower was broadly stable over the past 20 years.

The Trentino Province aims to keep constant the today value of hydroelectric production. A fairly large proportion of energy production will be lost due to the MVF increase, depending on the variation of strategies. The effect of the MVF on hydroelectric production considering the average of the recent years was assessed equal to 6.5% (PEAP, 2012). With regard to the climate change effects in the province, specific studies suggest that they should not lead to significant reductions in rainfall in the Alps.

The future impact of the MFV has not yet been precisely quantified. It fluctuates between 17% which is set by the ’Burden Sharing’’ (BS) decree as national target (L.G. 2011) and about 11% that could be the target resulted from the strategy set by the Province of Trento.

In the first case there would be a further production loss of 10.5% and in the second would lead to an additional reduction of approximately 4.5%. In the most favorable scenario (MFV= 11% in 2020), there would be a production loss of about 169 GWh respect to 394 GWh considering the less favorable scenario (MFV = 17% in 2020) (PEAP, 2012). A graphical comparison is reported in Figure 4.

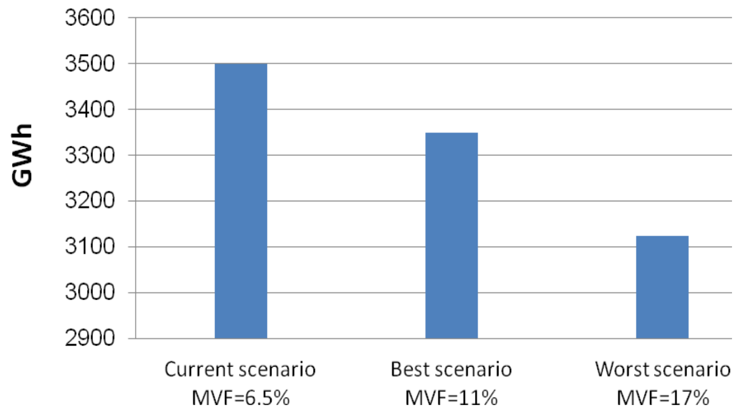

Fig. 4. Power production losses, considering the MFV value [%] (18)

Considering the current production, three types of strategies are analyzed in a recent report (PEAP, 2012):

- repowering of existing facilities;
- construction of small scale hydro plants;
- construction of plants on the Adige river.

The variation of all the parameters regarding role of MFV, new authorizations, repowering, etc., give the following conclusions: in the best case scenario for 2020 the Trentino province hydropower production could increase up to 2% compared to 2010, while the worst case scenario would be reduced by 10%, as reported in Figure 5.

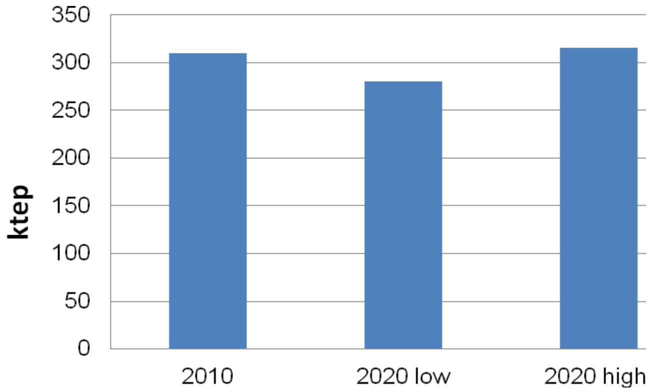

Fig. 5. Hydroelectricity generation in 2010 in Trentino and two scenarios proposed for 2020 (18)

As Figure 6 shows (PEAP, 2012), the trend of energy production from renewable sources in Trentino is growing with contributions from other sources such as biomass. This also depends on the fact that the hydropower sector has already reached nearly optimal exploitation in recent decades. On the other hand, it is clear that the biomass sector, despite being prominent in changing the current scenarios, does not alter the central role of hydropower production from renewable sources in this province, because of the very high availability of water resources suitable for energy exploitation.

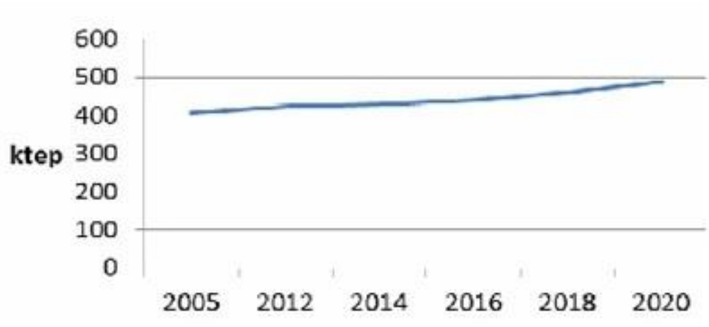

Fig. 6. Power generation increase in Trentino province, due to renewable resource exploitation

This can be demonstrated by simple comparisons as reported in Table 1, where data on local and national basis are reported concerning hydropower, municipal solid waste (MSW) and residual MSW availability, organic fraction of MSW (OFMSW) collection. Data on Table 1 demonstrate as follows:

- ✓ the potential role of MSW to energy is more relevant at national level as the hydropower production in Trentino shadows the other sectors and the high selective collection efficiency in Trentino diverts a significant amount of combustible materials that, thus, cannot contribute to a local generation of electricity;
- ✓ selective collection makes it available a stream of food waste suitable for anaerobic digestion with generation of biogas to be used for electricity generation, but its amount is secondary compared to the role of residual MSW, even in Trentino where the role of residual MSW is reduced and OFMSW is collected with high efficiency.

The recent decisions made by the province, that intends to treat the Residual Municipal Solid Waste for Solid Recovered Fuel (SRF) production and export outside the territory boundaries will affect the local role of MSW in the power generation sector (Rada 2014; Rada and Ragazzi, 2014).

Table 1. Yearly per capita energy generation from the hydropower sector in Trentino and in Italy and comparison with other sources; data for calculations were taken from (RRU 2013, Rada, 2013).

	TRENTINO	ITALY	
Hydropower sector			
yearly generation from hydropower plants	3,60E+09	4,16E+10	kWh y^{-1}
resident inhabitants	523577	59443598	inh
per capita hydropower generation	6876	700	kWh_{el} inh^{-1} y^{-1}
Municipal solid waste (MSW) sector			
Per capita gross production of MSW	524	528	kg inh^{-1} y^{-1}
Selective collection efficiency	70%	38%	-
Per capita residual MSW	157,2	328,944	kg inh^{-1} y^{-1}
Lower heating Value of residual MSW	12	10	MJ/kg
Theoretical efficiency of conversion into electricity	25%	25%	-
Per capita net potential electrical generation	131	228,4	kWh_{el} inh^{-1} y^{-1}
Organic fraction of MSW sector			
Per capita collection of OFMSW	95	76	kg inh^{-1} y^{-1}
Theoretical specific generation of methane	90	90	m^3/t_{OFMSW}
Theoretical efficiency of conversion into electricity	40%	40%	-
Per capita electrical generation	34,2	27,36	kWh_{el} inh^{-1} y^{-1}

Co-generation from wood in district heating plants plays a limited role compared to hydropowering, giving an amount of electricity that is around two orders of magnitude lower (PEAP, 2012).

Discussions are focusing on the construction of micro-hydropower plants, by exploiting the slopes of the supply networks for drinking water. This strategy, however, cannot lead to a significant modification of the presented scenario because of the limited power and number of the plants potentially viable.

4. Conclusion

The present paper demonstrates that, in territories where the local production of electricity from hydropower plants is remarkable, the contribution from other evolving sectors (in particular from the biomass one) are growing their relative importance but cannot reach a dominant role.

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Occupational noise. Risk assesment hearing loss using homogenous exposure noise groups

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Abstract

The paper presents a technical method in order to measure noise exposure evaluation in working environment and for the calculation of noise exposure levels. The research presented in the paper is very useful when there is necessary a technical class determination of noise exposure, for example for detailed studies of noise exposure, for epidemiological studies of hearing loss and for observing other negative effects regarding noise exposure. The method requires observing and analyzing of all noise exposure conditions in order to control the quality of measurements. The work analysis shall provide sufficient information about the work and the workers under consideration so that an appropriate measurement strategy can be selected and measurements can be planned. The method was applied in a tyres factory analysing half of the working staff, covering all the production workplaces. The results obtained according to this method provided sufficient information in order to define the main priorities regarding noise protection plan.

Keywords: noise, exposure, risk, assesment, protection plan

1. Determining the occupational noise

Acoustic measurements clearly indicates how the noise can provoke hearing loss and also facilitates noise reduction solutions. Noise measurements permit noise diagnose, analyzation and elaborations of the noise reduction solutions very usefull to occupational and environmental noise reduction program and all of those to improve the quality and life.

Generally the noise determination in working environment must be prefferablly conducted in an undisturbed acoustic field, using the microphone in the position occupied by the human ear, to the most highly exposure value and to a sufficient distance of it, in order to prevent the difraction and distance effects on the measured value. If necesarry that the employee to be present the microphone should be placed.

The parameters that should be measured (daily noise exposure) can be determined directly using integrativ noise analyzers or can be calculated from measurements of soud pressure made with regular noise analyzers and with noise exposure durations. The measuremets made with regular noise analyzers are good enough in cases when the workers activities unfolds in repeated positions and generates approximate noise levels broadband on entire working day.

According to the romanian safety and health at work legislation (GD no. 493/2006 and EU noise directive 10/2003/CE) the methods and the noise measuring equipments must to be adapted to the existing conditions in working environment, specially considering the characteristics of noise, exposure duration, the environment and the characteristics of the measuring equipments (Directive 2003/10/EC, 2010).

2. Frequently used methods for measuring and determination of occupational noise

2.1 ISO 1999:1996

Provides the method for calculation of permanent displacement of threshold produced by the noise, the audible threshold of adult populations produced by noise levels and durations and represents the basis for the calculation of audible handicap when various threshold of audible noise levels at audiometric frequencies or combination of such frequencies exceed limits. The parameter for noise exposure is *weighted acoustic exposure – A mediated and the*

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continous equivalent sound pressure level wighted A ($L_{Aech,\,T}$ daily considered for 8 hours). The ISO 1999:1996 is based on statistic data and it is used for the prediction or determination of hearing loss or acoustic handicap for individuals.
The daily exposure noise level for a 8 hours rated working day $L_{EX,8h}$, is calculated using the forrmula:

$$L_{EX,\,8h,} = L_{Aech,\,Te} + 10\lg\,(T_e/T_0);\qquad \text{dB} \tag{1}$$

where:
T_e - the effective duration of the working day;
T_0 – reference duration (= 8h).

2.2 ISO 11202:2010

Provides a method for measuring the sound pressure levels of emission at the workplace and in other specified positions in adjancency of the working equipment using *„in situ"* measurements in an semireverberant field. The method applies to all the mobile or stationary working equipments inside or outside (ISO 11202:2010).

According to ISO 11202:2010 the basic parameters that had to be determined in every specified positions on every functioning phase of working equipment are:

- weighted sound pressure level A - L_{pA};
- weighted sound pressure peak level - C $L_{pC,\,peak.}$

For a specified noise source the time range T, can be composed from several time partial measurements Ti each one match to a specified functioning phase of the equipment. The sound pressure level of emission can be obtained by mediating of the weighted sound pressure levels A :

$$L_{pA} = 10\lg\,[\,\sum^{N}_{i=1}\ T_i\ \ 10^{\,0,1LpA,\,Ti}\,]\quad \text{dB} \tag{2}$$

2.3 ISO 9612:2009

Provides a stepwise approach method to the determination of occupational noise exposure from noise level measurements. The procedure contain the following major steps: work analysis, selection of measurement strategy, measurements, error handling and uncertainty evaluations, calculations, and presentation of results. The method specifies three different measurement strategies: task-based measurement; job-based measurement; and full-day measurement. This method gives guidance on selecting an appropriate measurement strategy for a particular work situation and purpose of investigation (ISO 9612:2009).

Main parameters used for the determination of daily noise exposure are:

- A-weighted time-averaged sound pressure level $L_{p,\mathrm{A},T}$
- A-weighted equivalent continuous sound pressure level $L_{p,\mathrm{A},\mathrm{eq}T}$
- ten times the logarithm to the base 10 of the ratio of the time average of the square of
- the A-weighted sound pressure, p_A, during a stated time interval of duration T (starting
- at t_1 and ending at t_2), to the square of a reference value, p_0, expressed in decibels.

$$L_{p,\mathrm{A},T} = L_{p,\mathrm{A},\mathrm{eq}T} = 10\ \lg\left[\frac{\frac{1}{T}\int_{t_1}^{t_2} p_\mathrm{A}{}^2(t)\mathrm{d}t}{p_0^2}\right]\ \mathrm{dB} \tag{3}$$

where the reference value, p_0, is 20 μPa

- A-weighted noise exposure level normalized to an 8 h working day
- daily noise exposure level $L_{\mathrm{EX,8h}}$ occupational noise level, in decibels, given by the equation:

$$L_{\mathrm{EX,8h}} = L_{p,\mathrm{A},\mathrm{eq}T_\mathrm{e}} + 10\ \lg\left[\frac{T_\mathrm{e}}{T_0}\right]\ \mathrm{dB} \tag{4}$$

Overall occupational activity that is carried out by a worker, consisting of all the tasks performed by the worker during the entire working day or shift. A worker often has a job title that describes his or her job, sometimes complemented with an additional description to ensure clear identification. Figure 1 illustrates the hierarchy of jobs and tasks (ISO 9612:2009).

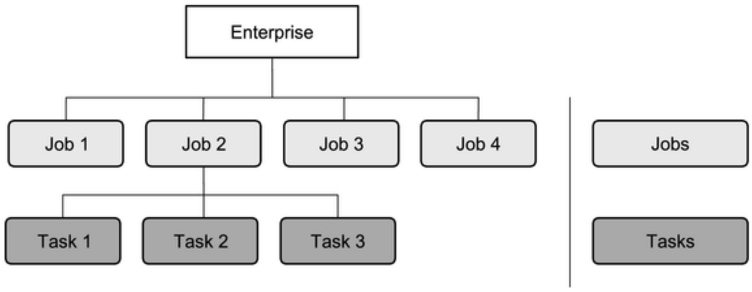

Figure 1 - Example of the hierarchy of jobs and tasks

3. Risk assesment hearing loss using homogenous exposure noise groups – HNEGs.

Following the guidances provided by the ISO 9612:2009 together with a producer of tyres located in Slatina, Romania it was developed a method regarding noise exposure assesment at the workplace in entire factory. The method starts from the need that measurement efforts can be reduced by defining specific *Homogeneous Noise Exposure Groups - HNEGs.* These are groups of workers that are performing the same job (as sum of the same tasks) and are expected to have similar noise exposures during the working day. The homogeneous noise exposure group shall be clearly identified and can consist of one or more workers. HENGs should be verified in consultation with the workers and supervisor, and ultimately by evaluating the measurement results. A nominal day, including work periods and breaks, shall be determined in consultation with both workers and management. The work shall be studied in order to obtain an overview and understanding of all factors which can influence the noise exposure (Safety management procedure 28#00, 2013)

For each worker, issues that shall be addressed are:

- list of the tasks;
- tasks duration, including any breaks, meetings, …, whether they should be regarded as a part of the nominal day.

In some cases, the work and consequently the noise exposure, varies from day to day so that there is no typical daily exposure, e.g. for workers who work in different locations or jobs each day. In these cases, the nominal day can be defined from work situations during several days, e.g. 1 week. In case of mobile worker engaged in complex or unpredictable tasks, or carrying out a large number of discrete tasks, there is no need to consider any specific tasks to build the nominal day (e.g., fork lifter drivers, maintenance workers, production assistant, …) (INCDPM Bucharest research Study, 2015).

Measurements shall be planned to ensure that all significant noise events are included.
For each of the tasks, it shall be recorded when it occurred, its nature, duration and daily frequency.

Any indicators that characterize the work with respect to noise shall be identified, quantified, and reported. Examples of such indicators are type of production in process, materials, quantities, thickness of workpiece, adjustment, speed and number of workers involved (Directive 2003/10/EC, 2010).

3.1 Selection of the measurement strategy

The selection of an appropriate measurement strategy is influenced by several factors such as the purpose of the measurements, complexity of the work situation, number of workers involved, effective duration of the working day, time available for measurement and analysis. As far as the aim of this procedure is concerned, the measurement strategy has to be job-based only, namely a number of random samples of sound pressure level are taken during the performance of particular jobs [5]

Job-based measurements - the principle of this measurement strategy is that random samples of noise exposure are taken by measuring $L_{p,A,eq\,T}$ during the performance of jobs identified during the work analysis.

The measurement plan shall be established starting from the jobs identified, then HENGs shall be established. After this step, for each HENG: (INCDPM Bucharest research Study, 2015).

- determine from the following Table 1 the minimum cumulative duration of measurement for the number of workers (n_G) belonging to the HENG;

- select a sample duration and number of samples (at least 5), such that the cumulative duration meets or exceeds the minimum duration determined in the step above;

- among the members of the HENG, 50% of the workers needs to be monitored;

- plan to take samples which are distributed randomly among the members of the group and across the duration of the working day.

Number of workers in the homogenous exposure group n_G	Minimum cumulative duration of measurement to be distributed over the homogenous exposure group
$n_G \leq 5$	5 h
$5 < n_G \leq 15$	5 h + (n_G - 5) × 0,5 h
$15 < n_G \leq 40$	10 h + (n_G - 15) × 0,25 h
$n_G > 40$	17 h or split the group

Figure 2 - Specifications for the minimum duration of measurements to be applied to a HENG of size n_G

3.2 Occupational noise risk assessment using HENGs on a tyres factory

- There were 78 HENGs mandatory to evaluate;

- Minimum cumulative duration of the measurement for every HENGs was between 300 - 2640 de minutes;

- The number of the workers in a groups varies from 1 to 88. According to the method it was chosen minimum 5 samples on every HENGs and that has to be meet or be larger with the minimum of the cumulative establish duration, but is has to be used at least 50% of the workers on every HENGs. The total number of the noise measured samples depends by the number of the workers in a group and the minimum cumulative duration. A larger number of samples reduce measurement uncertainty, and this is good for the accuracy of the results. In our case the noise exposure was evaluated for 877 samples distributed on 78 HENGs. During the measurements were observed all the main events regarding noise on entire working day and on all shifts (shift A to shift D). The measuremets were made from monday to friday between 08:30 AM to 7:30 PM. (S. N. Platon, A. Antonov, 2013)

Table 1 - Example of obtained results after analyzing noise exposure on the workplaces using HENGs

Department		Noise working group	Obtained daily noise exposure evaluation $L_{EX,8h}$, [dB(A)]
		BY 1 – Mill 1, 2, 3	**90.3**
101		BY 2, BY 4	**86.3**
	Cota 0	BY 3 – Mill 1, 2, 3	**90.3**
		BY 5, BY 6, BY 7	**85.3**
111		BY 8, BY 9	**84.5**
101		BY 1, BY 2, BY 3	**83.5**
	Cota 7	BY 4, BY 5, BY 6, BY 7	**84.3**
111		BY 8, BY 9	**84.9**
		Lift	**82.4**
		Quick Control lab	**71.8**
		Reinforcement lab	**76.5**
101		Fizic lab	**66.7**
		Chemical lab	**72.6**
	Cota 0	Offices	**79.5**
111		PTSM 1, PTSM 2	**84.3**
400		Maintenance	**67.4**
		Warehouse office	**79.0**
101, 111, 400		Transport operators	**83.8**
101, 111		Carbon Black operators	**80.4**
		Mechanical – Maintenance	**85.1**
111		R&D Offices	**79.3**
	Cota 7	Production	**58.1**
101		Maintenance	**75.0**
101, 111		Transport operators	**85.3**
		Bochetonisti	**80.9**

	TTM, TTS, TTO operators	82.0
	Bandina 1, Bandina 2 operators	81.0
	Filler, Capiatrice operators	81.2
102	Operatori Bartell, Calemard	82.9
	Calandra operators	83.4
	Q-plex 1, Q-plex 2 operators	85.9
	Duplex 1 operators	82.5
	Comerio 1 operators	81.6
	Filler, Capiatrice, Bartell operators	79.2
	Bandina 3 operators	78.4
112	Triplex, Duplex, Comerio, SRH	80.9
	TTM 3, TTS 3	79.5
	Hydraulic	73.1
	Confection efficiency	83.3
	Maintenance	88.3
	Vulcanization efficiency	88.8
103	Tyre vulcanization	88.2
	Samples	87.9
	Boiacca Transport	83.0
	Boiacca Fix	82.9
	Confection office	84.6
	Tailoring operators	81.4
103	phase 1 Modulo Plus operators	81.6
	phase 2 Modulo Plus operators	81.5
	phase 1 Flexi operators	80.7
	phase 2 Flexi operators	80.0
	phase 1 Tradizionale operators	83.2
	Phase 2 Tradizionale operators	82.1
	Phase 2 Flexi operators	79.5
	Phase 2 Flexi operators	79.8
113	EVO operators	81.7
	tyres Recover	79.2
	Mechanical	86.5
	Boiacca Transport	84.3
104	Vulcanization A operators	84.1
	Vulcanization B, C operators	84.2
	Vulcanization D operators	86.8
114	Vulcanization E operators	85.9
	Vulcanization F, G, K operators	84.9
	Tyres Uniformity operators	85.8
	Tyres Classification + Online control	83.9
	Triming	85.2
105	First and Second Control	82.9
	Scerografie	82.8
	X-Ray	83.3
	Transport	87.7
	Tyres Repairing	87.4
	Tyres Uniformity operator	84.6
115	Grinder	89.7
	X-Ray	81.3
Thermic power plant	Operators	86.2
Fire department	Fire safety operators	78.4
Compressor station	Operator GSM (facility)	76.3

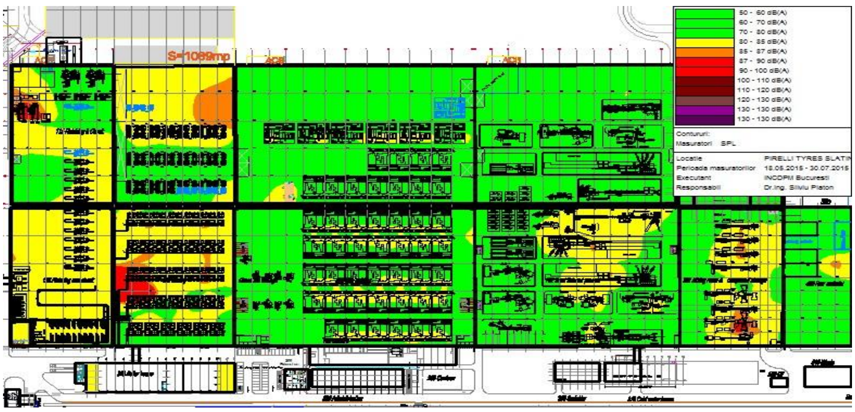

Figure 3 - Noise map of the tyes factory

4. Conclusions

The paper presents a technical method in order to measure noise exposure evaluation in working environment and for the calculation of noise exposure levels. The method was applied in a tyres factory analysing half of the working staff, covering all the production. According to the romanian safety and health at work legislation (GD no. 493/2006 and EU noise directive 10/2003/CE) the methods and the noise measuring equipments must to be adapted to the existing conditions in working environment, specially considering the characteristics of noise, exposure duration, the environment and the characteristics of the measuring equipments at the workplaces.

Following the guidances provided by the ISO 9612:2009 together with a producer of tyres located in Slatina, Romania it was developed a method regarding noise exposure assesment at the workplace in entire factory. The method starts from the need that measurement efforts can be reduced by defining specific *Homogeneous Noise Exposure Groups - HNEGs.* There were 78 HENGs mandatory to evaluate and minimum cumulative duration of the measurement for every HENGs was between 300 - 2640 de minutes;

The number of the workers in a groups varies from 1 to 88. According to the method it was chosen minimum 5 samples on every HENGs and that has to be meet or be larger with the minimum of the cumulative establish duration, but is has to be used at least 50% of the workers on every HENGs. The total number of the noise measured samples depends by the number of the workers in a group and the minimum cumulative duration. A larger number of samples reduce measurement uncertainty, and this is good for the accuracy of the results. In our case the noise exposure was evaluated for 877 samples distributed on 78 HENGs. The results obtained according to this method are presented in the paper and provide sufficient informations in order to define the main priorities regarding noise protection plan.

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ISO 9612:2009 *Acoustic.Determination of noise exposure in the work environment. The technical method;*

ISO 11202:2010 *Acoustic. Noise emitted by the machines and equipments. Measuring the sound pressure levels of emission at the work place and other specified positions. In situ method;*

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH"

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Research of air-methane explosions using high speed imagery analysis

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Abstract

So far, analysis of gas explosion resulted from physical experiments carried out in shock tubes, galleries or tunnels experimental, spherical or rectangular vessels etc. These constructions have usually opaque walls and are possibly provided with one or more viewing windows, and sensors for pressure and temperature measurements. Experimental stands of this kind offers the advantages of high pressures supported. But the main drawback of this kind of constructions is to limit the measurements only at the predetermined points, at the locations of the sensors. In this way, the volumes of the two points are assigned consecutive average values of parameters and gradients, missing the precise information on when and where the change occured and the speed with which it takes place is an average approximation.
This paper proposes a model of a transparent experimental stand that allows carrying out gas explosion image analysis by highlighting Schlieren effect. For this, two transparent explosion chambers have been designed, in which have been tested ignitions of explosive air-methane atmospheres at different concentrations, the phenomena being recorded using high speed video camera. Video materials – as results of these tests - allow post-processing and determining the values (e.g. flame propagation velocity) between any two very close points, significantly increasing the measurement accuracy.

Keywords: methane explosion, experimental stand, Schlieren effect, INSEMEX

1. Introduction

An explosion is a complex phenomenon with unpredictable evolution which includes chemical and physical processes such as burning reaction, heat transfer, flame formation, exchange of gases with the environment, structural transformation of building materials and resistance elements (Pasculescu et al., 1962). Unfortunately, the most severe accidents occurred during the last two decades in Valea Jiului basin were triggered by methane accumulated in the caved goaf (Moraru et al., 2013). Worldwide, thorough research aimed at understanding the elements related to the occurrence and prevention of the explosion risk caused by methane gas, demonstrates that no price is too high to reward the conquests in the underground safety at work field (Moraru et al., 2014). Research conducted so far have led to the determination of an entire suite of characteristics and parameters related to this phenomenon, from the Chapman-Jouguet detonation velocity and pressure to equivalence ratio and its effects in turbulent behavior of the flame (Day et al., 2006). But, in most cases, the rise of the pressure or the propagation of the flame can be "seen" only through the sensors fitted to shock tubes or to other experimental vessels. By using a high speed camera and transparent walls for experimental explosion chamber, the light required for recordings often comes to the detriment of the flame visualization. To overcome this inconvenience, additional equipment was used to highlight the flame front through the Schlieren effect.

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2. Schlieren setup

The Schlieren technique is an optical method used to observe refractive index gradients in gases, especially air, and other clear media (McRae et al., 1992). A simple Schlieren setup is shown in Figure 1, where a light beam is projected from the source to a concave mirror. Reflected beam passes through test area and is received by the lens of the camera. A knife edge is set in the light spot of the reflected beam, serving as a cut-off filter for light intensity. Any deflected ray – like that figured by interrupted line – that passes a medium with a different density between A and B points will light the sensor of the camera with a different intensity, thus producing a significant increase in contrast.

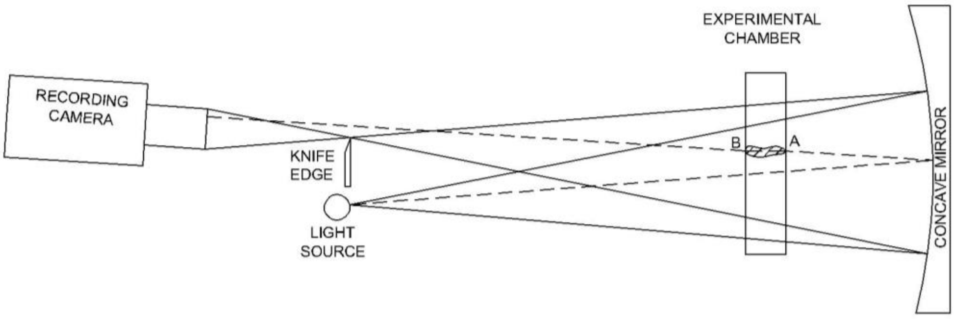


Figure 1. Schlieren setup

The mirror used for this research work was a straight one, bended to an arrow of 36 millimeters, in order to extend as much as possible the length of visible Schlieren test area. The knife edge used in this case was not a razor blade, like usually, but a grid that covered just a part of the lens of the recording camera, because the bended mirror (straight in vertical plane) focused the light in a line shape, in contrast of the real concave mirror that focuses on a dot. Instead of a point light source, a line light was used in order to see the light on full high of the mirror. The Schlieren setup used for this work is presented in Figure 2.

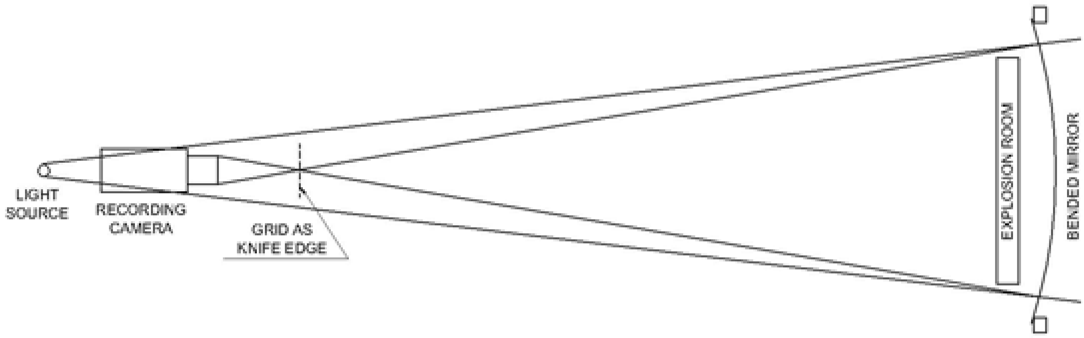


Figure 2. Schlieren setup used for this research work

An Olympus iSpeed 2 high speed camera was used, which required a high level of light intensity, even for a small number of frames per second. Thus, all the methane-air explosion experiments presented were made at a frame rate of 5000 fps.

3. Explosion chambers

Two explosion chambers for air-methane combustion were made, both with clear glass walls. Each of them has a free section of 50 x 50 millimeters and, at one end, is provided with a stopper and two electrodes in order to ignite the explosive mixture. The first chamber (Figure 3) has a total length of 330 millimeters and the second explosion room has 850 millimeter length. The other ends of the chamberss were covered with polyethylene film and a metal plate or, as the case, with a polyurethane foam plug.

Figure 3. The transparent explosion chamber and the bended mirror (top view)

4. High speed records

All high speed recordings were made at the same frame rate of 5000 fps. For the first explosion chamber (330 mm length), four different methane concentrations were used in order to record the behavior and the velocity of the flame front, from the ignition location to the other end of the chamber. All recordings were made at 94 kPa (station atmospheric pressure) and 21.5˚C. A number of 3 tests were made for each methane concentration. Note that some of the images supported a post process for a better visualization.

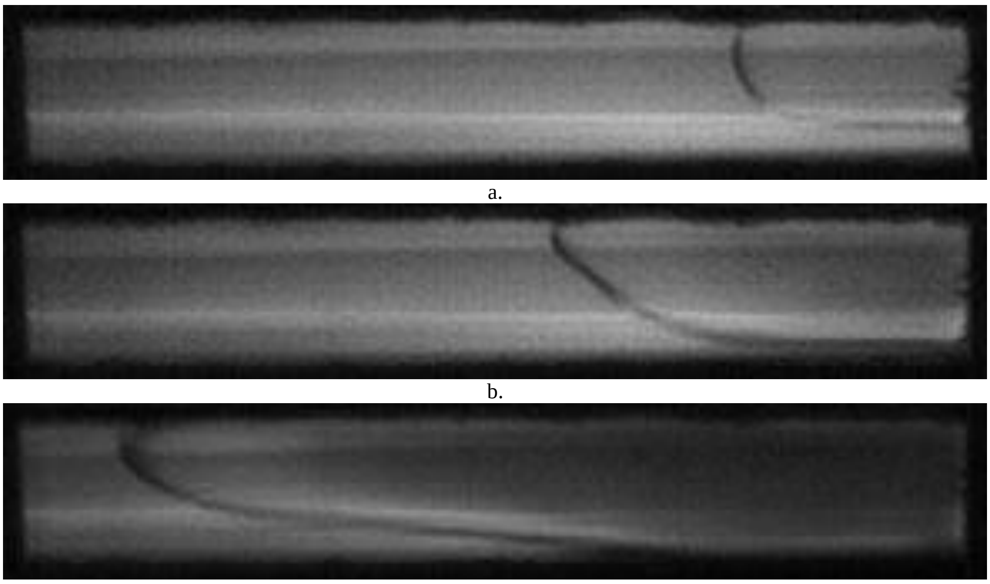
4.1. Flame behaviour at 5%vol CH_4 in air

After the mixture was ignited, the flame was propagated about 20 millimeters measured in horizontal line, climbing toward the ceiling of the chamber, as can be seen in Figure 4. After that, the flame was quenched.

Figure 4. The behaviour of the flame at 5%vol CH_4 (post processed image)

4.2. Flame behaviour at 5.5%vol CH_4 in air

At 5.5%vol CH_4, the mixture was ignited as well, but the flame was propagated until the end of the tube. After a short period of time from the ignition moment, the same climbing behaviour of the flame was registered (Figure 5).



a.

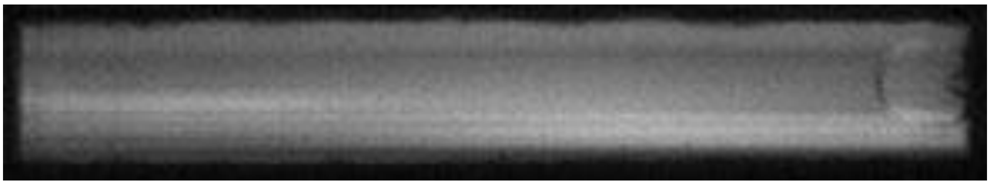
b.

c.

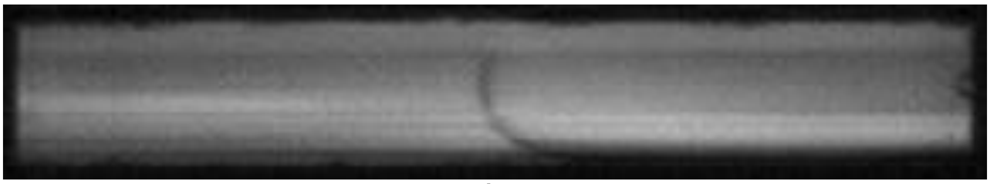
Figure 5. The behaviour of the flame at 5.5%vol CH_4

4.3. Flame behavior at 7.5% and 9.5%vol CH_4 in air

For the concentrations of 7.5% and 9.5 vol CH_4 in air, the flame registered a laminar development (Figure 6), from the ignition location to the other end of the tube, the difference between these two cases consisting of the front flame's speed.



a.



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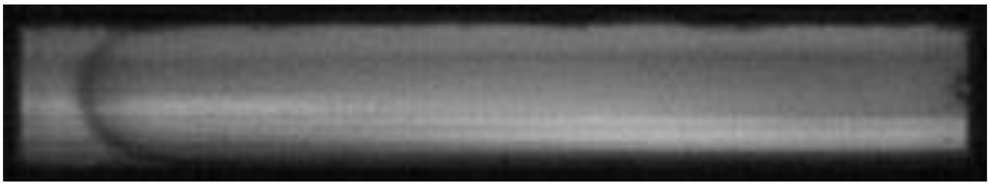


c.

Figure 6. The behavior of the flame at 7.5% and 9.5% vol CH_4

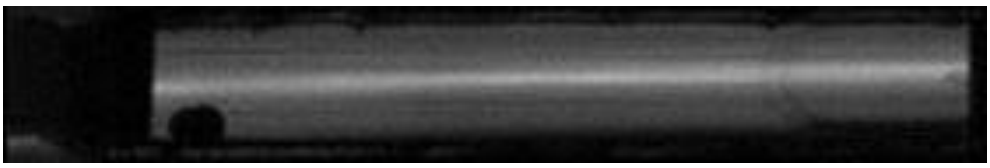
The end of the chamber was covered with a polyethylene film and a metal plate in all the above cases. The average speeds of the flame front registered for the above cases are presented in the table 1:

Table 1. Flame front speed

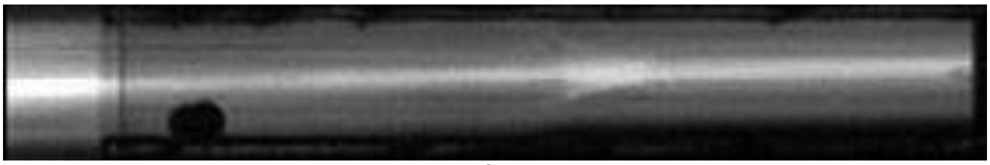
CH_4 Concentration [%vol]	Average speed [m/s]		
	Test 1	Test 2	Test 3
5.0	0.119	0.117	0.119
5.5	0.785	0.795	0.785
7.5	5.969	6.138	6.699
9.5	11.554	12.123	12.105

4.4. Flame front behavior in the chamber closed with a foam plug

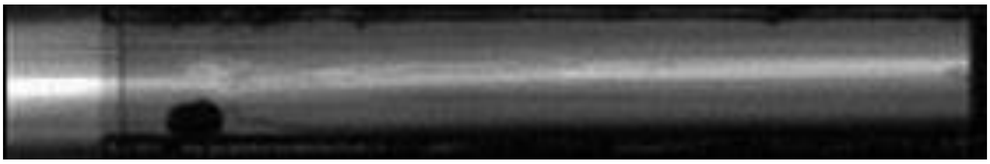
The behavior of the flame front in case of a closed chamber with a polyurethane foam plug is different from the case with the explosion chamber closed with a thin polyethylene film. After the plug is expelled due to rising the inside pressure, the center of the front of the flame falls inside it, making a "hole" which is ending with a "fungus hat" in the opposite direction of the normal propagation of the flame. This "mushroom" of the flame is quenching in time, but the advanced front of the flame, after a short period of stagnation (when the "mushroom" is forming) starts again with a superior velocity and turns from laminar flame into a turbulent front of flames (Figure 7). The same behavior of the flame front is observed when the explosion room is closed, at the opposite end of the ignition, with a polyethylene film not very thin.



a.



b.



c.

Figure 7. The behavior of the flame front in case of a closed room with a foam plug

A second transparent chamber was used in order to visualize the explosion propagated on a greater length. This chamber had the same free section of 50 x 50 millimeters as the first chamber, but its total length was of 850 millimeters. In order to highlight the flame front by Schlieren effect, it couldn't be recorded the full length of the chamber, just about 750 millimeters of it. Testing air-methane explosions in this longer chamber closed with a foam plug, the second "mushroom" was observed (Figure 8).

a.

b.

c.

Figure 8. The flame propagation in the longer explosion room; the second "mushroom" observed in the last image

The velocities of the flame front for 8 periods of the record, the following graphic resulted (Figure 9).

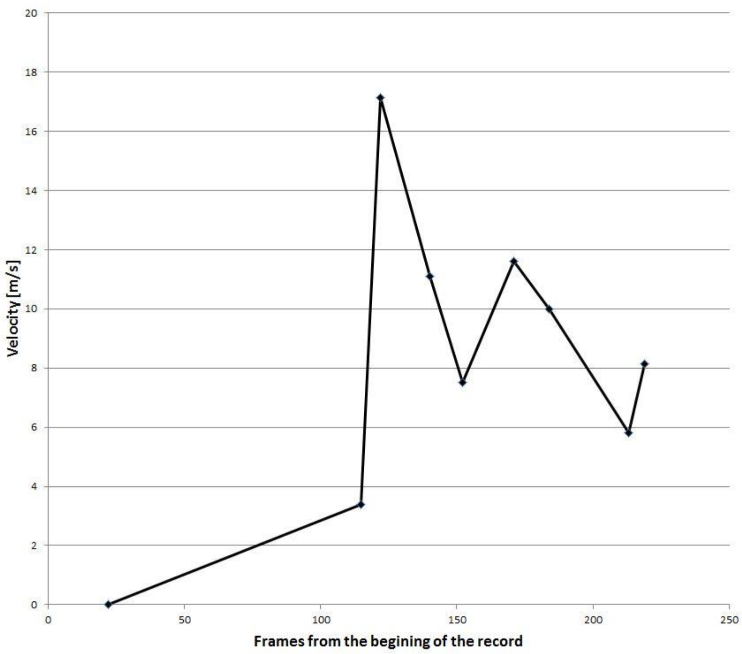


Figure 9. Graphical representation of the flame velocities recorded in the longer explosion chamber

Note that the results of this work cannot be compared with those obtained in different condition. To compare the results obtained in different laboratories it is advisable that they should be performed in similar conditions, at least from the point of view of test cell volume and shape (Prodan et al., 2014).

5. Conclusions

The first conclusion from the experiments presented in this work is that an obstacle located in front of the explosion flame will increase the speed of the flame and hence, will increase the aggressiveness of the explosion.

A strange behavior is observed in case of opposite pressure, when the center of the flame front turns its direction making a “mushroom” and the flame, in proximity of the walls, becomes turbulent. Another curious behavior is the climbing flame in case of lower methane concentrations.

Thinking on future research, the combination of a high speed camera, transparent walls of the explosion room and Schlieren technics offers extended possibilities in comparison to opaque rooms for studying explosion phenomena in gaseous environments.

The great advantage of this ensemble is observing of every moment behavior of the flame front during its propagation on the length and height of the experimental chamber. Another advantage is the possibility of accurate measurements of the flame velocity between any two very close points. Also, the moment of the outlet membrane breaking can be precisely determinate.

The disadvantage consists of limiting the explosion pressure to that supported by the transparent walls of the experimental camera.

For future experiments involving gas explosions in closed spaces, the transparent chambers need to be equipped with pressure sensors.

The immediate utility of this work is that the results serve as a comparison set in validation of the computational simulations of methane-air explosions.

Acknowledgements

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Managing ventilation re-establishment after an average intensity explosion

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Abstract

Explosion type phenomena which may occur at the level of a ventilation network generate changes of the network's structure determined mainly by the destruction of ventilation constructions. The flame front generates a high quantity of burning gases having an extremely high temperature, which leads to their rapid expansion. Over the entire length of the mine workings where the gas distensions occur, the workers subject to the event are exposed, beside the dynamic effect, to high temperatures and high concentrations of toxic and asphyxiating gases, respectively to the drastic decrease of oxygen concentrations, atmosphere which is incompatible with life. The phenomenon of the explosion causes serious disturbances in the ventilation system. May occur reversal of the direction of air flow, unventilated or poorly ventilated areas or destabilizing the functioning of active fan. These are a few reasons for that restore ventilation becomes priority. Within FFCS Coal RTD Programme was developed AVENTO project - Tools for Advanced Ventilation Methane Emissions and Control, which had one objective restore ventilation network, affected by explosion.

Keywords: ventilation, explosion, re- establishment ventilation network

1. Introduction

When an explosion occurs, there is formed on one hand a dynamic wave developing an overpressure ranging between 1-8 bar in case of methane participation (Moraru, R.I., Băbuţ, G.B., and Cioca, L.I.,2013; Moraru, R.I., and Băbuţ, G.B., 2014) and between 1-11 bar when coal dust also participates, and on the other hand the flame front generating temperatures of over 2500 °C. The flame front generates a high quantity of burning gases having an extremely high temperature, which leads to their rapid expansion. The expansion of hot gases takes place during less than a second, after that takes place the phenomenon of burning gases contraction due to their fast cooling in contact with the walls of the mine workings. Depending on the volume and concentration of the explosive mixture, there may take place distensions up to 10 times higher than the initial volume in case in which coal dusts also participates.

Due to high pressure generated by explosion in underground mine workings (Covaci Şt., 1983), there occur high forces which action upon all obstacles encountered on the propagation direction of the dynamic wave. These forces exceed by far the resistance breaking o compression, shearing strength tensile strength, resistance to buckling or torsion specific to materials encountered on the dynamic wave propagation direction.

The least resistant obstacles encountered by the dynamic wave are ventilation constructions – regulator doors, insulation doors, insulation dams (Baron O.et al., 2004; Barthnecht W., 1981; Cioclea, D., 2010; Hîndoreanu E., 1972; Lei P. et al., 2012; Simion S. et al., 2004).

Due to these situations, the following effects can occur:

- maintaining the air flowing direction with the decrease of air flow on some branches;
- increase if air flow on some branches;
- reversal of air flowing on some branches;
- intensification of existent spontaneous combustion phenomena:

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- occurrence of new spontaneous combustions;
- increase of carbon oxide concentrations (up to 2-3% vol.);
- decrease of oxygen content (up to 3-7 % vol.).

2. Ventilation re- establishment

Following the occurrence of an explosion in the complex ventilation network, if the active fan is not operationally affected, results a change of the ventilation network structure and as a consequence a change of the active fan's operational parameters. Due to these aspects, occurs a new air flow repartition on the branches of the ventilation network / Băltăreţu, R.,and Teodorescu, C., 1971; Gherghe, I., 2004; Patterson A. M., 1992; Teodorescu C., et al., 1980/.

For ensuring safety conditions after the event, the re-establishment of the ventilation network is required.The re-establishment of the ventilation network is performed on the basis of critical pathways. In order to identify the critical pathways there have to be firstly established ventilation constructions in relation with their related emergency level. Emergency levels are established in connection with the risk generated by their destruction upon the active mine workings, from the point of view of uncontrolled explosive gas releases in active mines and from the point of view of a new explosion's occurrence in conditions of an efficient ignition source existence. Emergency levels are established as follows:

- **Emergency levels 1 –** of this category are part ventilation constructions aiming to close the goaf.
- **Emergency level 2** – of this category are part ventilation constructions aiming to adjust air flow in active coal faces.
- **Emergency level 3** – of this category are part critical ventilation constructions. They are represented by the ventilation constructions which produce instability in the ventilation network and as a consequence large variations of operation parameters of the operating fan. Therefore, by restoring these constructions, the operational parameters of the active fan considerably tend to the fans nominal parameters.
- **Emergency level 4** – of this category are part ventilation constructions aiming to adjust the air flow at the level of the ventilation network.

Critical pathways are represented by ventilation circuits on which are located ventilation constructions comprised in the emergency levels.

The restoration of the ventilation network is performed step-by-step. Within each phase are determined the operational parameters and is solved the ventilation network in the new given conditions.

Re-establishment of the ventilation based on critical pathways corresponding to an emergency level 1: in order to perform this, there are identified ventilation constructions comprised in this category. There are established the operational parameters of the active fan in the new conditions and there is solved the ventilation network for the new given conditions.

Re-establishment of the ventilation based on critical pathways corresponding to an emergency level 2: in order to perform this, there are identified ventilation constructions comprised in this category. There are established the operational parameters of the active fan in the new conditions and there is solved the ventilation network for the new given conditions.

Managing re-establishment of the ventilation based on critical pathways corresponding to an emergency level 3: in order to perform this, there are identified ventilation constructions comprised in this category. There are established the operational parameters of the active fan in the new conditions and there is solved the ventilation network for the new given conditions.

Re-establishment of the ventilation based on critical pathways corresponding to an emergency level 4: in order to perform this, there are identified ventilation constructions comprised in this category. There are established the operational parameters of the active fan in the new conditions and there is solved the ventilation network for the new given conditions.

3. Software for re-establishing the ventilation

For re-establishment based on critical pathways corresponding to the emergency levels of a ventilation network affected by an explosion, within the project were developed two software, in JAVA language, as follows:

- VENTEX software developed for simulating an explosion at ventilation network level

- VENTREF software for simulating the step-by-step process for restoring a ventilation network affected by an explosion

The two software used for simulating some processes may work with any external software specialized for solving ventilation networks. Within this project, VENTEX and VENTREF operate using CANVENT external software /3 D CANVENT, 2010 /. At the same time, VENTEX is integrated in the specialized software VENTREF. VENTREF can simulate the explosion phenomenon and the restoration of the ventilation network for each junction or branch specific for the ventilation network, respectively for every pressure comprised between 0.1 and 10 bar. For exemplification, there are presented the results obtained using VENTREF application for an average intensity explosion - 6 atm.

Firstly, the junctions and branches which result from the analysis peformed for determining emergency levels specific for the ventilation network of Uricani mine unit are the following:

Emergency level 1 =27 ventilation constructions:

Emergency level 2 =5 ventilation constructions:

Emergency level 3 = 10 ventilation constructions:

Emergency level 4 = 41 ventilation constructions which represent the remaining ones.

Characteristic curves and operational parameters, in normal conditions, related to active fans from within main ventilation stations Ventilation Shaft E and Ventilation Shaft W are presented in Figure 1 and Figure 2.

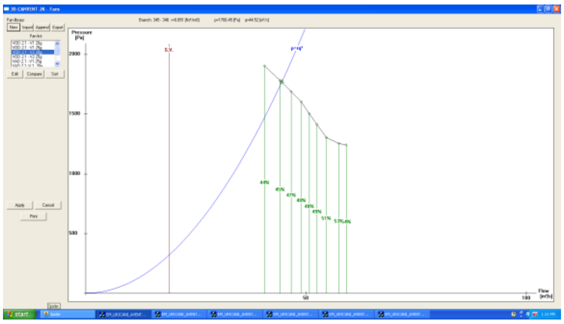

Fig. 1. Characteristic curve main ventilation station V.S. E

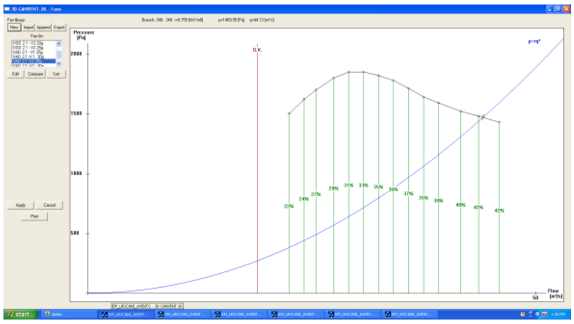

Fig. 2. Characteristic curve main ventilation station V.S. W

Details specific for an average intensity explosion simulation at the level of Uricani mine unit ventilation network are presented in Figures 3-5.

Figure 6 show the simulation on the restoration of Uricani mine unit ventilation network based on critical pathways, emergency level 1.

Fig. 3. Uricani ventilation network - VENTEX simulation – 6 bar

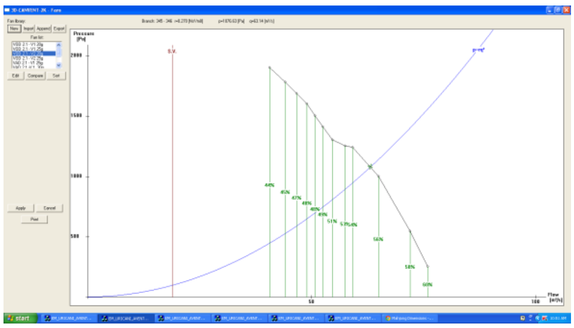

Fig. 4. Characteristic curve main ventilation station V.S. E

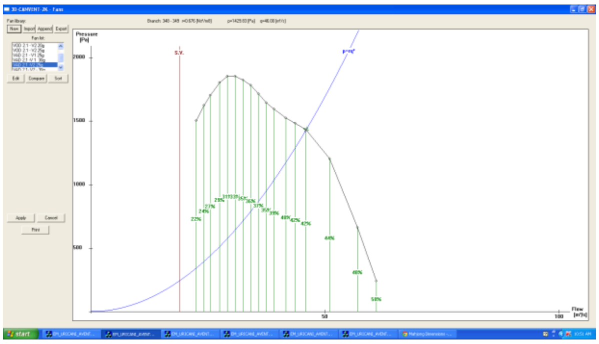

Fig. 5. Characteristic curve main ventilation station V.S. W

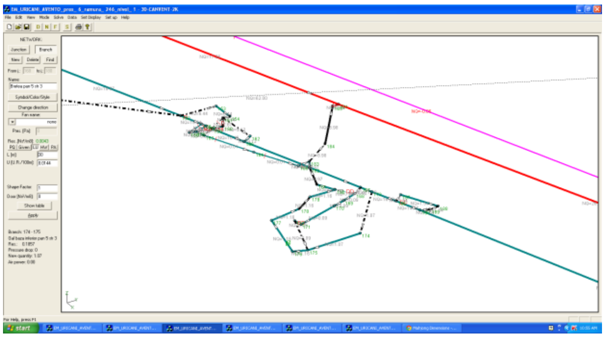

Fig. 6. Detail Bl. IV S - VENTREF simulation – Emergency level 1

Characteristic curves and operational parameters related to active fans from within main ventilation stations Ventilation Shaft E and Ventilation Shaft W are presented in Figure 7 and Figure 8.

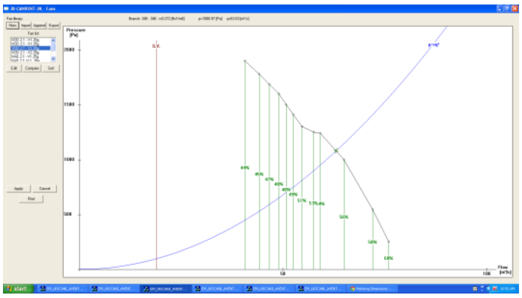

Fig. 7. Characteristic curve main ventilation station V.S. E – Emergency level 1

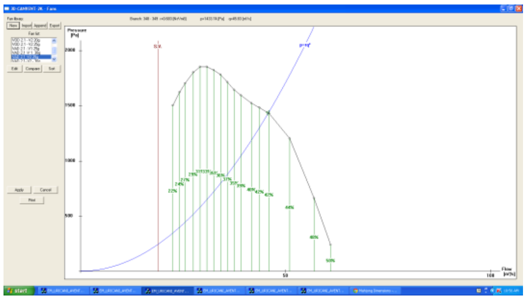

Fig. 8. Characteristic curve main ventilation station V.S. W – Emergency level 1

Figure 9 present the simulation on the restoration of Uricani mine unit ventilation network based on critical pathways, in relation with an emergency level 2. Characteristic curves and operational parameters related to active fans from within main ventilation stations Ventilation Shaft E and Ventilation Shaft W are presented in Figure 10 and Figure 11. Figure 12 present the simulation on the restoration of Uricani mine unit ventilation network based on critical pathways, in relation with an emergency level 3.

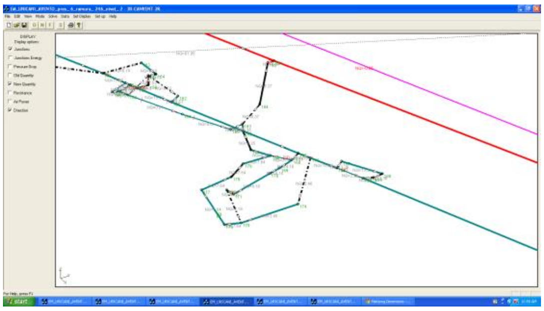

Fig. 9. Detail Bl. IV S - VENTREF simulation – Emergency level 2

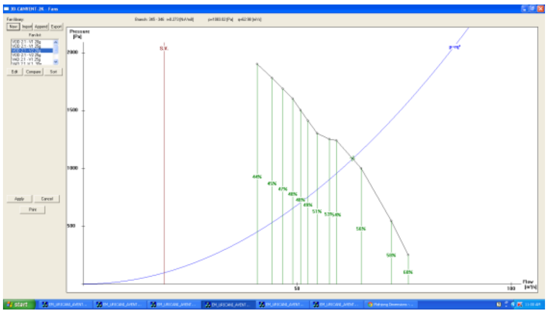

Fig. 10. Characteristic curve main ventilation station V.S. E – Emergency level 2

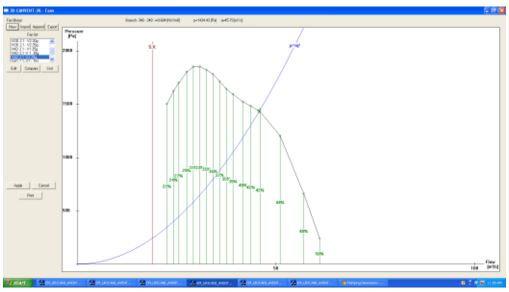

Fig. 11. Characteristic curve main ventilation station V.S. W – Emergency level 2

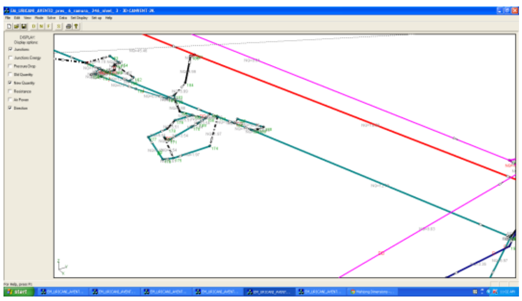

Fig. 12. Detail Bl. IV S - VENTREF simulation – Emergency level 3

Characteristic curves and operational parameters related to active fans from within main ventilation stations Ventilation Shaft E and Ventilation Shaft W are presented in Figure 13 and Figure 14.

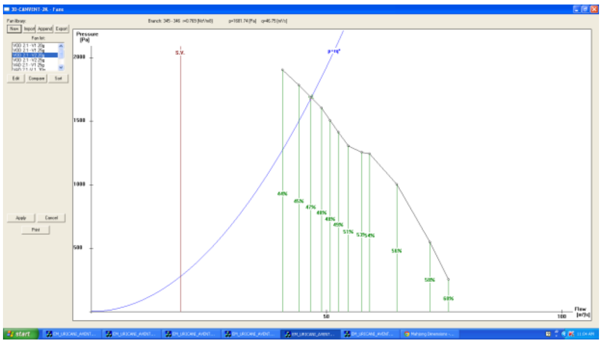

Fig. 13. Characteristic curve main ventilation station V.S. E – Emergency level 3

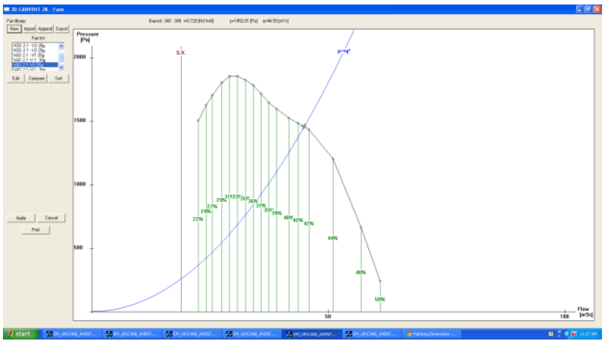

Fig. 14. Characteristic curve main ventilation station V.S. W – Emergency level 3

Figure 15 presents the simulation on the restoration of Uricani mine unit ventilation network based on critical pathways, in relation with an emergency level 4. Characteristic curves and operational parameters related to active fans from within main ventilation stations Ventilation Shaft E and Ventilation Shaft W are presented in Figure 16 and Figure 17.

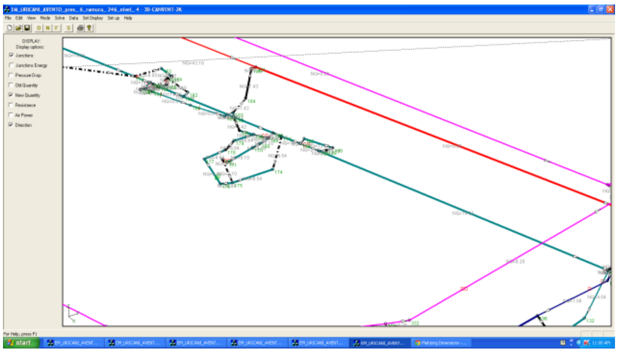

Fig. 15. Detail Bl. IV S - VENTREF simulation – Emergency level 4

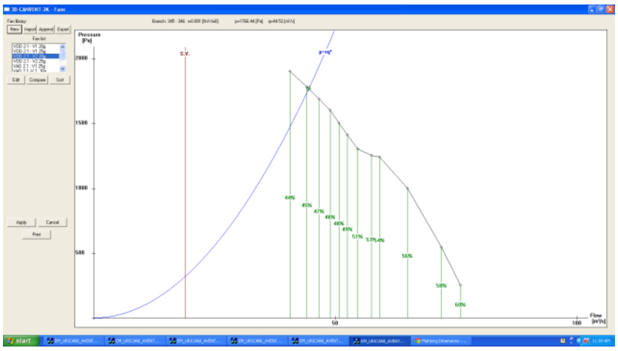

Figure 16. Characteristic curve main ventilation station V.S. E – Emergency level 4

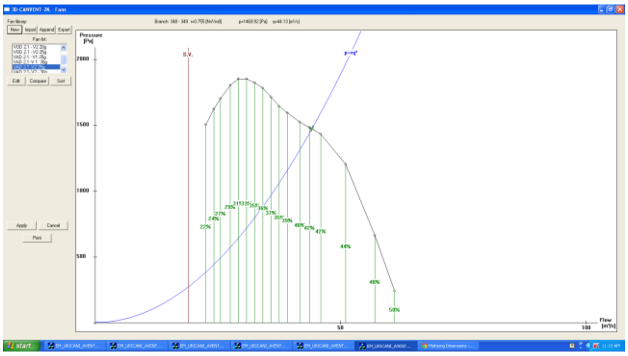

Fig. 17. Characteristic curve main ventilation station V.S. W – Emergency level 4

From the information presented, there may be noticed that simulations conducted using VENTREF lead to obtaining the step-by-step and in safety conditions restoration of Uricani mine unit ventilation network based on critical pathways in relation with emergency levels. Also, values of operational parameters related to active fans from within main ventilation stations after the last restoration phase are almost identical to the ones specific for the normal conditions before the explosion.

4. Conclusions

In case of explosion, there is formed on one hand a dynamic wave developing an overpressure ranging between 1-8 bar in case of methane participation and between 1-11 bar when coal dust also participates, and on the other hand the flame front generating temperatures of over 2500 °C. These forces exceed by far the resistance breaking o compression, shearing strength tensile strength, resistance to buckling or torsion specific to materials encountered on the dynamic wave propagation direction. Following the occurrence of an explosion in the complex ventilation network, if the active fan is not operationally affected, results a change of the ventilation network structure and as a consequence a change of the active fan's operational parameters. Due to these aspects, occurs a new air flow repartition on the branches of the ventilation network.

The reestablishment of the ventilation network is performed on the basis of critical pathways. In order to identify the critical pathways there have to be firstly established ventilation constructions in relation with their related emergency level. For re-establishment based on critical pathways corresponding to the emergency levels of a ventilation network affected by an explosion, within the project were developed two software, in JAVA language, as follows: VENTEX and VENTREF. In the work are presented the results obtained using VENTREF application for re-establishment ventilation network after average intensity explosion - 6 atm. for the Uricani mine unit.

The values of operational parameters related to active fans from within main ventilation stations after the last restoration phase are almost identical to the ones specific for the normal conditions before the explosion.

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Field study on professional effort in some gas transport activities

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Abstract

The paper presents some results of a field study concerning mental and physical effort in some activities in gas transport field. The study aimed to assess the professional effort, in order to emphasize the risk /demand factors and to establish measures for occupational safety and health management system in order to protect the employees' health, safety and wellbeing at work. The methodology consisted in: analysis of the work content and conditions; assessment of the professional effort (mental and physical) and work capacity; assessment of work tiredness. The results showed the levels of mental (neuropsychic) and physical effort in the studied activities, the risk factors that determine tiredness at work, and the risk factors that cannot be eliminated / reduced.

Keywords: mental professional effort; risk factors; safety and health at work; work effort

1. Introduction

The opportunity, aim and necessity of the study resulted from the present occupational safety and health (OSH) law requirements, concerning with: (1). the necessity of the process of identification and assessment of occupational risk and demand factors and monitor the personnel' health state and the work conditions (especially in activities with high level of work load – mental of physical), in order to assure the health and safety at work, to maintain the optimal level of work capacity all along the working life, to emphasize the eventual negative influences of risk factors on organism and work performance; (2). establishing the adequate methods for eliminate / reduce the emphasized risks.

The paper presents some results of a field study concerning mental and physical effort in some activities in gas transport field, with a focus on neuropsychic effort.

The study aimed to assess the professional effort, in order to emphasize the risk /demand factors and to establish measures to be integrated in the occupational safety and health management system, in order to protect the employees' health, safety and wellbeing at work.

2. Methods

The methodological approach was intended to be multifactorial, multidimensional and multidisciplinary, in a interdisciplinary research team, taking into account that: in the present technical and technological conditions, the personnel is exposed to a cumulus of occupational nocivities; one and the same risk can emerge from the cumulated action of occupational, extra-occupational and individual factors; the occupational risk factors are complex and they could derive from the deficiencies of one or more components of the work systems that the human operator interacts with – equipment, work task, work environment; human being, as bio-psychosocial entity, reacts as a whole to the action of external factors – also occupational, on all plans – somatic, psychological.

The work activities considered for analysis were: dispatcher (from National and Territorial Dispatch Centres) and System Analysis (SA) engineer.

As work effort represents a multidimensional concept of the individual biologic cost invested in an activity and depending, in the same time, on occupational, extraprofessional and individual factors, its analysis and assessment must be multidimensional and multifactorial as well. Thus, starting from the work analysis of the investigated categories of personnel, analysis of work conditions, and assessment of risk level for the workplaces, as well as from requirements of

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ergonomic standards (SR EN ISO 10075, Parts 1, 2 and 3) and analysis of neuropsychic (mental) effort (McCracken and Aldrich, 1984, Wickens, 2000) and human errors (Moraru, Babut, Cioca, 2010; Cioca & Cioca, 2007) there were assessed some work load indicators: work task indicators, psychophysiological indicators and subjective assessment indicators. These indicators were assessed during different times of work day. Analysis of work task indicators used a questionnaire focused on different factors derived from work task and environment and their effects on health, safety and wellbeing at work. For the subjective assessment of work effort, there was used TLX-NASA index.

Psychophysiological and cognitive indicators (memory, attention, reaction time at visual and audio stimuli) were recorded (using Digital Tachistoscop and Conflict meter – STRUKTURA Ltd., Hungary) at the beginning and the end of work day (for SA engineers group), and the beginning – middle – end of workday, during day and night shifts, respectively (for dispatchers group).

Participants:

The investigated personnel were dispatchers (from national and territorial centres) and system analysis (SA) engineers.The parameters considered to analyse for the participants groups were: average age, total work seniority and average seniority at the actual workplace.Thus, at national dispatcher centre, the participants group had the following characteristics: average age 42.17 years (standard deviation SD = 7.45). Total work seniority: 20.9 years (SD= 5.7) and average seniority at the present workplace: 8.8 years (SD = 6.5). All participants were men.

The participants group from territorial dispatcher centre: average age 47 years (standard deviation SD = 9.67). Total work seniority: 26.6 years (SD= 10.2) and average seniority at the present workplace: 16.7 years (SD = 11.4). All participants were men.

The participants from SA engineers group was characterized as follows: average age 45.17 years (standard deviation SD = 7.17). Total work seniority: 24.4 years (SD= 8.2) and average seniority at the present workplace: 14.6 years (SD = 7.4). Participants were 6 men and 2 women (all personnel of the system analysis centre).

3. Results

The technical, structural and psycho-physiological analysis of activity on investigated staff categories revealed the following:

1. The Dispatchers of the National Dispatch Centre develop a complex activity of high cognitive content and high degree of responsibility, exercising the authority of operative management of natural gas transport from source to consumer, providing appropriate functional parameters, optimum transport in conditions of quality, efficiency and safety.

Starting from the content of the workload the dispatcher activity involves two different functions: *monitoring function* (tracking operative demands / gas supplies, shooting and planned work, framing consumers, how to ensure the necessary conditions for gas transport system at the compression stations etc.) and *operational command and control function* (e.g. apply the necessary measures to comply with the technological transportation constraints in cases of overcoming nominations). Both functions are developed by permanent receiving and processing the information from several psycho-physiological perceptions (visual, hearing) at different levels and by means of different equipment (telephone communications, equipment for information processing and display, etc.).

In case of critical and/or unanticipated situations, the dispatcher gets two more functions: the *diagnosis function* for the situation and the *problem regulating/solving function*. The detection (possible anticipation), diagnosis, development of a measure plan, decision, disposition and control represent the phases of the dispatcher activity whenever such situations occur.

The working schedule in shifts of 12 hours with 2-3 days off is positively perceived by all dispatchers, given the contact with the problems of the systems, feed-back of the actions taken and the possibility of dealing with their own personal matters.

2. The activity of the *territorial dispatchers* consists mainly in providing operative and permanent dispatching in the allocated area by permanently monitoring the situation and applying the dispositions of the National Dispatchers in permanent contact with the operators of the work points and teams that develop works. The structure of activity is similar to the dispatchers of National Dispatch Centre, restricted to a certain area, implying a more reduced responsibility and amount of work.

3. The activity of the *Service of System Analysis engineers* is a complex activity of high responsibility, taking into account the staff involvement in: setting the optimum technological regime for natural gas transport on different zones or the whole system; managing and updating the technological schemes of the transport system and technological plants connected to it; calculating the gas quantity that has to be maintained in the pipes, storage capacity, transport capacity of the system or parts of it, solutions to modernize, rehabilitate and develop the transport system.

The *amount of activity* for the staff of the System Analysis service staff is quite high. The *workload* is not always the same, depending on the emergency of certain works, the system state etc., that can occasionally imply overwork. Psycho-physiologically, the main functions the workload includes for the System analysis engineer are: *calculation and checking function* and *monitoring and managing function*, respectively. In some cases the workload also implies the *creative function* and implementation of changes of several components in the technological platform, as well as the *anticipatory function* and proposals for optimization measures of the monitored systems.

The identification / assessment of mental effort factors (through the work task indicators) pointed out some risk factors with high level for all categories of personnel: the average level of some work tasks difficulty; the work rhythm and work breaks regime are not considered to be risk factors; temporal demands coming from hurrying in completing the activity – average level; the work load due to different occupational behaviours – high risk level; work precision in carrying out the different tasks – high level; repetitive nature of some operations – frequent (high level of risk) for electricians working in power stations; the need for communication and cooperation with different categories of persons – high level; work responsibility related to the risk of producing errors with important consequences – high level of risk; mental demands – over average level.

The investigation of the cognitive and psychomotor capacities indicators showed the results presented as follows.

In dispatchers group, the assessment of the attention performance showed significant changes between the beginning, middle or end of the work shift, especially during night shift

Table 1

	Beginning of workday (day shift)	End of workday (day shift)
Middle of the workday (day shift)	0,83 p = 0,009**	0,75 p = 0,03*
	Beginning of workday (night shift)	Middle of workday (night shift)
Middle of workday (night shift)	0,91 p = 0,001**	-
End of workday (night shift)	0,92 p = 0,001**	0,96 p = 0,001**

* p < 0,05
** p<0.005

The test for *work memory* showed no significant changes in general performances of the participants, between the beginning, middle or end of the work shift. As concerning the reaction time at acoustical stimuli, there were significant changes of performances between the different periods of work day (both for day and night shifts), as follows: increase in values at the end of both work shift, therefore decrease of the reaction time determined by tiredness; higher differences at the end of the day and night work shifts: 0.041 / 0.060; t_{day} = 3.02 (p<0.02); t_{night} = 7.56 (p<0.001).

For SA engineers, the test for *attention* showed no significant changes in general performances of the participants, between the beginning and the end of the work shift. The test for *work memory* showed significant changes in general performances of the participants, between the beginning and end of the work shift (t-Student, t= -3,162, p=0,025).

As referring to the reaction time, there could be seen a significant decrease of performance between the beginning and the end of workday, for reaction time to visual stimuli (t-Student, t= -2,721, p=0,041). Through assessment of work effort through subjective, using TLX-NASA, the participants from dispatchers group recorded level of total work load (7.56), with the emphasis on mental and temporal demands (9.11 and 8.78, respectively). The SA engineers recorded also high level of total work load (8.5), respectively high levels of specific demands (mental demands / 9.17 and temporal demands 7.83)

4. Discussion

The dispatcher and also SA engineer should search for information and should be permanently informed about installation functioning regime, manoeuvres achievement, programmed and random events analysis.

Dispatching is a continuous activity, shift work being organised on a monthly graphic. Two work shifts are organised during the 24 hour workday; the mean duration of a work shift 12 hours. The work regime for SA engineer involved one workday shift, for 8 hours. Workload (especially its mental / neuropsychic dimension) was identified as the main risk factor for dispatchers' safety and health.

In relation to the mental demand derived from the workload characteristics, it can be stated that there are *factors of neuro-psychical demand* which could influence the workers' heath state and work capacity of the investigated categories, demand specific to the workload of *medium level in the majority routine situations and high or very high in cases of peak mobilization* developed in circumstances of specific tasks of *increased difficulty and responsibility*.

A first category of psycho-social occupational risk factors for the studied activities refers to the *intrinsic factors of the workload* deriving from its nature and determining a certain *occupational effort (mainly neuro-psychical*) which can become an occupational risk factor whenever it leads to *overstressing* situations. The psychosocial risk factors refer also to *time exigencies* which, in the case of the studied activities are sometimes present as increased difficulty and demand, emergency, too short deadlines for certain works.

Work in shifts, another factor present in such activities puts a special stress on the worker, affecting his/her biological rhythm, variations of the body temperature, metabolism, level of glycaemia, efficiency of mental activity; it can also lead to sleep disorders, food conduct, disturbances in family, social life, etc. From the physiological point of view, the work in the night shift is stressful because of the delay or inversion in the 24 hour body rhythm. Another series of psychosocial risk factors derives from the *organization and management* of activities, teams and company as whole, factors of increased importance in the modern society.

For the studied activities it should be especially noticed the *responsibility* towards other people and their safety, as well as the equipment. Thus, factors generating high levels of mental load were identified: necessity to quickly mobilize the adjustment capacity to mental overload conditions; difficulty and complexity of particular operations; specific mental demands; pausing conditions; time pressure; precision, correctness and speed in work operations achievement; overloading situations; tiredness; high responsibility; individual effort to permanently adjust the biorhythms related to shift work conditions.

5. Conclusions

The study was followed with some proposed measures:

A multidimensional (ergonomic) program containing measures to decrease / eliminate the risks factors was established and implemented (Cail, 1992; Dejours, 1987):

a. Medical and psychological examination at initiating work and periodically afterwards: removing the persons not presenting required levels of medical and psychological aptitudes according to professional standards; removing the persons presenting medical and / or psychological disorders; caution in employment of persons with vulnerabilities.

b. Optimal organization of work time – workday duration, breaks, work shift – in order to maintain the optimal level of individual capacities and decrease the overloading situations.

c. Ergonomic lay - out of the workplace. Activity requests assurance of adequate work conditions: workplace arrangements; comfortable microclimate and lighting conditions etc. – according to the Romanian legislation.

d. Monitoring health status, both physical and mental, and also monitoring the evolution during the work life of the physiological and physical capacities, of the general personality traits, in order to precociously identify the eventual reversible disorders / decreasing of capacities.

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The place and role of proactive safety behavior in occupational risk management

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Abstract

This paper addresses a global problem, namely workplace safety, which is an important issue not only for employers but also for employees. The health and safety is focus on reducing work-related incidents and increase safety at work. Anything that jeopardizes these priorities should be detained and prevented from happening again. Risk management tools provide systematic methods of managing such events. Current figures available on the number of accidents and occupational diseases and deaths are still unacceptable. Injuries and occupational diseases can have severe consequences on workers, their families, employers and the entire community. This paper aims to highlight ways to limit hazardous behaviour and increase safety behaviors. Proactive behavior of safety and health at work addressed the entire population, can provide social support for behavior change concerning safety at the workplace.

Keywords: safety management; human error; tools, work task; safety behavior.

1. Introduction

How often have we experienced situations in which an employee's competence in a work process is assessed at the point that they leave the training room with the assumption that, once learned, the process will be applied correctly and safely?

Health and safety at work focuses on risk assessment in the workplace, work equipment / means of production, work task, working environment to ensure safe working conditions in terms of occupational health and safety. The next step consists in elaboration of rules, regulations, procedures, instructions and safety training as well as work permits in order to ensure safety systems. However accidents and occupational diseases occur and to reach for a goal as well as zero accidents is not possible without taking into account the workers behaviour. Safety behaviour is an integral part of safety management that focuses on the workers behaviour.

Workers may have unsafe behaviour for several reasons:

- workers do not have the equipment and tools to do the work task safely. (sometimes they do have the equipment and tools, but do not use them)
- there are no well-established rules and procedures (sometimes there are rules and procedures but workers do not follow them).
- sometimes under the pressure of production workers ignoring safety rules.
- they choose the easiest way to save time (omitting the use of personal protective equipment, etc.) but compromise the safety and health at work.
- do not focus on the work task because they are tired, stressed, preoccupied or cannot detach from personal problems.
- sometimes they see colleagues behaving unsafely, but do nothing in this regard.

Behaviour can be defined as an action by an individual that is observable by others. Accident statistics and analysis showed that over 90% of accidents and occupational diseases involving human error, attitudes and unsafe behaviour.

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Behaviour modification regard safety in the workplace can reduce the incidence of unsafe actions. The traditional safety triangle shows that as severity decreases, frequency increases (fig.1), the triangle can be extended to include near misses and unsafe behaviours, wich presents opportunities to modify unsafe behaviour from unsafe to safe. By reducing unsafe behaviours, it is possible to reduce injuries in the upper part of the accident triangle. There are more major injuries than fatalities, more first aid cases than over-three-day injuries, and more near misses and unsafe behaviours than incidents of all kinds. Unsafe behaviour is an early warning system for accidents.

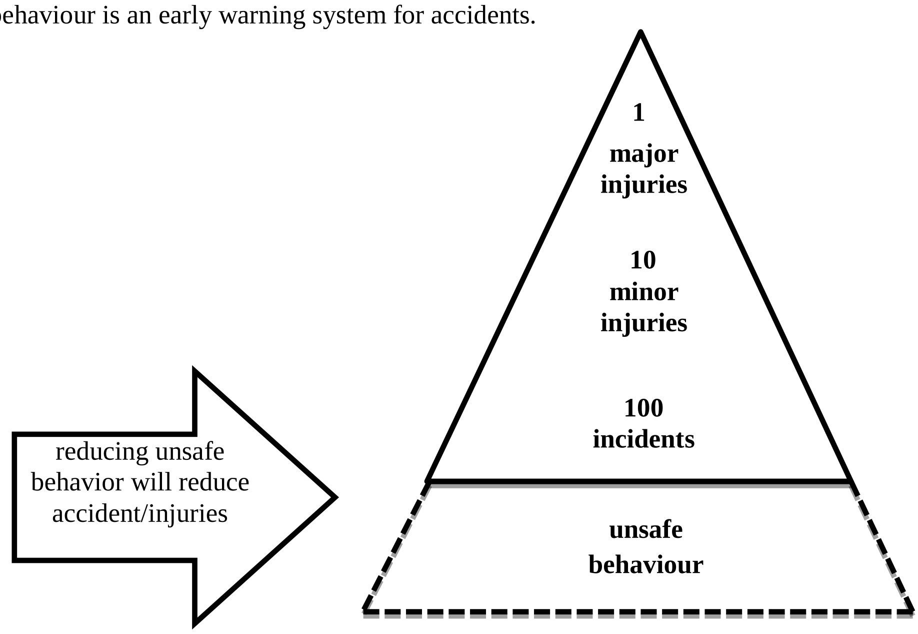

Fig.1: Accident triangle extended to include unsafe behaviour

2. Behavioral characteristics and human errors

Various approaches have had reasonable success in reducing unsafe behaviours in the workplace. Some involve penalties; others involve surveillance; others involve guidance, codes and procedures to follow; others still are supportive and training-oriented.

Human behavior is difficult to understand because people react differently depending on the situation to which they are exposed. Factors that influence the behavior can be: internal (working environment) and external (personal lives of workers). On external factors cannot act without respecting the private life of workers, instead internal factors can be influenced. Humans are not perfect, and will never be and for this reason, workers will always be prone to make errors. Management tools can affect internal influences because they are directly dependent on the structural conditions.

Table 1: Possible internal and external influences on workers

Internal influences	External influences
trust	leisure time
work conditions	family and friends
management support	self accomplishment
organizational culture	Maslow’s pyramid
responsibilities	social level
work programme	
wages	
pressure	
motivation	
job security	

The main human factors that interact with human working environment are:

- Attention - the modern workplace can „overload” human attention with enormous amounts of information, far in excess of that encountered in the natural world. Attention on a work task can only be sustained for a fairly short period of time, depending on the specifications of the task. Approximately 20 minutes, after which, fatigue sets in and errors are more likely to occur. This is why air traffic controllers are obliged to take breaks from their attention-intensive work at regular intervals.
- Perception - the interpretation of senses, visual information, signals detection, all of which have implications for the way in which the danger signals are perceived in the workplace.

- Memory - our capacity for remembering things and the methods we impose upon ourselves to access information often put undue pressure on us. Increasing knowledge about a subject or process allows us to retain more information relating to it.
- Logical reasoning - deficiencies in reasoning and decision making can have severe implications for complex systems, such as chemical plants and for tasks such as maintenance and planning.

Human error is an unintentional action or decision involving a deviation from an accepted standard and leading to an undesirable outcome. There are several methods for identifying human error and the most known and used methods are: Rasmussen and Reason methods.

- **Rasmussen method**

In this method, the author defines three types of human behavior:

- ✓ *Skill Based Behaviour*: human operator actions are performed automatically and respond to signals; these signals represent information directly assimilated on system status, without going through some stages of interpretation;
- ✓ *Rule Based Behaviour*: human operator adopts this type of behaviour when face known situations; information received is interpreted in order to know the system status and the operator establishes a correlation between the current situation and predetermined objective; because it is a situation already encountered, the link between task (defined by the existing situation and the objective pursued) and actions to be taken is performed automatically;
- ✓ *Knowledge Based Behaviour*: this behavior is met when the situation does not correspond to an identified situations previously encountered; human operator is obliged, based on the knowledge that, to create ("invent") task and required actions.

Rasmussen's method lies at the basis of the errors classification made by Reason

- **Reason method**

According to the Rasmussen's method, human operator reacts to system status through a sequence of actions. Depending on the nature of the action, intentional or not, Reason distinguishes:

- ✓ wrong executions and omissions, which are the consequence of unintended actions
- ✓ errors or violations resulting from intentional actions (deliberate).

This classification is based on Rasmussen method, each type of error can be associated with a behavioural level:

- ✓ wrong executions (misfire) and omissions are execution errors which can be correlated with skills based levels;
- ✓ errors (mistakes) based on rules which correspond to rule based behaviour;
- ✓ knowledge-based errors which are associated with knowledge based level.

It should be stressed that for Reason the deliberate violation of the task is not an error. The types of human errors identified by Reason, in relation to a prescribed procedure are:

- ✓ ***intrusions:*** performing contingency actions in the work task;
- ✓ ***omissions:*** actions which are missing from the sequence;
- ✓ ***inversions:*** two actions are interchanged places;
- ✓ ***disorder:*** generalized form of inversion, in which all actions from the sequence are performed, but in the wrong order;
- ✓ ***contretemps:*** failure to perform action in time, too early or too late.

3. Behaviour modification

There are several well established principles which underpin the modification of human behaviour.

Behaviour can be measured: and to make measurement possible, the behaviour you wish to change must be carefully defined and observable.

Behavior is a function of its consequences: people will continue to behave as they do until either the consequences reinforce behaving in a different way or the consequences (punishment) no longer reinforce behaving in the established way.

Behavior can be changed by providing reinforcement and feedback: positive reinforcement (thanks, praise), support from colleagues and management that promote behaviour change, whereas in an organizational context disciplinary action is often counter-productive. Also, once bohaviour has been measured, people need to see the results. Immediate and specific feedback is more effective than feedback which is delayed, infrequent and vague.

Goal setting: when people are involved in setting challenging and achievable targets for changing their behaviour, this adds to the positive effects of reinforcement and feedback.

It is possible to define and measure behaviours that may wish to change. By altering the consequences of a specific behaviour, providing positive reinforcement and specific feedback, the behaviour occurs more often. If behavioural goals are also set, this adds to the positive effects of feedback and reinforcement.
How these principles of behavior modification are typically applied in order to improve safety at work is presented in table 2.

Table 2: Applying the principles of behaviour modification to improve safety

Behaviour modification principle	Implementation
Behaviour can be measured	Through careful site-specific analysis of past incidents, risk assessments, task analysis and experts judgements, a complete list of the unsafe behaviours preceding accidents is prepared. The desired safe behaviours are also clearly stated and communicated. Trained observers systematically observe the frequency of safe and unsafe acts, using the checklist of safe and unsafe behaviours. A formula is used to calculate a behavioral safety index. Using the behavioural checklist and safety index, a baseline measure of safe behaviour is established.
Behavior is a function of its consequences	People may behave in an unsafe manner because they are rewarded for doing so, for example rushing to complete a work task to meet production targets, which is tacitly encouraged by management. Although rushing is unsafe and may lead to accident or injury, feedback in the form of an accident is very infrequent. Therefore feedback is missed or ignored.
Behavior can be changed by providing reinforcement and feedback	Observers provide feedback and reinforcement either at the time to those observed, or by graphically displaying the frequency of observed safe and unsafe acts. When unsafe acts are observed, positive feedback is maintained by concentrating on encouraging the safe act. Observers may provide face to face feedback on their observations via group meetings or posting results in a visible place.
Goal setting	Once a baseline measure of safe and unsafe behavior has been established, employees may be asked to set their own goals for improvements.

Whilst behaviour modification is not always successful in improving safety, often as a result of poor technical implementation, studies in the field has demonstrated that safer behaviour may lead to reduction of accidents / incidents, cost saving and improvements in employee attitudes towards workplace safety.

Behavioural modification can lead to significant changes in safety related behaviour. A wide range of unsafe acts can be reduced or eliminated and replaced by safe behaviours. These positive effects have been demonstrated across a wide range of industries.

Many reports also highlights on the positive impact of behavior modification programs on:
- employee involvement and commitment to safety
- willingness to take personal responsibilityfor safety
- integration of safety with production and quality

4. Safety observations and occupational risk management

When we examine an incident report and ask questions around why a person behaved in a certain way, we tend to look at antecedents, or what occurred to ‘set off’ the behaviour. However, if we examine the report with a view to consequences, we will gain a clearer picture of why the behaviour occurred. For example, if an eye injury occurred and

the individual was not wearing PPE, we need to examine what were the consequences for wearing the PPE (e.g., possible but not definite reduction of injury) and what were the consequences for not wearing PPE (e.g., immediate comfort, better vision on the job).

Safety observations are an opportunity to specifically indicate the positive actions that a worker does for his own safety. The basic idea of safety observations is nothing more than observing employees as they perform their jobs, in order to find out if they are doing them safely. While this sounds very simple, it is a powerful tool for preventing accidents.

The usual methods of risk analysis are using a risk matrix, a tool that quantifies hazards based on frequency and severity. A risk matrix defines numerical scales for the frequency and severity of possible incidents to determine how large of a risk that event is. For example, if something has high severity and high frequency, it is considered high risk. If something is low in both of those areas, it is considered low risk.

Risk management tools provide systematic methods by which it can be observed the behavior of workers during work task work as Job Safety Analysis.

Job Safety Analysis is a method used in units, for workplaces where workers perform manual activities on/or near a machine production or a technical equipment. The method is suitable especially for work tasks well enough defined (limited). The object of analysis may consist for example in a limited number of work tasks performed in a production cycle. Then, a list is covered point by point, trying to detect the different risks. The analysis should lead to the adoption of measures both technical and organizational.

The stages that must be completed when applying the method of occupational safety analyze are the following:

1. preparation;
2. structuring - drawing up the list of work tasks and operations conducted to meet them;
3. identifying the risk sources;
4. risk assessment;
5. risk evaluation;
6. proposal of prevention measures;
7. completion.

In the preparation phase, the necessary information are gathered, work tasks and situations are to be analyzed are identified, the operations that are performed within each work task are identified; all participants in the analysis are selected and instructed. Information base consists of: description of the tasks, work instructions, technical books of machines, maintenance instructions, reports on cases of injury, occupational diseases and dangerous incidents, interviews with employees, shooting videos. The informational basis is needed to achieve a more complete list of operations that are carried out as well as to identify the risk sources.

At identifying the work tasks and situations that will be analyzed, the following will be considered: training before starting work, initiate the production process, how work is carried out under normal conditions, measures to be taken in case of some flow disturbances of the production and how they are applied, transfers within and between work tasks, how does the production process end, maintenance and repairs, order and cleaning, how does the work end.

For the inventory of risk sources: the employees are interviewed, managers and coordinators of the production process, the way in which work is carried out is followed, the list of possible risks is used, problematic situations are sought out, technical equipment failures and shortcomings of the work methods are sought out, deviations from the normal development of the work stages.

Within this method there are not separately estimated the probability and severity, but it appeals to a risk assessment practice as follows:

- 0 - Negligible risk
- 1 - Acceptable risk - no need to take action
- 2 - Certain risk - it is recommended to take action
- 3 - High risk level - measures must be taken
- 4 - Very high risk - measures must be taken immediately

For each work task is drawn a sheet that includes the following categories: operations, risks/ risk sources, risk assessment, measures. At each operation within a task, more risks can be identified; each risk may have multiple sources of risk. In order to establish prevention measures, the identified and assessed risks will be taken into account in descending order and at the establishment of measures will take into account the ranking criteria of the measures, namely: risk elimination, risk containment, risk avoidance, worker confinement.

5. Conclusions

Safety management practices not only improve working conditions but also positively influence the attitude and behaviour of workers on safety, reducing accidents in the workplace.

More and more we need to look at new approaches to achieving safe and healthy workplaces. We need to apply the learning from the many years of analyses of accidents and ill health because this will contribute to future prevention strategies and activities.Behavioural Based Safety as an approach to safety that focuses on workers' behaviour as the cause of most work-related injuries and illnesses. To be successful a behavior-based safety program must include all employees, from the top management to the front line workers including hourly, salary, union employees, contractors and sub-contractors. To achieve changes in behavior, a change in policy, procedures and/or systems most assuredly will also need some change. Those changes cannot be done without buy-in and support from all involved in making those decisions. Behavior-based safety done right can be very effective at helping you discover what’s wrong with an organization, find the core organizational causes of risk.

If corporate management supports and encourages safe behavior by eliminating root causes – such as engineering, process, communication or training failures – then employees are more likely to want to adopt safe behaviors.

Employers, managers and supervisors who actively and vocally support safe production and put money and resources behind that support are less likely to get pushback from employees regarding safe behavior.

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Health analysis of residents near the coal deposit - Roșiuța coal pit

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Abstract

Rosiuta coal pit is part of the Motru coal pits whose activity performed within the current lignite coal pit and has a capacity of about 3 million tons per year. During the studies it was found that all mining activity occurs due to its specific, multiple and varied adverse effects on the environment and consequently on population, as exemplified by: changes in the landscape, occupying large areas of land for operating activities, stockpiles, storage minerals, industrial plants, roadways, etc., land degradation, watershed polluted surface and groundwater, the groundwater hydrodynamic imbalance, negative influences on the atmosphere, flora and fauna, soil chemical pollution, noise, vibration and radiation spread into the environment, with a strong adverse action.

Keywords: coal pit, health safety, environmental risk, Rosiuta coal pit, Romania

1. Geographical location, history and overview of the activities in the coal pit area

Motru municipality is located on Route 67A, 44 km from the city of Tg. Jiu and 42 km from Dr. Tr. Severin, being the second city of size and importance of Gorj county, after Tg. Jiu. It is located at the southern limit of county. City area is 50.09 km^2. The number of resident population of the municipality and villages belonging to Motru is 22 295 inhabitants. Motru city population number is: 18 309.

Roșiuța coal pit is part of Motru Mining Exploitation of coal pits subunit of Oltenia Energy Complex SA, located in the north-west of Oltenia (Oltenia coalfield) and in the south-western county of Gorj, in the north - east of the Motru mining basin on the administrative are of Motru municipality, Roșiuța village and administrative territories of Ciuperceni, Mătăsari and Slivileşti municipalities (figure 1).

Fig.1. Geographical location

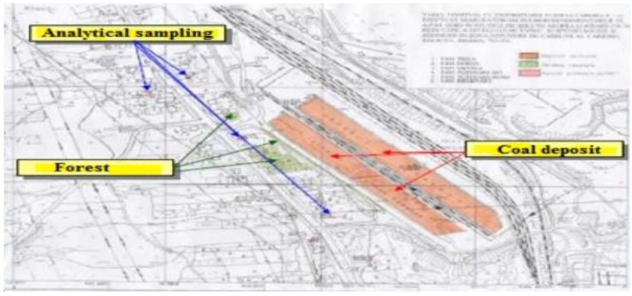

Fig. 2. Rosiuta coal deposit

Placement of Rosiuta coal pit was determined by the existence of large reserves of lignite, with exploitative workings to date (Fodor, D., 1996). Roșiuța coal pit was put into operation in 1969, when the work began with underground mining at a capacity of 1,000 tons/year. In 1980 the stripping work began to open small coal pits works that have continued in the period of 1981-1985. From 1985 until now, the work was carried out in the current lignite pits, with an operating capacity of 3 million tons per year. The exploitation method is to transport the sterile to inner dumps part (Roșiuța) and partly to external dumps (Bujorăscu Mic Ştiucani, Rogoaza). The occupied area is 571 hectares and the calculated reserves until 2020; future development of the business until 2020 has considered the request of lignite domestic assessing the needs of the same traditional customer - Ișalnița power plants and Craiova South, but other

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secondary possible beneficiaries are CET Oradea, CET Suceava etc. and population.

The coal deposit, which serves the coal pit, is located in its perimeter, in Roșiuța, near the DN 67 national road that connects the towns Tg. Jiu - Motru - Dr. Tr. Severin (figure 2).

2. Characterization of population exposure to dangerous substances and dangerous situations

The sulfur dioxide. Adverse effects associated with exposure to elevated concentrations of SO_2 include breathing problems, impaired pulmonary defense mechanisms and worsening cardiovascular disease. Children, the elderly, people with asthma and people with cardiovascular disease or chronic lung disease (chronic bronchitis, emphysema) are the populations most susceptible to adverse health effects associated with exposure to SO_2. Odor threshold is around 0.5 ppm and 6-10 ppm and cause eye irritation, nose and pharynx. SO_2 can cause chronic obstructive pulmonary disease in terms of exposure to high doses. SO_2 causes exacerbations of asthma in individuals with the disease at levels of 0.25 ppm (Fodor, D., 2014).

Nitrogen oxides are absorbed so large airways and small airways. Very high concentrations (> 200 ppm) are very dangerous determining lung damage, pulmonary edema and bronchopneumonia. Lower concentrations affects mucociliary clearance, transport particle, the function of macrophages and local immunity. Headache and respiratory symptoms were reported especially those with preexisting lung disease. In human subjects, exposure to high levels (2-5 ppm) 3:00 causes inflammation in the airways and increased serum IgE-specific antibodies, IgA, IgG and IgE locally. Moderate exposure to NOx 260 ppb (0.260 ppm or 0.490 mg / m3) for 30 minutes non-specific reactivity increases and in 6.6% of cases decreased PEFR in the last phase of the asthmatic reaction to antigen. About 80 ppb levels were associated with a significant increase in acute respiratory infections, angina, common colds and truancy.

Low concentrations of **hydrogen sulphide** is not harmful, but shows an odor. The odor threshold is 1-45 mg/m^3 for people sensitive and higher for those exposed repeatedly. At low concentrations, hydrogen sulfide is oxidized blood passes sulphides and does not accumulate in the body. However, citing the occurrence of liver and kidney in individuals chronically exposed. Can produce effects include ocular conjunctivitis, diseases irreversible eyeball, which is associated with an exposure of 20 ppm. Brief exposure to H_2S, between the limits of 5 to 15 ppm can cause eye irritation, common effects to human and animals (Fodor, D., Baican, G., 2001).

Methane. Basically methane is not a toxic substance that produces adverse effects on the health of the population. There is a study that shows that exposure of human erythrocytes methane and nitrogen can produce their hemolysis. Ruminant methane can produce effects on fatty acids. Methane can cause central nervous system depression on hypoxia (in terms of massive exposure deliberate and/or accidental), and rarely cardiac excitability disorders. Methane combustion can release carbon monoxide (especially under conditions of incomplete combustion) that can be dangerous to health, in spacious dark and stuffy (Lazăr, Maria, Dumitrescu, I., 2006)

Polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals resulting from incomplete combustion processes of coal, oil, gas, wood, organic waste, tobacco and even meat. There are over 100 different PAHs. Solids are colorless, white or yellow-green, average spread in the air, water and soil. Air attaches to the surface of the particles in suspension. They are poorly soluble in water. A total of 17 PAHs are suspected to have adverse effects on health, of which the best known are: acenaphthen, anaceftilen, anthracene, benzantracen, benzopyrene, benzapiren, benzofluoranten, benzoperilen, crizen, dibenzantracen, fluoranthene, fluorene, indenopiren, phenanthrene and pyrene. The most common sources of exposure are inhalation of cigarette smoke, auto exhaust, fumes from burning coal, wood or organic waste from agriculture. The average levels of the atmosphere are estimated around values of 0.02-1.2 ng/m^3 in rural areas and 0.15-19.3 ng/m^3 in urban areas (Dumitrescu I., 2002, 2004).

Noise. Overall noise with its stimulatory effects, indifferent or inhibitors represent a natural component of the environment. Its absence cause an artificial atmosphere of quiet, hard bearable, thanks to a so-called "assault of silence" that under certain conditions of prolonged and repeated exposure manifests its harmful influence on the entire body, especially on organ specific receptor.

3. Measurements carried out in authorized laboratories approved by the legislation for the area to be analyzed - homes near Roșiuța coal deposit

Total suspended particulates - sediment particles. The concentration of emission pollutants in ambient air can vary depending on weather conditions more or less favorable to a good dispersion. According to the environmental authorization number 20 of 19 February 2009 were imposed as conditions:

a) Monitoring of sedimentary powders to monthly limit of functional area locations; the following families: Manescu G., Popescu I., Tutunaru I., Brebinaru Maria, Tutunaru P., Jilavu Ctin, Mihai M.;

b) Monitoring of suspended particles, indicatives measures for the locations; the following families: Manescu G., Popescu I., Brebinaru Maria, Mihai M., Jilavu Ctin;

c) Noise monitoring - determination to the limit area of influence due to the equipment operation and installations in the vicinity of residential areas, for locations: Mănescu G., Popescu I., Brebinaru Maria, Mihai M., Jilavu Ctin.

The monitoring network of air quality in the analysis area for TSP pollutant (total suspended particulates) included in the range from March to August of 2015, 7-point sampling, samples arranged in 7 dwellings (measurements required by the environmental permit No. 20/19.02.2009) of Roșia namely: home of Jilavu, Brebinaru, Carlaont, Mănescu, Mihai Vasilescu and inhabited area of town Lupoaia (neighboring village Rosia). Synthesizing the results appear in Table 3.1.

Tabel 3.1. Synthesizing the results

No.	Sampling point	Month - year 2015	Average concentration of suspended particulates [mg/m^3] determined by short time sampling (30 min)	M.A.Q mg/mc STAS 12574/87	Exceeding the maximum admitted concentration
1	Jilavu residence	march-nov.	0,029	0,50	-
2	Brebinaru residence	march-nov.	0,068	0,50	-
3	Carlaont residence	march-nov.	0,064	0,50	-
4	Manescu residence	march-nov.	0,11	0,50	-
5	Mihai residence	march-nov.	0,076	0,50	-
6	Vasilescu residence	march-nov.	0,091	0,50	-
7	Lupoaia residence area	march-nov.	0,029	0,50	-

Regarding the **particulate sediment**, the monitoring network of air quality in the analyzed area for sediment particles pollutant comprised between January-October of 2015, eight sampling points with samples arranged in 7 residences of Rosia (village neighboring Roșiuța village - Table 3.2).

It follows from that the sedimentary powders are found exceeding the allowable admitted concentration compared to 1.1 - 1.7 times (Eg. 17g / m^2 / month - cf. STAS 12574/1987), charging the atmosphere are due to activities in the coal depot career but heavy traffic due to the increasing number of vehicles and the fact that the deposit is located near national road DN67. From previous studies, the studied risk conducted by INSEMEX Petroșani, it was revealed that - in total lignite dust powdered sediments collected represents 72.85% - 81.73% and the rest is street dust. Given that the coal deposit is not working 365 days/year (there are public holidays, weekends or warehouse is loaded to capacity waiting for delivery etc.) we believe that the admitted concentration/year respectively 200 t/km^2/year is not exceeded.

Table 3.2. Particulate sediment

No.	Sampling point	Month - year 2015	Concentration of particulate sediment [g/m^2/month]	M.A.Q g/m^2/month STAS 12574/87	Exceeding the maximum admitted concentration
1	Tutunaru I. residence	febr. - oct.	26.42	17	1.5
2	Tutunaru P. residence	febr. - oct.	28.16	17	1.6
3	Brebinaru M. residence	febr. - oct.	18.33	17	1.07
4	Manescu Ghe. residence	febr. - oct.	30.37	17	1,7
5	Popescu I. residence	febr. - oct.	26.73	17	1.5
6	Jilavu C. residence	febr. - oct.	11.45	17	-
7	Mihai M. residence	febr. - oct.	18.73	17	1.1
8	Lupoaia - 110 kw power station	febr. - oct.	7.60	17	-

During 2015 systematic measurements were made at different times, locations of measuring the sketch provided by the customer (EMC Motru), monitoring of noise being made in seven sample points, respectively:

- 34 - 3 m from the house facade of Jilavu Constantin, Roșiuța village, in the direction of the noise source - facility drive strip 2 motors of 630 kW, located approximately 100 m; secondary noise source - coal transport lanes;
- 35 - 3 m from the house facade of Brebinaru Maria, sat Roșiuța (near national road Tr.Severin - Motru - Tg-Jiu) direction noise source - driving lane facility with two 630 kW engines and excavators in operation near coal deposit, located approximately 50 m from the point of measurement;
- 36 - 3 m from the house facade of Carlaont, Roșiuța village, direction noise source - plant drive motor 630 kw + excavator commissioned in the coal deposit, Roșiuța coal pit;
- 37 - 3 m from the house façade of Mănescu Ghe., Roșiuța village perpendicular to the noise source - systems drive strip with 2 motors of 630 kW at about 25 m from the point of measurement;
- 38 - 3 m from the house of Vasilescu, Roșiuța village direction noise source - coal transport lanes shareholders located approximately 50 m from the point of measurement;
- 39 - 3 m from the house of Mihai Mihai, Roșiuța village direction noise source - coal warehouse equipment (coal conveyor at about 50 m from the point of measurement;

- 40 - 3 m from the house facade, Lupoaia inhabited area, the direction of the noise source - coal transport strip above the forest edge at about 150 m of measuring point;

Identification and location of the main sources of noise fixed and mobile were made by noise measurements at various points, measurements conducted using the methodology prescribed by urban noise monitoring 10009/88 and STAS STAS 6161/1 - 2008. The data monitored by the EPA Mehedinți, indicator noise outside homes, measured at 3 meters away from inhabited buildings facade, with the microphone at a height of 1.5 m from the ground, perpendicular to the noise source considered for each measurement point in part, it appears that there is exceeding the permissible noise limits imposed by OM no. 536/1997 of 50 dB (A) in daylight (See table no. 3.3.). Limit of 40 dB (A) at night does not exceeded, so it is not adversely affected by industrial activity in the area. It is mentioned that the noise source is the auto transport lignite factories on the road and partially on the national road DN 67. To reduce the risk of environmental emission of dust and noise on some farms in the vicinity of deposit must be taken the following measures: *House decommissioning* for the environmental risk was assessed as significant, namely those between DN67 and Roșiuța coal deposit (no. 60 - Tricia Arista, No. 58 - Manescu Melania, nr. 51 - Carlaont I., no.50 - Popescu I., No. 49 - Nițoi M., No. 48 - Nițoi Elena, nr. 47 - Brebinaru Maria, No. 45 - Nebunu B.). *Combating pollutants* (dust and noise) from generating sources in compliance with the program of inspections and repairs and maintenance during combat existing protective systems. *Building and planning* a wave of land between the deposit and the road.

Table 3.3. The results of noise measurements - inhabited houses from Roșiuța and Lupoaia village

Point no.	Measurement point	Leq limit, dB(A) OMS 536/1997	Noise level dB (A)		
			Leq	Leq (without traffic)	Leq (with traffic)
1	3 m away from the house's facade of Jilavu Constantin	50 (40)	64	-	-
2	3 m away from the house's facade of Brebinaru Maria	50 (40)	-	63	74
3	3 m away from the house's facade of Carlaont	50 (40)	-	50	59
4	3 m away from the house's facade of Manescu Ghe	50 (40)	-	65	65
5	3 m away from the house of Vasilescu	50 (40)	-	62	64
6	3 m away from the house of Mihai Mihai	50 (40)	-	61	63
7	3 m away from the house's facade, Lupoaia resident area	50 (40)	48	-	-

Conclusions and proposals

In the previously studies conducted by ICSITPML Craiova and INCD INSEMEX Petrosani, in terms of environmental risk, it has been proposed solutions and measures for reducing particulate matter pollution and sediment particles and noise. Many of these solutions have been implemented by EMC Motru, reducing significantly the concentrations of particulate matter (measurements made in 2015 did not register any exceeding of allowable CMA), also compared with 2011 dust concentrations sediment (which are non-toxic) measured were lower in 2015, even if it hasn't been reduced below allowable limits. It is believed that after the decommissioning of the eight households (Eg. Trica A., Manescu M., Carlaont I. Popescu I., Nitoi M., Nitoi E., Brebinaru M. and Nebunu V.) and achieving the wave of earth, which will isolate the coal deposit from DN67, the pollution with dust will be significantly reduced.

Among the unrealized measures, we state: installation of sound-absorbing panels to the deposit's limit and use of fog curtains in points of load-discharge of the machineries for coal dumping. Furthermore, the efforts will be made from EMC Motru, the reduction of these pollutants by solving the "step-by-step" goals of the compliance program.

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Accident risk assessment for three working places from an industrial assembly workshop

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Abstract

Knowing the level of risk enables decision makers to act effectively on the preventive side of Occupational Health and Safety. This paper contains a partial assessment of the risk of accidents and professional diseases for a number of three jobs at a polling repair machinery workshop. Also it is briefly described the method that was used for this risk assessment by analysing the situation at the risk assessment date: technical equipment, staff workload, environmental conditions, workload of staff.

Keywords: knowledge, occupational risk, risk assessment

1. Introduction

The starting point in the optimization activity to prevent work accidents and occupational diseases in a working system is represented by risk assessment of that system. Whether it is a workplace, a workshop or a company, such an analysis allows to hierarchy risks according to their size and efficient allocation of resources for the priority measures (Moraru and Băbuţ, 2002). Risk assessment involves the identification of all the risk factors within the analyzed system and the quantification of their size based on the combination of two parameters: the severity and frequency of maximum possible consequence impact on the human body. Thus obtained partial risk levels for each risk factor, respective the global risk levels for entire analyzed system (Moraru, 2012).

From the multitude of methods used internationally and nationally for risk assessment of occupational accidents and diseases, I opted to use the method developed by I.N.C.D.P.M. Bucharest. The method developed by I.N.C.D.P.M. Bucharest belongs to the category of analytical, semi-quantitative methods and consists, essentially, in the identification of all the risk factors in the analyzed systems (workplace) using preset checklists and quantifying risk dimension for each risk factor, based on the combination of severity and frequency of the maximum foreseeable consequence. The overall risk level, on workplace, is determined as the weighted average of the partial risk levels, so that any compensation should be minimal. The level of security also resulting indirectly is inversely proportional with the level of risk. In the first part of the paper is presented a description of the method developed by I.N.C.D.P.M. Bucharest. The second part contains the analysis of risk levels overall values for three workplaces in an assembly workshop of a liability company.

2. Theoretical basis of risk assessment

The notion of risk is defined in the literature through the probability by which in a working process accident or occupational disease occurs with a specific frequency and gravity of consequences (Cioca and Moraru, 2012). Risk factors are characterized by risk level - a conventional indicator which expresses synthetically and cumulative the size of injury and / or occupational diseases risks existing in the system (Cioca et al, 2009). Is mentioned that it is not possible a strict delimitation the risk factors of injury and the risk factors of occupational disease the only difference

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being the level and duration of exposure to the body, so that a factor of disease can become a factor of injury and vice versa (Moraru et. al 2014). Principle of the method applied consists of:

- Identification of the main risk factors based on pre-established checklists for each workplace through a detailed analysis of each job activity according to the four elements of the work system;
- Establishing the consequences of action on the victim, including their gravity;
- Establishing the probability of risk factors on the executor;
- Assigning the level of risk depending on the gravity and probability of the consequences of risk factors;
- Quantifying and ranking the risks.

The main basis for risk assessment consists of taking into account two parameters: frequency of accidents and the severity of the maximum foreseeable consequence (principles included in European standards). The method used is the only one which establishes the involvement of each element of the work system in the risk level value existing within a particular activity.

Risk assessment of accidents and / or occupational disease involves 3 stages:

Stage 1 – systematic analysis of the activities set out in order to identify the risk factors dependent on the four components of the work system:

- Means of production;
- Work environment;
- Work task;
- Executor.

Means of production – the totality of work means - technical equipment - and work objects - raw materials, etc., which are used in the work process;

Work environment – all of the physical, chemical, biological and psychological conditions, where one or more executors carrying out their work task;

Work task – all of the actions to be carried out through the means of production and in certain environmental conditions by the executor, to carry out the work process;

Executor – the man directly involved in carrying out a work task.

Workplace accidents are random events that occur at dysfunction (deviation from normal) of the four elements of the work process. Work accident involves the interaction of at least two causes: one subjective and the other objective, only thus can take place the impact between the victim and material which affects the human body. The analysis was done thorough detailed examination of activity at the workplace with the participation of heads of operations, taking into account the existing situation at the date of the assessment (technical equipment, the utilization of technical equipment, the existing personnel, environmental conditions, work task of personnel).

Stage 2 – Establishing the risk of accidents and occupational diseases in identified activities, using the scale for severity and probability of occurrence a work accident or occupational disease, risk assessment grid and scale for the classification of risk level. Rating scale of severity of the consequences is based on medical criteria of clinical diagnostic, functional and work capacity assessment. The severity of consequences on the executor falls into seven classes of severity: negligible, minor consequences, temporary work incapacity for 3 to 45 days, 45-180 days, disability grade III, II, I and death. In assessing the risk level is taken into account the foreseeable maximum severity. The probability scale of occurrence the maximum foreseeable consequence is assimilated to European Union standards.

Probability class is from 1 (extremely rare consequences) to 6 (very common). In determining the probability of risk action is taken into account the number of people exposed, the number of accidents and occupational diseases registered in a given period and the technicality level of the workplace (activity) rated. The risk assessment grid brings together in the form of a matrix with 7 rows and 6 columns the severity classes and probability of occurrence the maximum foreseeable consequences.

Stage 3 – establishing the global risk level for each activity analyzed, based on the calculation formula given below. The global risk level (*Nr*) for each activity analyzed is calculated as a weighted average of the risk levels established for the identified risk factors.

The formula for calculating the global risk level is:

$$Nr = \frac{\sum_{i=1}^{n} r_i \cdot R_i}{\sum_{i=1}^{n} r_i} \qquad (1)$$

where:

Nr : is the global risk level of the occupational system;

Ri : the risk level for the risk factor *i*

r_i: the risk factor rate i

n : the number of risk factors identified in the occupational system.

The level of security (Ns) for a job is identified on the "scale of risk/security levels "established on the principle of inverse proportionality between risk and security levels. Unlike other methods, the method used has the advantage of identifying all injury risks existing in the workplace and seriousness of their action on the human body, allowing the ranking of all actions to prevent accidents or occupational diseases by taking measures to avoid each risk. The results of evaluations are summarized in" Assessment sheet", centralizing documents of the risk factors identified and quantified. It is noted that the risk level scale is from 1 to 7, the level 7 representing a critical level at which the security is minimal. In this limit the conduct of work process can no longer be held, being equivalent to accident/occupational disease.

It is considered an acceptable risk level of 3.5; over this amount will be required to take technical and/or organizational measures for its reduction, depending on the work system element that contributes to overcoming.

3. Case study for three working places from an industrial assembly workshop

In this paper have been identified and evaluated the risks of accidents and occupational diseases for professions: Mechanic; Welder; Turner.

i) Mechanic: performs periodic repairs to work equipment in the workshop area. Mechanical repair department is equipped with workbenches, grinder, drill machine, tool and utensils, lockers for subassemblies storage. In the work of maintenance - repairs possible risk of accidents are: machinery, parts, subassemblies with discharging and moves in the workshop; the existing equipment in repair workshop, the way that repairs is performed (Cioca and Cioca, 2014). Work task repair works is performed only by qualified and trained personnel. The main components of work task are: disassembly, cleaning, checking and fixing component parts of technical equipment, (Fig. 4). The work environment is characterized by noise, physical and chemical pollutants released during the performance of work task.

ii) Welder: performs electric welding works in the workshop area. For electric welding the welder is equipped with welding generators and power transmission cable; pliers port-electrode; accessories (wire brush, welding hammer, protective equipment), (Fig. 5). Work environment – environmental conditions are characterized by the presence of particular pollutants arising during the welding process (nitrogen oxides, iron oxides, carbon oxides, ozone). Physical pollutant - electrolyte powders, metal powders resulting from preparation of the welding surfaces, various powders existing in the workplace. High temperature and ultraviolet radiation, noise. Work task: the welding works are performed by qualified personnel. The main components of working task are preparing surfaces to be welded through cleaning, chamfering and welding.

iii) Turner: performed cutting operations of different metal components necessary to repair and maintenance of technical equipment. Work environment – is characterized by the presence of noise generated during the processing of metals, presence of metal powders and aerosols of oil (emulsion), (Fig. 6). Centralization of data in risk assessment sheets for the three studied professions (Fig. 1, Fig. 2, Fig. 3), we have the following results:

Table 1. The global risk level (*Nr*) for the studied professions:

MECHANIC	$N_r = \frac{\sum_{i=1}^{58} r_i R_i}{\sum_{i=1}^{58} r_i} = \frac{5(5\times 5)+10(4\times 4)+27(3\times 3)+16(2\times 2)}{2\times 5+12\times 4+22\times 3+16\times 2} = 3{,}33.$
WELDER	$N_r = \frac{\sum_{i=1}^{35} r_i R_i}{\sum_{i=1}^{35} r_i} = \frac{4(4\times 4)+22(3\times 3)+9(2\times 2)}{4\times 4+22\times 3+9\times 2} = 2{,}98$
TURNER	$N_r = \frac{\sum_{i=1}^{35} r_i R_i}{\sum_{i=1}^{35} r_i} = \frac{4(4\times 4)+19(3\times 3)+8(2\times 2)}{4\times 4+22\times 3+9\times 2} = 3{,}18$

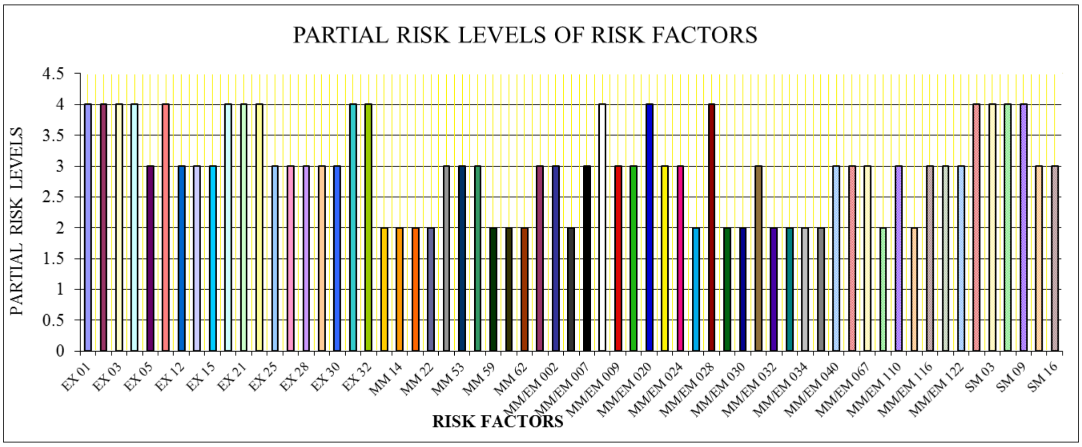

Fig. 1: Mechanic - Partial risk levels of risk factors

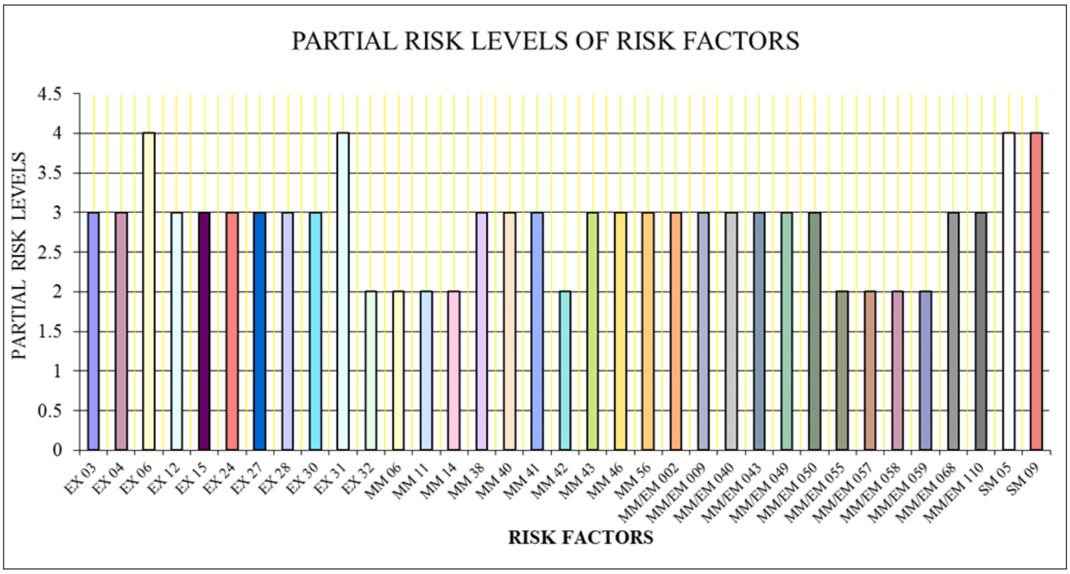

Fig. 2: Welder - Partial risk levels of risk factors

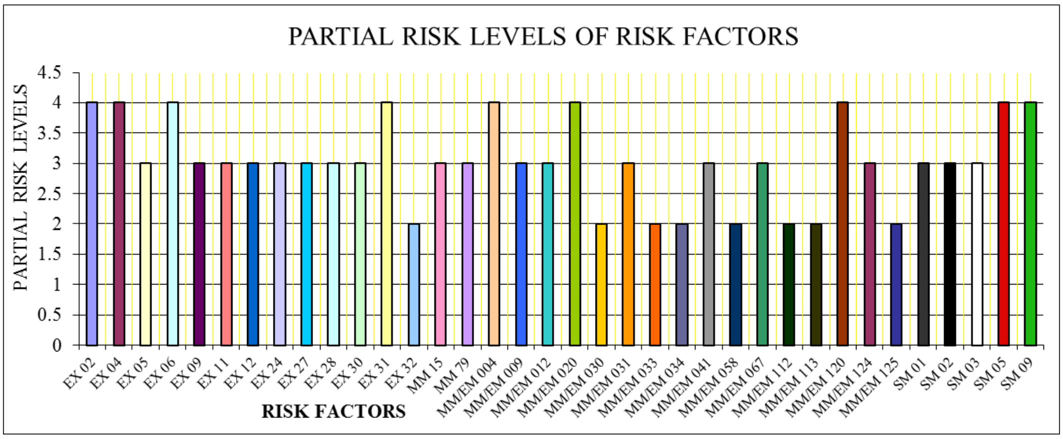

Fig. 3: Turner - Partial risk levels of risk factors

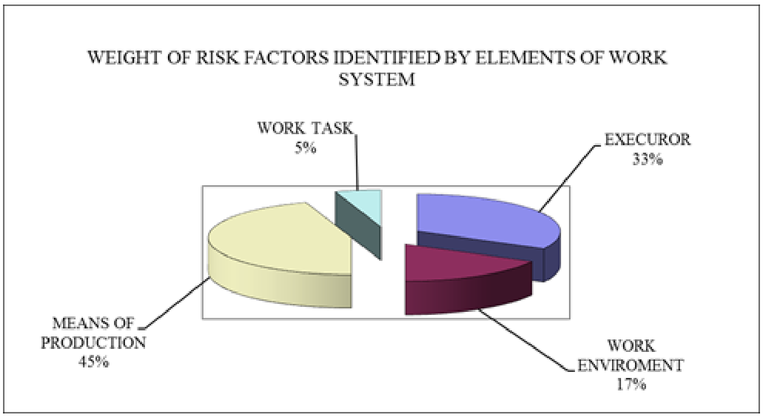

Fig. 4: Mechanic - Weight of identified risk factors

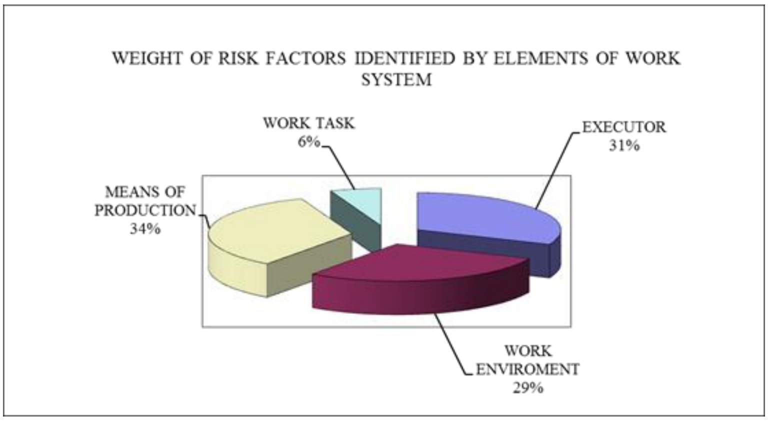

Fig. 5: Welder - Weight of identified risk factors

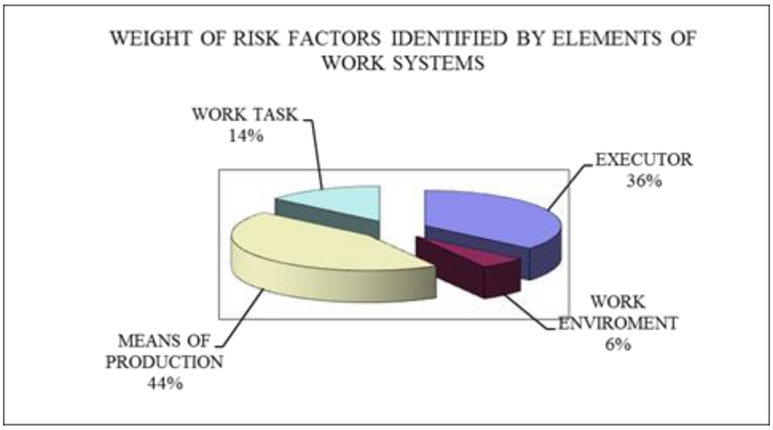

Fig. 6: Turner - Weight of identified risk factors

4. Conclusions

Knowing the risk level allows company management to act effectively on the preventive side.

Identification of injury risks (Fig.1, Fig.2, Fig.3), was made in the presence of leaders, through the analysis of existing situation at the time of the assessment: technical equipment, environmental conditions, work task.

Following the assessment of global risk level on three analysis profession (mechanic, welder, turner), the section Repair resulted the value $N_g = 3$.

Risk level scale is from 1 to 7, the level of acceptable risk being 3.5 - above this value is necessary to provide organizational and technical preventive measures to reduce at the most reasonable possible level in the existing conditions.

Considering that the risk level values is less than 3.5 shows that in Repair department there are prerequisites for working in safe conditions. It must not forget that respecting the law, rules and workplace instructions / professions should be a constant concern of the company leaders.

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Study on concentrations of pollutants in flue gases generated by the production of ceramic building materials

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Abstract

Emissions from industrial plants, including those producing ceramic building materials (bricks, tiles, etc.) represent a considerable share of key atmospheric pollutants total emissions having significant environmental effects. Large volumes of flue gases and dust are continuously and constantly released into the atmosphere through exhaust chimneys of heat treatment facilities. As a result, righteously, these plants are considered to be major stationary sources of anthropogenic emissions, which according to Law 278/2013 must be monitored. In this respect, given the importance of actions to reduce pollution at national level, traders producing ceramic building materials are bound by the environmental permit to monitor gas concentrations in effluents, through discontinuous measurement. This paper presents the assessment of environmental impact generated by production of ceramic building materials and its effects on the local population. Depending on the specific production processes, plants manufacturing ceramic products cause emissions that are discharged into air, water and soil (waste). Type and amount of air pollution depend on different parameters, such as raw materials being used, auxiliaries, fuels and production methods. The trader where emission measurements were taken gas used mari clay and fire clay as stock for manufacturing bricks, tiles and other construction products and the fuel used in thermal process is natural gas. This paper is a summary of a scientific study based on the European Directive 2010/75/EU and Law 278/2013 on industrial emissions that refer to limiting greenhouse gas emissions into the environment.

Keywords: environment; impact; gas emissions; pollution

1. Generalization

Usually the term 'ceramics' (ceramic products) is used for inorganic materials (with possibly some organic content), made of nonmetallic compounds made permanent by a burning process. In addition to clay-based materials, current ceramics also include a plurality of products with a small fraction of clay or not at all. Ceramics can be enameled or matte, porous or vitrified. Burning ceramic products leads to time-temperature transformation of minerals components, usually in a mixture of new minerals and vitriform phases. Characteristic properties of ceramic products include high strength, wear resistance, long life, chemical inertia and lack of toxicity, resistance to heat and fire, (usually) electrical resistance and sometimes also a specific porosity. Nowadays environment protection must be treated as a major issue of communities due to the desire to exploit natural resources to increase comfort, which always affect the environmental condition. From the perspective of environmental protection, the most important area of human activities is industry. Industrial development hasn’t had in mind that the actual progress of human society depends not only on the goods it offers, but also on the environmental damage caused (Ciolos, 2012).

Through its various branches industry impacts all environmental factors (air, water, soil, flora, and fauna), causing damage to human health, property or the environment. (Marinescu, 1985).

At EU level, the legal framework for industrial emissions is covered by Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control). This European regulation is the result of bringing together seven directives into one. Main issues brought in by Directive 2010/75/EU consist in extending the scope of the Directive to include new activities in its Annex 1, obligation to apply the conclusions on best available techniques,

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imposing more stringent emission limit values for some pollutants and specific inspection and control rules for covered activities. (Kovacs. 2011). Directive 2010/75/EU was transposed into national legislation by Law 278/2013 which repeals several laws, government decisions and orders.

2. Industrial pollutants emissions into the environment

Depending on the specific production processes, plants manufacturing ceramic products cause emissions that are discharged into the air, water and soil (waste). Type and volume of polluted air, waste and waste water depend on different parameters such as raw materials, auxiliaries, fuels and production methods:

• Air emissions: particulate matter / dust, soot, gaseous emissions (carbon oxides, nitrogen oxides, sulphur oxides, inorganic fluorine and chlorine compounds, organic compounds and heavy metals) may result from manufacture of ceramic products;

• Water emissions: wastewater from the process mainly contains mineral components (insoluble particles) and other inorganic materials, small quantities of numerous organic materials as well as certain heavy metals;

• Dissipations from process / waste: waste in from the manufacture of ceramic products mainly consist of various types of sludge, broken products, worn plaster molds, outworn sorption agents, solid residues (dust, ashes) and packaging waste;

• Energy consumption / CO_2 emissions: all ceramic industry sectors are great energy consumers, as an important part of the manufacturing process involves drying followed by burning at temperatures between 800° and 2000° C. At present, natural gas, liquefied petroleum gas (propane and butane) and EL fuel oil are mainly used for burning, while heavy fuel oil, liquefied natural gas (LNG), biogas / biomass, electricity and solid fuels (e.g. coal, petroleum coke) can play a role as energy sources for burners.

Manufacture of ceramic products (figure 1) takes place in different types of furnaces, with a wide range of raw materials in many shapes, sizes and colors. However, the general procedure for t manufacture of ceramic products, is fairly uniform, and in addition, when manufacturing ceramic floor tiles and crockery, household ceramic, sanitary items and technique ceramic often is used a process of combustion in more steps.

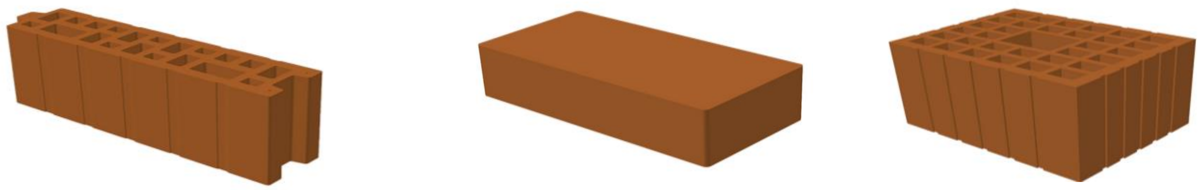


Fig. 1 Ceramic items

Usually, raw materials are mixed and cast, pressed or extruded into shape. Water is regularly used for thorough mixing and shaping. This water is evaporated in dryers and the products are either manually placed in the oven - especially in wagon type furnaces operated periodically - or are placed on wagons that are carried through tunnel furnaces or on roller bakestones operated continuously. Rotary furnaces are used for manufacturing expanded clay aggregates.

During the combustion, a very accurate temperature gradient is needed to ensure that products are handled correctly, following the controlled cooling so that products may gradually eliminate heat and keep their ceramic structure. All industrial activities affect to a lesser or greater degree all environmental factors, creating phenomena of pollution and environmental impact, almost every technological process being carried out as shown in fig. no. 2.

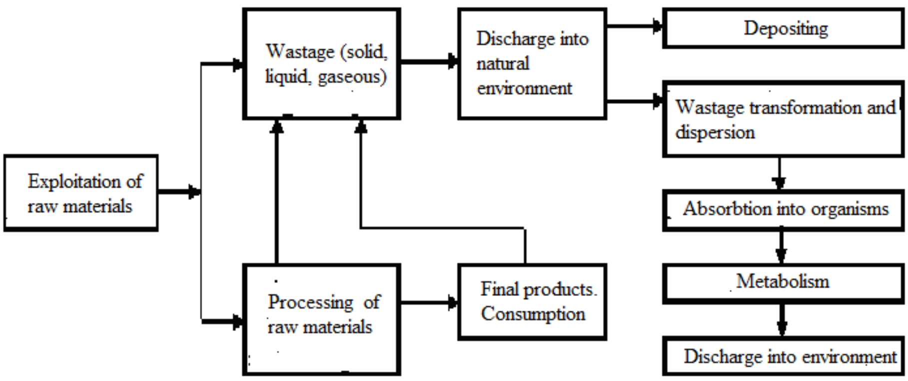


Fig. 1 Interaction between industrial processes and environment

3. Technological ceramics production phases

Investigations conducted in this paper were carried out in Gorj County, at a plant for manufacturing ceramic products by burning, in particular roofing tiles, bricks, refractory bricks, tiles, ceramic or porcelain products, with a production capacity exceeding 75t / day / CAEN code: 2332 - Manufacture of bricks, tiles and other construction products. Raw clay from the area of the coal deposit cover from Rovinari is the raw material. Qualitative characteristics of the raw material used to manufacture ceramic products are determined by analyzes carried out in approved laboratories. The oxide chemical composition highlights the material homogeneity; main constituents of these clays (silica, alumina and carbonate components) have the characteristic proportions of easily fusible clays with marl composition; size composition shows fine texture clay, suitable for manufacturing thin-walled ceramic products and tiles.

Main technological stages

1. **Preparation of the material.** Clay is extracted from lignite pits, from the area of coal deposits cover run by S.N.L. Oltenia, is loaded into vehicles and transported to the buffer warehouse. Clay is gradually discharged into the bowl feeder box via a relay of belts and transported in preparation station, where the crushing- mixing process takes place.
2. **Preparation**. Raw material, respectively clay, is taken from the warehouse for homogenization and then passed through a crusher where it is shredded, passing through a coarse roller where it is laminated to 2 mm, after which it is transported to the mixer where humidity is regulated by input of process water, followed by another lamination sing the fine roller where it is brought to a size of 1 mm. The process continues with dosing the quantity of clay and its transportation to the mixer and the press.
3. **Molding.** In the press, clay takes the form of the desired product by extrusion and product dimensions are achieved through cutting.
4. **Handling of raw products**. From the cutting table, the products are taken to charging columns and through metal grates they are deposited on the drying wagons.
5. **Drying.** The drying tunnel consists of 6 drying lines, each with a capacity of 16 wagons, carrying out a drying cycle of approximately 28 hours, bringing the products from a moisture content of 20% to 4%.
6. **Handling dry products**. Coming out of the dryer, wagons carrying dry products are transported to discharge columns where dry products are unloaded and placed on furnace wagons. All operations are executed automatically.
7. **Burning the products**. The new line produces only ceramic blocks, respectively large elements with void volume up to 50% of the total volume of the element. The capacity is 400 tons of product / day. Tunnel furnace has a length of 141 m, with a 30 hours combustion cycle and burning capacity of 400 t / day. The process includes introducing wagons with dry products at a rate of 23 wagons / hour covering the following areas: preheating, burning, fast cooling, cooling to room temperature, and exhaust to unloading / wrapping facility. Burning is achieved using natural gas as fuel. In the product cooling zone there is facility for the recovery of hot gases and heat from flue products that redirects them towards the dry house, being used for drying products.

4. Case study on gaseous pollutants generated by ceramic products burning furnaces

In order to monitor air quality, INCD INSEMEX Petrosani staff conducted in 2012-2013 gas determinations related at furnace chimneys of a factory producing ceramics in Gorj County. The ceramics factory under study has to monitor the following emission indicators: carbon monoxide, nitrogen oxides, particulates and sulphur oxides both at the tunnel furnace and at the ceramic products drier.

The method for measuring gaseous components in industrial emissions is the direct method using a numeric display multigas apparatus. The test method consist of measuring concentration of gases sampled from emissions from stationary sources (industrial chimneys, pipes), using the Testo 350XL equipment.

The Testo 350 XL multigas analyzer is composed of the sampling probe, analysis unit and control unit Fig. 3 (A, B, C). Samples are taken with the help of an internal pump unit and gas is cooled to 4-8° C on the suction route, water vapors being condensed with the direct result that NO_2 and SO_2 have the lowest humidity absorption. Condense is pumped to the desiccator installed in the equipment's body.

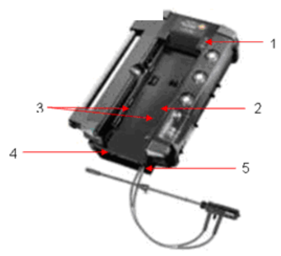
Dry gas is passed through filters designed to retain suspensions. The filters are also meant to retain water vapors. If the filters are water logged, their pores are closed and protect the pump and internal sensors. A very small part of the gas passes through to sensor membranes where gas concentration is converted into an electrical signal, excess gas being removed.(M. Kovacs 2013)

For sampling gaseous effluents a stainless steel metal probe is used, provided with an inside thermocouple for measuring effluent temperature.

Analysis and control unit is comprised of:

- Sampling pump - having the role of extracting a sample from the chimney / tube through the sampling system (probe);
- Primary filter for retaining particles with a diameter greater than 10 micrometers (fitted at the tip of the sample probe), which will be cleaned after each measurement to avoid reactions between condensation and gases measured which would lead to erroneous results;

- Secondary filter to remove dust to protect the pump (analyzer). This is included in the sampling line on the probe. This filter will be used to retain particles with a diameter greater than 1 μm.
- Device for removing water vapor that works on the principle of water vapor condensation / cooling;
- Measuring cells, which are intended to produce an electro-optical or chemical response corresponding to gas concentration.



A. Multigas analyser B. Control unit C. Logger

Figure 3. TESTO 350 XL multigas analyser

A.
1 Control unit
2 Logger
3 Sampling probe

B.
1 Printer
2 System bar
3 Screen
4 Function bar
5 Function keys
6 Commutation keys
7 Network connection
8 PC interface

C.
1 State led
2 Attachment
3 Direct contacts
4 Connexions
5 Sampling probe

The results of concentrations of gases emitted into the atmosphere in accordance with to regulations are shown in Table 1.

Table 1

No.	Location /Installation name /Technologic flow	Measured component	Average value [mg/m^{3}N]	Maximum value [mg/m^{3}N]	Observations (conditions of the process from which residual gases result)
1	Discharge chimney –Present (old) line	NO_x	175	216	$T_{ambiental}$ = 18,3 ºC $T_{efluent}$ = 112,1 ºC $P_{ambiental}$ = 986,8 mbar CO_2 = 1,45 %vol O_2 = 18,26 %vol $V_{efluent}$ = 1,59 m/s
		SO_2	1951	3679	
		CO	723	780	
2	Discharge chimney - New line	NO_x	396,0	480,9	$T_{ambiental}$ = 21,5 ºC $T_{efluent}$ = 64,3 ºC $P_{ambiental}$ = 986,3 mbar CO_2 = 3,02 %vol O_2 = 17,08 %vol $V_{efluent}$ = 1,82 m/s
		SO_2	1813,8	2626,5	
		CO	5033,8	5676,7	
3	Discharge chimney –Present (old) line	NO_x	197	243	$T_{ambiental}$ = 17,8 ºC $T_{efluent}$ = 143,7 ºC $P_{ambiental}$ = 979,2 mbar CO_2 = 1,79 %vol O_2 = 17,81 %vol $V_{efluent}$ = 1,59 m/s
		SO_2	1428	2418	
		CO	324	394	
4	Discharge chimney - New line	NO_x	9070,2	11104,8	$T_{ambiental}$ = 23,5 ºC $T_{efluent}$ = 51,1 ºC $P_{ambiental}$ = 979,0 mbar CO_2 = 1,38 %vol O_2 = 18,62 %vol $V_{efluent}$ = 3,42 m/s
		SO_2	4908,4	7487,4	
		CO	13310,9	20675,4	
5	Flue gases chimney –new furnace	NO_x	499	736	$T_{ambiental}$ = 29,9 ºC $T_{efluent}$ = 119,8 ºC $P_{ambiental}$ = 992,2 mbar CO_2 = 2,0 %vol O_2 = 18,18 %vol $V_{efluent}$ = 7,84 m/s
		SO_2	0	51	
		CO	4286	4738	

6	Flue gases chimney –old furnace	NO_x	123	165	$T_{ambiental}$ = 34,0 ºC $T_{efluent}$ = 137,9 ºC $P_{ambiental}$ = 991,3 mbar CO_2 = 2,0 %vol O_2 = 17,68 %vol $V_{efluent}$ = 6,9 m/s
		SO_2	0	22	
		CO	859	953	
7	Discharge chimney old drier	NO_x	0	0	$T_{ambiental}$ = 38,3 ºC $T_{efluent}$ = 46,5 ºC $P_{ambiental}$ = 991 mbar CO_2 = 0,0 %vol O_2 = 20,67 %vol $V_{efluent}$ = 3,7 m/s
		SO_2	0	0	
		CO	0	0	
8	Discharge chimney new drier	NO_x	114	186	$T_{ambiental}$ = 37,5 ºC $T_{efluent}$ = 30,9 ºC $P_{ambiental}$ = 988 mbar CO_2 = 1,0 %vol O_2 = 20,30 %vol $V_{efluent}$ = 10,86 m/s
		SO_2	48	97	
		CO	20	54	

Chart no. 1 - Graphic representation of NOx concentrations for discharge chimneys

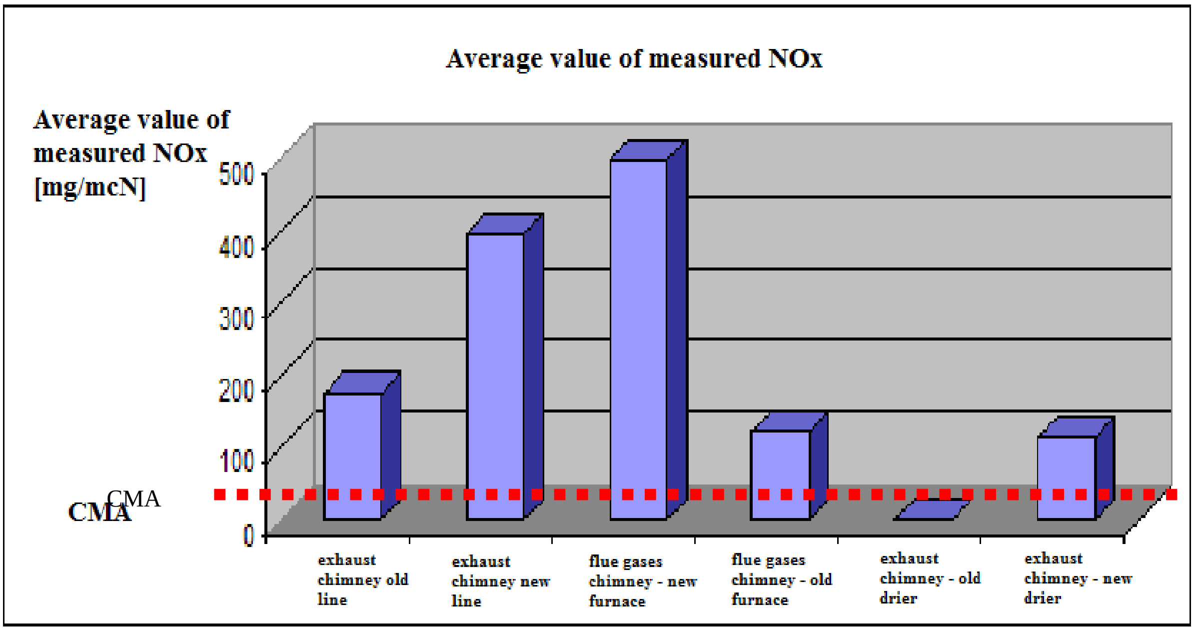
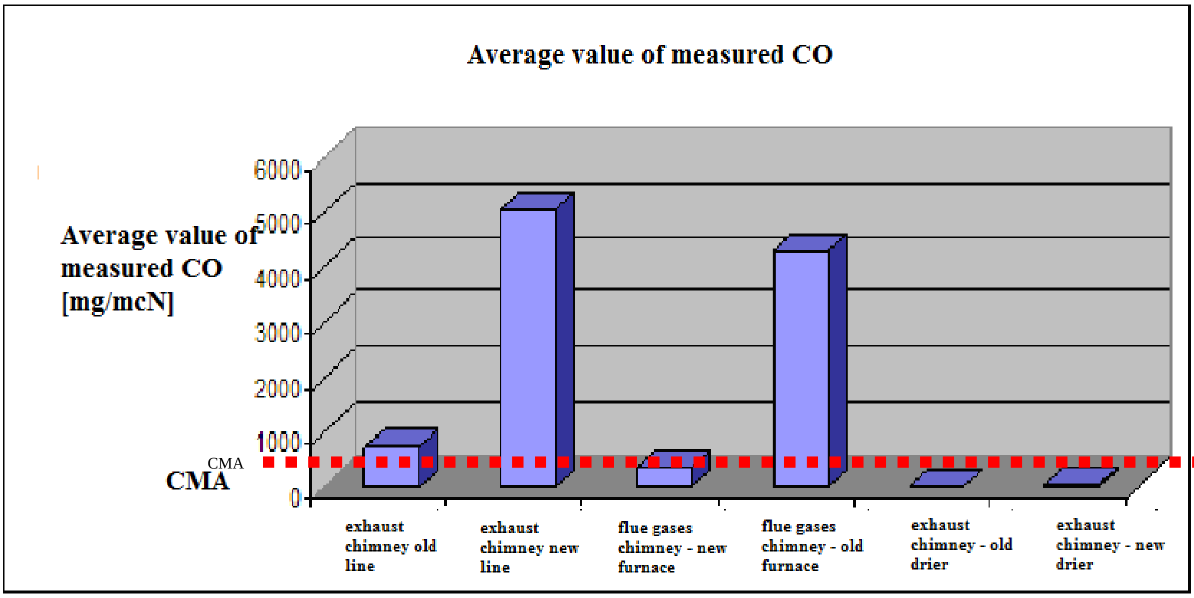


Chart no. 2 - Graphic representation of CO concentrations for discharge chimneys



Analyzing results presented in Table. 1 and graphs no. 1 and 2, shows the following:
- For NOx the emission limit value (stipulated by Law no. 278/2013) is exceeded up to 111 times, levels recorded at the flue gas chimney at the new furnace;
- For CO the emission limit value (stipulated by Law no. 278/2013) is exceeded up 206.7 times, levels recorded at the flue gas chimney at the new furnace; (Directive 2010/75/EC, Law no. 278/2013)

5. Conclusions

Following the measurement of pollutants from flue gases generated by the production of ceramics in order to assess the environmental impact and their effects on the local population the following conclusions resulted:

- Periodic measurements of emissions from stationary sources are widely used, particularly where automated measuring devices aren't available for permanent installation, or when automatic measuring systems are considered inadequate for technical reasons or because of the costs. Monitoring of air pollutants emissions are carried out mainly for checking compliance with the concentrations limit values set by applicable law or environmental permits.
- The fuel used for burning ceramic products is natural gas. Through chimneys, furnaces in the ceramics industry into the atmosphere are (continuous and constant) emitted large volumes of flue gas containing concentrations of polluting gases.
- Significant concentrations of SO_2 are found in the exhaust gases, and these are not standardized in national laws for combustion plants using natural gas. The emergence of sulphur dioxide in the exhaust gases is explained by the fact that the raw material is clay containing sulfur (clay pits derived from lignite).
- In order to prevent and improve air quality in order to avoid adverse effects on human health and the environment as a whole, an important role is played by compliance of activities and facilities to European legislation in the field of atmosphere protection, respectively Directive 2010/7 /EU on industrial emissions (integrated pollution prevention and control), transposed into national law by Law 278 /24.10.2013.
- Due to high concentrations of flue gas emissions generated by the production of ceramics, large imission concentrations are transferred to residents in the area, affecting air quality in neighboring areas.
- In conclusion, manufacture of ceramic products in Gorj County should adopt a system that integrates several variables, namely: competitiveness, economic growth, respect for the environment and quality of life through different short, medium and long term approaches.

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*** Directive 2010/75/EC on industrial emissions

* * * Law no. 278/2013 on industrial emissions

* * * Law no. 104/2011 on ambient air quality

*** Order No. MAPPM. Technical 462/1993 on atmosphere protection

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Classification metodology of underground mining activities at Targu Ocna salt mine, in terms of gas emissions

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Abstract

According to the new classification methodology, salt mines and underground workings or parts of them, where the presence of methane in the underground atmosphere wasn't ascertained, but where in the advance boreholes drilled in the massive rock methane is found, are considered to be gassy mines/ mine areas or underground workings. This new classification system allows classifying only the actual operating areas (coal faces) as gassy the other part of the salt mine being considered un-gassy mine. The purpose of this paper is to establish the scheme of methane emissions (explosive gas) as well as carbon dioxide emissions (asphyxiating gas) in underground workings of Targu Ocna salt mine/ parts of the mine, in order to perform their classification.

Keywords: classification, methane emissions

1. Introduction

The purpose of this paper is to establish the scheme of methane emissions (explosive gas) as well as carbon dioxide emissions (asphyxiating gas) in underground workings of Targu Ocna salt mine/ parts of the mine, in order to perform their classification. The need for a new classification has emerged with the invalidation of ,,Occupational Safety Norms for Salt " and of ,, Labor Protection Law No. 90/1996 " and the emergence of ,, Safety and Health at Work Law No. 319/2006 ".

For elaborating this paper the following components were taken into account:

- Geological, technical and mining conditions of salt deposits in Targu Ocna mining area;
- Records and documentation regarding previous occurrences of gases and their manifestation;
- Results of quantitative and qualitative measurements of underground workings on:
    a) circulating flows;
    b) concentrations of methane and carbon dioxide;
    c) recordings of absolute flows;
    d) gas storage capacity;
    e) gas concentration and pressure in the massif.

According to the new classification methodology, salt mines and underground workings or parts of them, where the presence of methane in the underground atmosphere wasn't ascertained, but where in the advance boreholes drilled in the massive rock methane is found, are considered to be gassy mines/ mine areas or underground workings.

This new classification system allows classifying only the actual operating areas (coal faces) as gassy the other part of the salt mine being considered un-gassy mine.

2. General considerations on the reservoir and the mining area geology

Mine workings servicing Targu Ocna salt mine are placed in the Fetele Tirgului salt massif, near the town of Tg. Ocna, on the left bank of the Trotuş river. Geologically the region is located in the area of contact between the medial marginal unit of Miocene and the extreme unit of this geological formation. Rock salt deposits from Targu Ocna are

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represented by early Miocene deposits which, because of internal tectonic form a crease with salt, so that in both salt floor and roof occur early Miocene salt deposits. The salt massif is predominantly homogeneous having some sterile insertions (clay, marl and impure salt). A sterile insertion was identified at the level of horizon III, extending in depth with the tendency to move SE.

Tectonically the salt massif is limited to the west by a near vertical fault having the direction NS. On east side the salty formation is bordered by a middle inclined fault along which salt comes in contact with deposits of upper helvettian made of gypsum, marl, sandstone and tufacee marl. On the north side it is affected by a transverse fault that separates the salt massif into two compartments, of which southern one is the subject of exploitation.

Apart from overall tectonic, the salt deposit is also affected by internal tectonic that caused intense shriveling, rolling and thickening. In these conditions, a number of sterile insertions have been comprised into the salt body. However salt from Targu Ocna is pure and contains approx. 98% NaCl**.**

3. Opening, preparation and exploitation of the mining field

Trotuş mine was opened in 1969 by an I 101adit, performed at the level of horizon II. The gallery was dug into sterile, having a profile of 13,5m^2 and supported voussoir masonry. Upon salt massif entry the gallery was broadened to a profile of 32 m^2. To open the below horizon in depth, the gallery was continued with an inclined spiral level, at an identical profile. A concrete air shaft (with a section of 7,5m^2) of approx. 131m depth is used in order to achieve ventilation. It connects with the air funnel 204, which is deepened with the exploitation of new horizons.

Subsequently in order to increase transport capacity, for opening the horizon VII, a new adit (Unirea Gallery) was created, which was continued with an inclined level following the exploitation level, on which transportation of salt to the preparation plant is performed using conveyor belts. The first reference of Targu Ocna salt exploitation dates from 1595.

Salt exploitation was performed in bell-shaped rooms (until 1875) and was continued in trapezoidal rooms (mines Moldova Veche and Moldova Noua). Starting with 1970 salt exploitation started to be performed in “small rooms and square abandoned pillars ". Exploitation is performed downward on the horizons. At the beginning of exploitation the rooms were 16m wide and 8m high and pillars had 14m sides. Currently the rooms are approx. 13.75 m width and have 8m height vaults and pillars of 16.25 m in side. Between horizons a 8 m thick floor is left. Pillars are perfectly superimposed (coaxial). Salt hewing is achieved by running a track at the room’s foot using a coal-cutting machine, after which face blasting is performed by blowholes and shooting explosives. Blasted salt is loaded into dumpers and transported to the horizon X where is discharged on the conveyor belts and moved to the surface.

4. The mine ventilation system

General ventilation of the Targu Ocna salt mine is performed through induced ventilation, by using three main ventilation facilities (fan-motor assembly) located on the surface, in the ventilation shaft duct. A ventilation facility is equipped with a double suction centrifugal fan type V562-00 DA, having the following characteristics:

- Flow 5880m^3 / min;
- Depression 130 mm col H_2O;
- Speed 600 rev/min.

driven by a motor with the following features:

- power 319 kw;
- Speed 590 rev/min;
- Power-supply voltage 6000 V.

The other two facilities are equipped with axial fans type VOKD-1.5, with the following nominal parameters:

- Flow 3180m^3 / min;
- Depression 3318mm H_2O;
- Speed 960 rev / min.

driven by motors with the following features:

- Power 160 kw;
- Speed 980 rev / min;
- Power-supply voltage 380 V.

Fresh air penetration into the salt mine is performed through the two adits. The flow direction is downward washing the operating horizons being conducted on the short air funnels under the influence of the depression created by the fan and is discharged on the air funnel to surface on the air shaft.

5. Measurements performed in underground workings

To establish the scheme of gas emissions, respectively the classification, depending on the absence or presence of methane and carbon dioxide, quantitative and qualitative measurements were carried out, in the main and secondary polluted air exhaust current, in the active, inactive and reserve mine workings. In addition to these measurements, specific measurements were also performed to establish the presence of methane and during some technological operations to exploitation rooms:

- Punching blowholes in the salt massif;

- Performing the path at the coal face base;
- Measurement of gas concentrations in the coal face, rooms ceiling and in general exhaust air currents of the horizons and mine.

Measurements in active mine workings were performed also for a preparation work, when partial ventilation was stopped for 24 hours.

Prospecting for methane gas in the salt massif around mine workings, was performed through advance boreholes in which were inserted gas collecting probes. These were sealed for 24 hours. Also to this purpose were performed measurements in a horizontal bore, performed toward the salt-sterile limit and on the bottoms of blowholes remained after blasting coal faces.

6. Measurements results

The results of the measurements performed in the underground atmosphere and the salt massif, shown in Tables no. 1-2, revealed the following:

• Absence of methane in the mine primary and secondary air exhaust currents;

• Absence of methane when carrying out processes like: performing advance borehole, scaling coal faces, or after performing blasting operations in the coal faces;

• Absence of methane in the underground atmosphere if shutting the partially ventilation system;

• Presence of methane in the salt massif around mine workings and marginal tailings (advance boreholes and drillings), at salt cutting workings using the cutting machinery and when blasting coal faces;

• Lack of carbon dioxide in the atmosphere of mine workings and its presence in the salt massif;

• Lack of gas pressure in advance boreholes performed in the salt massif;

• No blower of methane or other manifestations of gases were shown.

Table 1 Gas concentrations in underground atmosphere of workplaces – Trotus mine

No.	Name of mine working	Air flows achieved with VOKD no. 1 in use (m^3/min)	Underground atmosphere composition (% vol.)				Absolute flow (m^3/min)	Observations
			CO_2	O_2	CH_4	CO	CO_2	
0	1	2	3	4	5	6	7	8
1.	ADIT I 101	2.220	0	20,8	0	0	-	Fresh air penetration into the salt mine
2	UNIREA GALLERY	70	0	20,8	0	0	-	
3	INCLINED LEVEL 501	150	0	20,7	0	0	-	
4.	HORIZON X	305	0	20,6	0	0	-	Air flows achieved at horizon level
5.	HORIZON XI	1.380	0	20,7	0	0	-	
6.	HORIZON XII	280	0	20,6	0	0	-	
7.	LEVEL 522 (after the air funnel)	-	0,4	20,6	0	0	-	Without partial ventilation
8.	AIR SHAFT DUCT	2.465	0,03	20,4	0	0	0,74	Total discharge of foul air

Table 2 Gas concentrations in the salt mine around mine workings – Trotus mine

No.	Name of mine working	Drilled rock	Advance borehole no.	Concentration of measured gases (% vol.)					
				Before sealing			After sealing		
				CO_2	O_2	CH_4	CO_2	O_2	CH_4
0	1	2	3	4	5	6	7	8	9
1	Drilling performed at level 522 sub-horizon. XII	salt	Drilling no. 180 58 m in length	0	8,5	40	0,1	2,5	91
2	Drilling in room 6229 horizon XI	salt	Drilling no. 242 90,7 m in length	0	20,4	0	0	18,0	0
3	Advance borehole performed in room 6238 and 6243 horizon XI, toward the marginal sterile intercalation	salt	G. 1	0	20,6	0	0	20,3	0
4	Room 6193 from 6211, horizon XI	salt	G.2	0	20,7	0	0	20,6	0
5	Room 6234 from 6246, horizon XI	salt	G.3	0	20,2	0	0	19,8	1,0

7. Conclusions

Considering the results of measurements and observations performed by INSEMEX Petrosani in Targu Ocna salt mine underground workings, in terms of carbon dioxide emissions the mine was classified as 1st CATEGORY and in terms of methane emissions the salt mine was classified as "NON GASSY'" mine and the following were kept in the 1st category GASSY :

- Coal faces ventilated using partial ventilation installations in dead faces;
- Coal faces where salt is cut with the use of cutting machinery, blasting holes are drilled, blasting operations are performed and blasted rock is uploaded;
- Rooms in which boreholes are performed to investigate salt deposits or sterile insertions and salt / sterile contact area.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH"

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The analysis of the influence of functioning parameters for fireworks and fireworks for professional use

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Abstract

Pyrotechnic articles are falling in dangerous products, Risk Class 1 - explosive. At European and national level there are Directive 2013/29/EU of the European Parliament and of the Council of 12 June 2013 on the harmonisation of the laws of the Member States relating to the making available on the market of pyrotechnic articles respectively Government Decision nr.1102 of 10 December 2014 establishing the conditions for placing on the market of pyrotechnic articles. Depending on the type and the category of pyrotechnic articles, their compliance is checked usually by application of the harmonized European standards which specify test methods with all the technical and organizational measures. Pyrotechnic articles shall be tested according to the manufacturer's instructions. To the extent that does not exist suitable instructions provided by the supplier regarding the mode of functioning in advance will be determined the type of object (E.g.: fireworks, Roman candle, battery, etc.) and will be test on basis of their instructions. The products intended for indoor use can be considered out as being the banal case whereas usually the factors are not exceptional at the use (20 ± 5 0 C, relative humidity 60 to 80% fairly ordinary, unnoticeable air currents, excluding compounds from burning pyrotechnic composition which generates toxic agents)

The situation of pyrotechnic articles of categories F2, F3 and F4 it is highly variable, regarding the conditions of micro-climate in which are used the pyrotechnic articles respectively the conditions of micro - climate in which are tested the products for the evaluation. Therefore, the variation in the temperature is directly proportional to the rate of burning and the intensity of emission of heat energy, or kinetic, high humidity adversely affect the functioning of the product in the sense slowing down the speed of burning or misfire situation (stop functioning); pressure is also an influencing factor in the sense that its growth also leads to higher burning speeds. A factor that is relatively difficult to monitor is the influence of wind, which manifests mainly on the trajectory of pyrotechnic articles which have ascension, on the noise and the propagation of smoke and noxious gases from the area of launching outside the safety zone downwind. Thus, during operation the wind speed vector changes randomly, assess on the influence on the trajectory and wind speed is difficult to quantify. Based on the analysis of functioning parameters of these types of pyrotechnics can be established on a scientific basis for each type / category of pyrotechnic article in part the possible influence of external factors specific for the test, environment which can affect their proper functioning, of which there may be mentioned in particular: the wind (the intensity and direction), ambient temperature, humidity, pressure, nature and composition / soil quality / the launching platform on which are placed the pyrotechnic articles.

Keywords: pyrotechnic articles, functioning, micro-climate, parameters

1. Introduction

The management policy of an organization is not based only on economic parameters, neglecting certain aspects of protection of workers' health and safety in carrying out their work. In line with European requirements, achieving security and health must become an integral part of the social role of the organization (Moraru and Băbuţ, 2010).

Conceptual ″ The art of leading″, defined as management has other attributes outlined in the Explanatory Dictionary of the Romanian Language, as well as all activities of the organization, management and business management or science and technology organization and their leadership.

Management processes and relationship management approaches in the formulation of principles and laws in the area and provides the scientific and technical tool for developing managerial mechanism necessary to attain the objectives expected.

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Through ″MR-PYRO″ management system, organizations can take to control risks to the health and safety at work (conditions and factors affecting state workers authorized as pyrotechnical and any other person) and to improve performance (measurable results related to the control system of organization of the risks relating to health and safety at work, based on policy and targets).

A management system ″MR-PYRO″ is applicable to any organization in the field of pyrotechnics, which aims: to establish a ″MR-PYRO″ to eliminate or minimize risk to staff as pyrotechnics authorized or directed to do so and other stakeholders They may be exposed to risks associated with the activity; establish, document and implement, maintain and continuously improve ″MR-PYRO″; to ensure compliance with policy ″MR-PYRO″ declared the application of legislation.

2. The basic elements and processes of the integrated system ″MR-PYRO″

The implementation of a MR-PYRO system must be in agreement with SR OHSAS 18001: 2008 and OHSAS 18002: 2009 and in compliance with harmonized technical requirements of Directive 2013/29 / EU.

The requirements of national legislation and recommended by SR OHSAS 18001: 2008 is based on the implementing and maintaining an OH & S system by the organization. To implement this system means to demonstrate a certain level of performance and to demonstrate that the system components are implemented at all levels and functions of the organization in order to have a procedural tool of implementation and an adequate control of the activities and processes to be considered.

Managing of health and safety in an organization that operating in the field of fireworks for professional use (F 4) is based on the following elements and processes of principle:

1. Policy and strategy for health and safety
2. Responsibilities, functions and competences
3. The structure of the system MR-PYRO.
4. Information flows and cooperation internal and external
5. The generalization of health and safety at work.
6. Documentation and document management.
7. Determination and evaluation of results and improvement of the system.

For the practical application of the principles outlined in the model system of security management and health at work, were developed models of quality system documents in the management of safety and health at work in the field of fireworks for professional use (F 4).

At the realization of the models system documents in the field MR-PYRO it was made taking into account adaptation of application requirements of this management system (Proposed by the project to the particularities of organizational and work processes specific to the pyrotechnic articles but with the current OSH legislation requirements and Law 319/2006 on health and safety at work and specific legislation (Law 126/1995 on the regime of explosive materials and technical norms of application amended and supplemented).

MR-PRO system documentation it may consist of:

- Checklist of fulfil of the requirements of OSH management system;
- OSH management manual, the main document of the system on which all other documents are developed;

procedures for system by detailing certain provisions of the manual, while establishing concrete aspects responsibilities, functions, competencies, ways of acting, information flows, recordings of some data, so that ensure functioning of the system in accordance with the requirements legislation and the model and the general OSH objectives of the economic operator .

2.1. The OSH checklist management system requirements for management activities with professional pyrotechnic articles (F 4)

This list is given in the Annex and is a working document describing the requirements of OHSAS 18001 referential: 2008, enabling verification / auto verifying compliance with the corresponding requirements of that standard in order to develop accurate and complete document system (MC PYRO-PYRO-OHS and SP-OHS) specific to fireworks for professional use

2.2. OSH management manual (MC-PYRO-OSH)

OSH management manual was developed taking into account: OSH requirements of the legislation in force; requirements model OSH management system proposed in the paper; OSH management system correlate with the quality existing in the organization; organizational particularities of the organization.

Also they have been provided and instructions for each point the layout of this document. The manual contains the "Political Declaration of OSH management" document that summarizes and certifies its signing by management concerns and objectives OSH. The introductory part of the manual is allocated for: an overview of the organization, purpose and scope of use and design and management manual. Further highlights basic issues for each element of the system that ensure compliance and implementation, maintenance and improvement of the management system proposed.

3. OSH management system procedures specific too fireworks for professional use (PS-PYRO-OSH)

System procedures are designed to detail the requirements of the OSH management system manual. These responsibilities are established procedures, modes of action, information flows, methods of recording data etc. In order to ensure compliance with the model and the effective functioning of OSH management system. In developing the system procedures were considered two main requirements of the model, which apparently are in a relationship of opposition to one another: the volume of documentation should be kept to the minimum necessary to ensure efficiency; documentation should provide general and detailed description of the basic elements of the system and their relationships.

Thus, the models were developed following system procedures specific to professional pyrotechnic PS-PYRO-OSH-01 "hazard identification, risk assessment and setting of controls'; PS-PYRO-OSH-02 "Evaluation of compliance with legal and other requirements"; PYRO-OSH-PS-03 "Competence, training and awareness"; PS-PYRO-OSH-04 "Communication"; PS-PYRO-OSH-05 "Participation and consultation"; PYRO-OSH-PS-06 "Control of documents"; PS-PYRO-OSH-07 "Preparing for emergency situations and response capacity"; PS-PYRO-OSH-08 "Monitoring and performance measurement OHSAS" PS-PYRO-SSM-09 "incident investigation"; PS-PYRO-SSM-10 "Non-conformities, corrective and preventive actions"; PS-PYRO-SSM-11 "Control of records"; PS-PYRO-SSM-12 "Internal audit"; PS-PYRO-SSM-13 "Management review".

3.1. Stages of implementing a risk management system (MR PYRO)

I. The first stage of system development is occupied by local analysis of the organization, interviews with workers, questionnaires assessing the situation, evaluating the activities of labor protection at the time of analysis against the requirements of OHSAS 18001: 2008. For starting work held trainings for managers with the knowledge necessary for the development and operation of the system, and then must start implementing MR-PYRO.

II. Over system development must be carried out risk assessment must be processed safety elements of the system, determined to achieve the goals of the MR-PYRO system must be harmonized goals of production and SSM, SSM organization's policy must be defined. Be terminated or revised risk analysis, containing risks of job security and significant risks related materials and dangerous goods, which characterizes the organization's activities, including normal operating conditions of the organization, as well as unexpected events, accidents and hazards possible.

III. The drafted Manual OSH management system and procedures. Management awareness of safety and health at work should be carried out necessary training to all levels of the organization, during which the employees become acquainted with the aims of the MR-PYRO with its duties, the importance of improving the system, where the system MR- PYRO in the overall management of the organization, tasks staff in implementing, maintaining and improving the MR-PYRO, the role of staff.

IV. After implementation of the MR-PYRO, in addition to continuous improvement and achievement requirements should be checked effectively referential (OHSAS 18001: 2008), then on the basis of the findings of internal audits and management review to be assured achievement possible corrections necessary.

4. Consideration of the environmental influences on the test regarding the functioning of fireworks and fireworks for professional use (F1, F2, F3, F4)

European Directive states that pyrotechnic articles tests have to be done under conditions that replicate as closely as the real ones that can meet their use.

As regards products whose intended use is specified in the safety data sheet that instructions are known, parameter limits of micro-climate that can meet (temperature, humidity, wind - those intended for outdoor use and temperature, humidity, generation of toxic compounds to those intended for use indoors).

The products intended for indoor use can be considered out as being the banal case whereas usually the factors are not exceptional at the use (20 ± 5 0 C, relative humidity 60 to 80% fairly ordinary, unnoticeable air currents, excluding compounds from burning pyrotechnic composition which generates toxic agents)

The situation of pyrotechnic articles of categories F2, F3 and F4 it is highly variable, regarding the conditions of micro-climate in which are used the pyrotechnic articles respectively the conditions of micro - climate in which are tested the products for the evaluation.

Therefore, the variation in the temperature is directly proportional to the rate of burning and the intensity of emission of heat energy, or kinetic, high humidity adversely affect the functioning of the product in the sense slowing down the speed of burning or misfire situation (stop functioning); pressure is also an influencing factor in the sense that its growth also leads to higher burning speeds.

A factor that is relatively difficult to monitor is the influence of wind, which manifests mainly on the trajectory of pyrotechnic articles which have ascension, on the noise and the propagation of smoke and noxious gases from the area of launching outside the safety zone downwind. Thus, during operation the wind speed vector changes randomly, assess on the influence on the trajectory and wind speed is difficult to quantify.

5. Conclusions

This management system developed in accordance with the harmonized standard ISO OHSAS is addressed to all manufacturers or service providers seeking to streamline the proactive management of health and safety at the firing of fireworks and fireworks for professional use

Based on the analysis of functioning parameters of these types of pyrotechnics can be established on a scientific basis for each type / category of pyrotechnic article in part the possible influence of external factors specific for the test, environment which can affect their proper functioning, of which there may be mentioned in particular: the wind (the intensity and direction), ambient temperature, humidity, pressure, nature and composition / soil quality / the launching platform on which are placed the pyrotechnic articles.

Implementation of these management systems in an organization that performs firing of fireworks and fireworks for professional use, complements the existing organizational system in organizations and promotes the systematic application of security legislation and health at European and national legislation.

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The personal protective equipment against falls from height at the limit between risk and security

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Abstract

In most industries there are works carried out at height for those the individual protective equipment against falls from height are the only measure of protection for workers against the risk of falls. Although it is successfully used in many activities carried out at height on horizontal surfaces, inclined or vertical, there are situations where the personal protective equipment against falls from height is itself a risk, either because of the discomfort caused by a failure of ergonomic design or stress due to the request of a static position "hooked" or improper selection or use in degraded condition. Based on these specific situations through the article realized I wanted to draw attention to the advantages and disadvantages of using this type of personal protective equipment, as of the measures to be taken to support the work at height safely.

Keywords: personal protective equipment, working at height, risk, security

1. Foreword

Whether the works are to lift the formwork, maintenance and rehabilitation of buildings, silos or chemical plants and reactors the activities performed at height are present in most sectors. Without denying the elements of progress in recent years and the decreasing number of work accidents of new cases of professional diseases by 27%, however, in terms of fatal accidents at work due to falls from the height, (Eurostat, 2016) the figures remain high. Furthermore, by analyzing various studies, we found that in many cases, although the workers were properly equipped, they have suffered various accidents due to the workload specific, performing improper work operations, omissions or exposure outside the work task to dangerous or harmful factors. (Baszczyński, 2011), (Baszczyński, 2007) The aim of this study is to present both the advantages and disadvantages of using personal protective equipment (abbreviated as PPE) against falls from height, in order to identify the appropriate and effective measures for prevention and protection, leading to reducing work accidents due to the falls from height.

2. PPE against fall from a height - additional measure for protection

For the activities carried out at height there is a hierarchy of measures to be taken: the organizational measures to prevent accidents (personnel selection, training, information and documentation and organization of the activity and job), the intrinsic technical measures and safeguards collective measures have priority over the individual protection measures. (Technical Committee PH/5, 2005) Even if collective measures designed to prevent falls from the height offer a better protection than personal protective measures, there are situations in which using personal protective equipment the fall risk is diminished or even eliminated.

Most times, the use of PPE against falls from the height remain the only measure of protection available when through a risk assessment has been observed that the risk of falls from height has not been removed by other means of protection or work done at height are short or for technical reasons planning a scaffold of proper railings or other similar safety devices is not possible.

So PPE against falling from the height is the last barrier between the body and the risk factors generated by the

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height difference, through which it can be avoided or prevented injury or the occupational diseases. Providing to workers the protection against falling from height is not accomplished by a single EIP, but by many PPE parts (supporter of the body, a means of connection with or without absorber, durable anchorage, lowering device, etc.) that are assembled differently depending on the configuration of the workplace and specific activity, forming a system of individual protection against falling.

Depending on the components used, their assembly order, the anchor manner and the anchor position relative to the body, the systems against worker falling from height have a high specificity and can be used to:

- **prevent falls from the height** - warn the user to enter freefall (the role during work is supportive or as support);
- **stop falls from a height** - prevent the user hitting the ground, a structure or another obstacle during freefall (serves to brake and thus to lessen the shock);
- **rescue** - provide emergency escape or rescue of another person, thereby avoiding a freefall (academy brochure). (CEN, 2008)

Because there is no personal protective equipment, which can provide a complete protection for most risks related to work in general for selecting PPE components needed for achieving the protection against a fall from height have to choose the best solution that offers a reasonable compromise between safety and comfort. Thus, regarding the PPE against fall from a height, the selection should be made considering:

- working conditions and the risks to which workers are exposed at the workstation where it will be used the PPE;
- distance from the workstations and ground or any reference basis where it can not fall (if the PPE is used to getting in and out of a job);
- the drop height and the potential consequences of a fall;
- the duration and the frequency of use;
- the need for evacuation and rescue in case of emergency;
- any additional risk resulting from the use of PPE for work at height (Crăciun, 2016b), (Guvernul, 2006) and not lastly of
- the requirements of the legislation on the conditions for free movement of PPE that this European CE mark of conformity accompanied by the body involved in the quality control of production, which certifies that the PPE against fall from a height comply with all the provisions included in the European Directive 89/686/EEC (The Council, 1989) transposed by GD 115/2004 (Guvernul, 2004) nationally amended and supplemented, and
- the characteristics of PPE against fall from a height available on the market, mentioned in the instruction sheet.

3. PPE against fall from a height - risk factor

Because each component of the system has an important role in protecting the health and safety of workers from hazards that can lead to death or against dangers that may seriously and irreversibly affect the health, PPE for working at heights is considered PPE of complex design and can be placed on the market or used safely only if it meets the essential safety and health requirements of the European Directive 89/686 / EEC (transposed at national level by GD 115/2004).

Although the essential requirements that must be met PPE against falls from height refers not only to ensure a minimal comfort, but also to preserve its protection throughout the period of use, research in this area showed that there are situations where this type the EIP is often a risk factor for the user.

However, whether used as additional protection or unique equipment to accomplish specific activities, the personal protective equipment against falls from the height can cause:

- discomfort and embarrassment due to an insufficient ergonomic concepts, either because of limiting the movements;
- accidents and health hazards:
  - due to inappropriate selection of PPE against falls from the height, inappropriate use, (Dobrescu et al., 2013), the use of PPE against fall from height in damaged condition, (Hunter, 2006),
  - that may occur during the stop of falling as result of the dynamic load exerted to user and user equipment; pendulum effect occurred after a fall; (Dobrescu et al., 2013)
- stress due to the static "hang" in the belt. Although in this case there are no specific regulations that dictate how to be carried out rescue operations, the research conducted in the field showed that serious medical problems start develop after 30 minutes of belt suspension. Because of that it is imperative that the prompt rescue to be done reducing the time of the belt suspension of worker. (Departament,1994)

Studies in the field (Seddon, 2002) pointed out that although a number of risks PPE generated, such as discomfort and embarrassment due to insufficient ergonomic conceptions, PPE selection or stress due to the "hanging" in the ring are eliminated by observing the characteristics specified in standards specific requirement or training, although there have been situations where PPE against falls from height was properly selected accidents occurred due to the breakage of various components. Breaking the various components of individual systems for protection against falls from height proved once again that regardless of the role they have the materials they are made and the form they have, they are susceptible to abrasion and mechanical damage (see Figure 1) and may, therefore, to lose the protection features under the action of various hazards existing in the workplace. (Executive, 2006)

Fig. 1. (a) damaged connectors; (b) damaged energy absorbers and webbing; (c) damaged rope

Loss of protection features lead to the obstruction of PPE against falls from height to act as the main factor of protection action which can lead most often to work injuries or occupational diseases serious.

3.1. The components of PPE against fall from a height - risk factors under the influence of hazards in the working environment

Given the large number of work accidents due to the falls from the height (Eurostat, 2016) in most industries at European level, there have been several studies that have investigated the effects that different hazards (physical, mechanical, chemical) existing in the work environment have on protective characteristics (static and dynamic) of the various components of PPE against fall from a height. Thus, K. Baszczyński, M. Jachowicz and L.Robinson, (Baszczyński, 2011), (Baszczyński, 2007), (Parkin, 2002), (Robinson, 2007) carefully analyzing concerete situations for working at height and anticipating the moves of users made to the workplace they watched the influence of:

- different types of edges due to improvised anchorage on static and dynamic means of connection;
- weathering action, mechanics, on the characteristics of light and dust protection (static resistance) of the constituting webbing of complex belts in order to estimate correctly the "lifetime" of harness.

The results of study (Baszczyński, 2011), (Baszczyński, 2007), (Parkin, 2002), (Robinson, 2007) showed that under the action of different degradation the protection characteristics of the components of PPE decrease by approx. 30%. Because of this, the PPE for working at height can turn into a risk factor, which at the time of a fall from the height would lead to workplace accidents.

Although the results of studies conducted by K. Baszczynski, M. Jachowicz and L.Robinson led to a better understanding of the size and pattern of accidents, however the allocation of a single specific cause for an accident or incident is rarely accurate and is often considered a flawed approach, because it fails to identify the real causes.

Because during their activities at height the hazards at the workstation can act simultaneously, the effect they may have on the characteristics of PPE against falls from height was followed in the study "Research on the behavior of personal protective equipment (PPE) for working at height to the synergic action of the risk factors, " (Crăciun, 2016a), study that led to the realization of the PhD thesis. Given the fact that each of the components that are used to make individual protection systems for working at height has an important role in ensuring the health and safety of the user, the study focused on tracking the synergistic influence of the risk factors present at the construction workstations to the protective characteristics of connection means made from rope, because this component:

- has an important role in most of personal protective systems used for work at height, providing a link between the body support device and the anchoring point,
- during use is exposed to the destructive effects of numerous factors present in the work environment, such as abrasive edge / sharp, dust, temperature variations, water, UV radiation that can damage their structure, reducing its protective properties;
- during the stop of the fall is subject to dynamic forces which can reach values of several thousand of Newtons. Whatever the action of risk factors present in the workplace, the anchor must maintain the connection between te body support device (belt) and the energy absorber or the anchor point.
- maintaining the characteristics of protection throughout the period of use is one of the most important issues related to the use of PPE, to estimate correctly the "lifetime" of the strings.

The components of personal protective systems intended to protect workers from falls from the height, the ropes are placed on the market only if they comply with Directive 89/686/EEC (The Council, 1989) transposed by GD 115/2004 (Guvernul, 2004) nationally or EN 1891 (CEN, 1998) standard requirements or other specific standards for connection means such as EN 358 (CEN, 1999) or EN 354 (CEN, 2010). As the property representative closely related to the sustainability of the rope is the static resistance (tensile strength) (CEN, 1992), the study was based on tracking the characteristics of different types of ropes under the influence of various potential hazards existing for the construction workstations.

The lack of test methods to pursue the synergistic effect of risk factors present in the working environment, led to the development of test methods accelerated based on the results of the risk assessment for three representative workstations at height (masons, smiths and scaffolding) from construction.

Since in time, the materials for the ropes realization have reached a plateau, where only one polymer prevail - polyamide (nylon), the research was based on tracking their characteristics under the action of potential dangers existing in the workplace.

Thus through the comparative analysis of ultimate strength obtained from the exposure of several types of ropes (with different diameters and with different number of strands) to various types of accelerated degradation, as is observed in Table 1 we can say that for most ropes, ultraviolet rays have a strong impact on their protection characteristics compared to other degradations. Exceptions are encoded ropes 10 N and 11 NK who registers lower values for the degradation by exposure to water and low temperature. Given that the two different types of rope had different diameters and different structures of rope components, their different behavior can be attributed to the lack of waterproofing treatment. Due to lack of hydrophobic treatment, water penetrates through the interstices between the fibers, increasing them during exposure to cold temperatures, thereby reducing the resistance to breakage. (Crăciun, 2016c).

Table 1. The influence of risk factors on the strength to breakage of the rope

Code rope (rope number is the diameter in millimeters)	Tensile strength, N, after exposure						
	t = 23 ° C, UR= 50 %, 168 hours	t = 23 ° C, UR= 50 %, 168 hours + 1000 abrasion cycles	t = 23 ° C, UR= 50 %, 168 hours + 1hour immersion in water + 4hours conditioning t= - 4 ° C	t = 23 ° C, UR= 50 %, 168 hours + 400 hours at UV radiation, 0,51 W/(m2·nm), λ=340 nm	t = 23 ° C, UR= 50 %, 168 hours + 1000 abrasion cycles + abrasive edges	t = 23 ° C, UR= 50 %, 168 hours + 1000 abrasion cycles + abrasive edges + 1hour immersion in water + 4hours conditioning t= - 4 ° C	t = 23 ° C, UR= 50 %, 168 hours + 400 hours at UV radiation, 0,51 W/(m2·nm), λ=340 nm +1000 abrasion cycles + abrasive edges + 1hour immersion in water + 4hours conditioning t= - 4 ° C
 10 NK	16.550	15.413	16.400	13.987	15.960	15.700	13.373
 10 AN	16.260	15.931	15.542	14.340	16.117	15.663	14.230
 10,5 N	17.820	17.227	16.973	17.030	17.200	16.600	15.893
 10,5 TRI	20.375	16.400	16.427	16.100	16.388	16.143	16.087
 10,5 NK	16.620	15.480	15.487	14.800	14.193	14.085	12.877
 11 AN	16.987	18.020	16.290	15.840	17.280	16.227	15.275
 11 NK	18.494	18.100	16.317	16.827	17.997	16.260	16.143

Results of research undertaken revealed the negative impact of the identified hazards and combinations of hazards in the work environment on the ultimate strength and as a result to the static resistance of the different rope types. Since the physical and chemical properties of the ropes polyamide largely depend on the nature, arrangement of chemical groups in their composition and size of the forces intramolecular or intermolecular, the deterioration of the mechanical properties at after series of tests, demonstrated once again that the action of factors mechanics, UV radiation and humidity, the polymer structure undergoes to various modifications.

Analyzing the results recorded in Table 1, it can be seen that the magnitude of the synergistic action of risk factors on the strength of the different types of rope exposed to combinations of degradation depends on the number of risk factors, the diameter of the rope and not at least the lack of treatments applied to the ropes. (Crăciun, 2016a)

4. Conclusions

The specificity of the activities carried out at height and the existence of situations in which work can not be made safe by taking collective protection measures, determine that the use of PPE against fall from a height to be the only measure of worker protection. Thus, regardless of the industry where it is used, the PPE against falls from height must:

- be properly selected so as to be adequately to the risks prevented, without introducing additional risk himself;
- respond to the existing conditions at the workplace;
- take in consideration the health and ergonomic requirements of the user;
- be able to be adapted to the user conformation.

Because of the features that this type of PPE has it acts as a barrier between the hazard (the level difference) and the human body, by distorting it or by destroying it partially, thus preventing the injury or the occupational disease.

However, there are situations when the PPE against falls from height can become itself a risk factor due to insufficient ergonomic concepts, inappropriate selection or damage under the influence of risk factors present in the workplace. Because many of the necessary features designed to prevent these risks from EIP depend on users or specific construction of the PPE (materials, dimensions and sizes) when purchase PPE, it should indicate the additional elements (such as the presence of elements for shoulder and leg comfort or the position of the belt gripper) that PPE need to had to ensure their minimal comfort while using.

As the results of studies on various components of PPE for work at height have shown that depending on the specific workplace the risk factors / degradations have a strong effect on their characteristics of protection, the safety issue for workers who work at height is still far from being resolved satisfactorily. Therefore it is absolutely necessary to improve the materials from which PPE for protection against falls from height are made, combined with the development of appropriate testing methods considering the specific hazards encountered at every workplace. Until then, it is essential:

- conducting a rigorous regime of inspection of PPE against falls from height by a competent person to watch before each use the functionality and integrity of each element or component and take decisions on disposal of PPE against falling height when it is found that defects or deterioration of it could lead to accidents or occupational diseases;
- additional measures of protection (nets or mattresses positioned immediately below the working area) to reduce the height of the fall or the consequences of a fall.

Given that there are situations where the PPE against falls from height is the only measure of protection for workers, the PPE can become a risk factor under the action of existing hazards in the working environment, it can be said that it is at the limit between risk and security.

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Minimum ignition temperature of dust cloud analysis for safe industrial processes

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Abstract

Unlike mixtures of gases or vapours flammable - air, which generally are quasi stable tending to occupy the entire available volume, the suspension of dust in the air is unstable systems, heterogeneous, in wherein the solid particles are deposited in time and on different distances, depending on their weight. The explosive behavior which is represented by a mixture of air and flammable substance is influenced by many factors of which the most important parameters are the chemical composition and concentration of flammable and explosive mixture with air. In particular, for the combustible powders, are intervening additional factors related to the physico-chemical properties of combustible solids, the shape and size of dust particles, as well as the environmental conditions under which dust exist in suspension. For this work were performed experimental determination of the minimum ignition temperature of dust cloud for some various technological powders derived from technological processes, as waste and was investigated the influence of particle size over the minimum ignition temperature of coal dust.

Keywords: explosion, technological powder, minimum ignition temperature of dust cloud, explosive mixture

1. Introduction

In the industry frequently occurs accidents caused by explosions (gas, dust or hybrid mixtures) that can cause equipment failure, damage to people and the environment (an explosion at a chemical plant, which can cause massive pollution of environment), closure of the factory or even destroy it completely, leading to large losses including loss of life. Although the risk of explosion is well known for decades, the destructive and repetitive nature of these phenomena pushed scientists towards the advancement of knowledge in order to anticipate, prevent or minimize the effects of explosions. Although there were made progress in the recent years in terms of explosive behavior of combustible dusts, further research is needed due to the complex oxidation mechanism of these substances (Agreda, 2010). In order to assess the risk of explosion, to prevent the unwanted events and to increase the level of explosion protection in industrial applications it is necessary to know the explosivity parameters of air - combustible dust mixture. Dust explosions are mainly characterized by the minimum ignition temperature, explosion limits, the minimum ignition energy, maximum explosion pressure and maximum rate of pressure rise.

Minimum Ignition Temperature (MIT) is the lowest temperature of a hot surface which will generate the initiation and propagation of the dust cloud explosion. Minimum ignition temperature of a specific combustible dust is defined as the minimum temperature of the air where the flame is observed due to the explosion of dust particles. Minimum ignition temperature evaluation is usually measured by tests described in EN 50281-2-1: 2003. Minimum Ignition Temperature plays an important role in the selection of explosion-protected electrical equipment when performing the explosion risk assessment of combustible dusts. The dust cloud is the main form of existence of combustible dust in the production area and the existence of effective ignition sources are the main causes of dust explosions in industrial processes. Although the explosiveness of gases and vapors is well known, the hazards associated with combustible dusts are less treated. Dust clouds from any source, including a layer of dust accumulation, may explode. Layers of dust can ignite due to the self-heating or hot surfaces and can create a risk of fire or overheating of equipment.

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A wide variety of working place can contain activities that can generate explosive or potentially explosive atmospheres. Dust explosions are common to many industries such as mining, storage and processing of agricultural products (flour, sugar, cocoa), and organic powders (pharmaceuticals, plastics) or process the metal powders (aluminum, magnesium). Multiple operations that include combustible solids such as milling, drying, collecting dusts, pneumatic transport and other modes of transportation are always exposed explosion risk (Zalosh et al., 2005).

In order to prevent and eliminate the risk arising from performing these operations, explosion parameters such as ignition temperature, explosion limits, minimum ignition energy, maximum explosion pressure and rate of pressure rise must be determined. The minimum ignition temperature at which a dust cloud ignites is used to prevent the occurrence of an explosion due to the presence of hot surfaces. The hot surfaces are able to initiate dust clouds existing in industry (ovens, burners, various dryers, enclosures of electrical equipment). In addition, hot surfaces can be generated by overheating of components or mechanical parts of the equipment. If an explosive dust cloud is generated in an uncontrolled manner in the proximity of a surface having a temperature higher than the minimum ignition temperature, may result in a dust explosion. As a consequence, in the dust explosion prevention and fighting, it is important to know the minimum ignition temperature of dust in order to take the necessary measures to ensure that hot surfaces will not exceed this value (Bartknecht, 1981).

The ignition temperature is influenced by the size distribution of dust. Some extremely fine powders can have ignition temperatures so low as they should be considered as a pyrophoric powder. The hot surfaces capable of igniting the dust clouds exist in a variety of situations in industry, such as furnaces, burners, dryers of various shapes, etc. Moreover, hot surfaces can be generated accidentally by overheating of equipment, metal parts. It is thus important to know the minimum ignition temperature and to take appropriate measures to ensure that in the area where dust can form a mixture of fuel to avoid this temperature. On the other hand, the minimum ignition temperature is not a constant for a specific cloud of dust, it depends on the geometry and dynamics of the hot surface of the dust cloud (Amyotte et al., 2007). Generally, the size of irregular particles is expressed best by its volume. In this way, the size becomes independent of form. The diameter of the sphere having equal volume to the particle is known as the nominal diameter of that particle. In the case of combustible dust, an additional factor (compared to gas) and also decisively on conducting dust explosion is the particle size (Colonna, 2009). Due to the complexity of industrial processes, where there is the possibility of forming an explosive atmosphere of combustible dust it is necessary to take all measures of prevention and protection. For this, depending on the specifics of each activity is necessary to observe all the conditions for forming such an atmosphere and prevent a possible ignition.

Experimental data obtained by Leuschke who conducted experimental studies of critical parameters on the initiation of deposits of various combustible dusts in nearly isothermal conditions of ambient air in passed through the sample (Eckhoff, 2003) are mentioned by Hensel in 1987, who investigated the influence of particle size coal dust on the minimum ignition temperatures. Some results are given in Fig. 1.

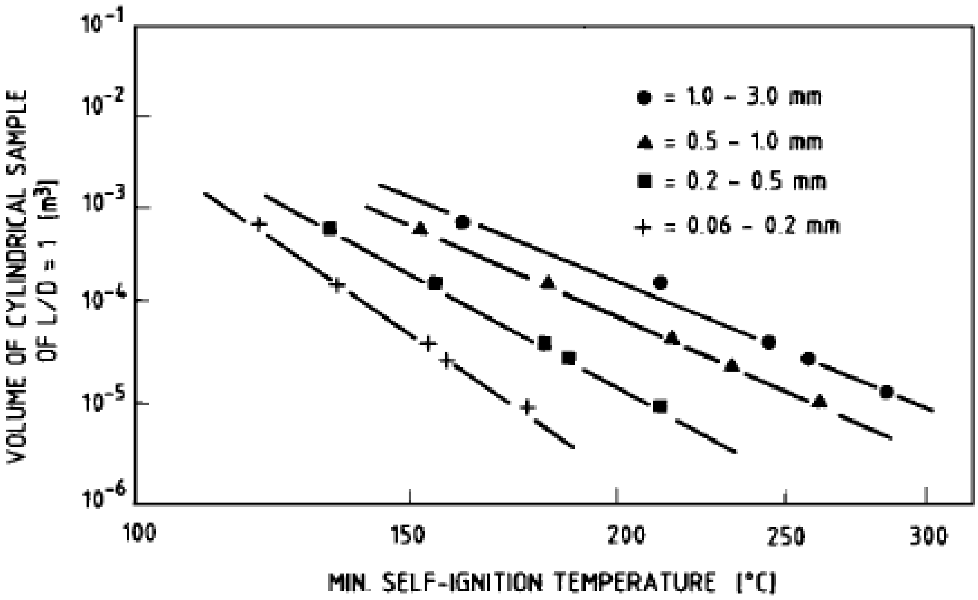

Fig. no. 1 The influence of the particle size of coal dust on the minimum ignition temperature [6]

For a specific powder, these data are influenced by the concentration of dust-air mixture, the humidity and dust particles. Studies related with the dependence of the particle size for a few types of powders have shown that there is a characteristic diameter where the minimum ignition temperature is no longer dependent on the particle size. For example, the minimum ignition temperature of polyethylene is independent of particle size below 80 μm (Conti and

Hertzberg, 1987) (Vahid, 2009). The data obtained from these experiments can be used to limit the temperature at which a cloud of powder is exposed and thus to prevent a dust explosion. Given the short duration of the test, the data are generally applicable to industrial applications where dust clouds are present for a short period of time. There are 3 types of furnaces where can be determined the minimum ignition temperature of the dust cloud, Godbert-Greenwald Furnace, BAM Oven and US Bureau of Mines (ASTM E1491, 2012, Kasalova and Balog, 2011). Each furnace yields slightly different minimum ignition temperatures data, with the largest deviations occurring at the greatest minimum ignition temperatures values. However, the lower minimum ignition temperatures range is of more practical importance and here the agreement is much better. The test data developed from these test methods can be used to limit the temperature to which a dust cloud is exposed so as to prevent ignition of the cloud. Because of the short duration of the test, the data obtained are most applicable to industrial equipment where dust is present as a cloud for a short time. In the past, results from small-scale laboratory tests were often applied directly to industrial plant design. However, it has been known for some time that minimum ignition temperatures of dust clouds vary significantly with scale. As shown by Eckhoff, care must be taken when using the data coming from these tests. The minimum ignition temperature is a strong function of the residence time of the dust in the furnace (Di Benedetto et al, 2010).

2. Materials and methods

The test chamber consists of a vertical ceramic tube of 3.9 cm diameter and 23 cm height, as seen in the fig. no. 2. The volume is 0.27 l. The glass tube connects the testing room with the dispersion chamber. Outside the test chamber is wounded with 6.4 m Ni-Cr wire heater. The windings are placed closer to each other at the top and bottom of the furnace than in the middle to achieve a uniform temperature. The windings are surrounded with insulation. The confirmation is given by the ignition flame that comes out by the bottom of the furnace. After the solenoid valve is activated, the previously weighted sample is dispersed in the oven.

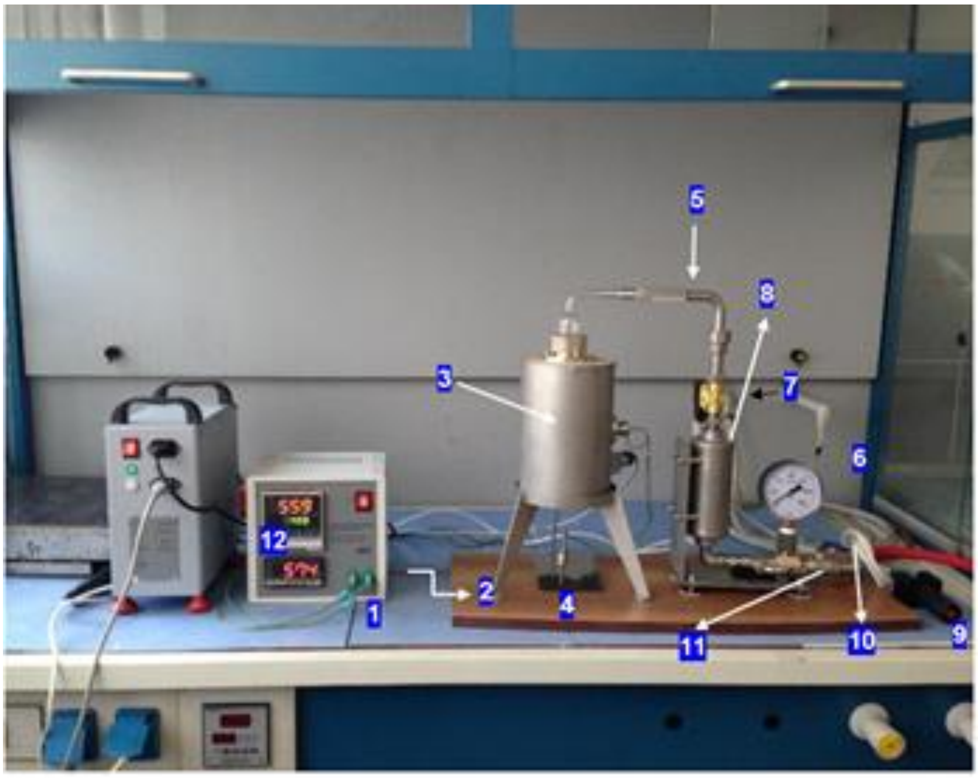

Fig. no. 2 – Godbert - Greenwald minimum ignition temperature apparatus

Legend:

1. T1, thermocouple for the oven temperature control;
2. T2, thermocouple for auto-ignition temperature recording;
3. Oven, testing room;
4. Mirror, which is used for the ignition confirmation.

5. Dust input device;
6. Pressure gauge for compressed air;
7. A solenoid valve, used for powder dispersion;
8. Compressed air container;
9. Control of the solenoid valve for air intake;
10. The discharge valve for pressure relief;
11. Device for monitoring and temperature control.

There were performed experiments in order to determine the minimum ignition temperature of dust cloud for various technological dusts or finite product with combustible properties. The combustible dusts were various assortment of flour dust, waste of zinc oxide from metallization process and wood dust residue from furniture processing. Also were performed tests on coal dust in order to evaluate the influence of coal dust particle size over the minimum ignition temperature.

3. Results and discussion

The analysis method allows the determination of the minimum ignition temperature up to 1000 °C. The tested combustible dusts had values of the between 420-780 °C, which are in good agreement with the literature data results obtained by Kasalova and Balog in 2011. The results are given in the table no. 1.

For the experimental determination of the influence of particle size on the minimum ignition temperature of a combustible dust cloud have been conducted experiments on coal dust collected from Mina Uricani layer 3 panel 8. The dust was subjected to sample preparation operations:

- drying at room temperature to eliminate the moisture;
- preparing the dust at particle sizes of 40 µm, 80 µm, 160 µm and 250 µm.

After determining the minimum ignition temperature for 4 granulations selected was obtained the minimum ignition temperature variation of the particle size of the powder tested according to the chart presented in the fig. no. 3.

Table 1. Minimum ignition temperature of various combustible dusts.

No.	Sample	Minimum ignition temperature of dust cloud °C
1.	Wheat Flour dust 1	420
2.	Wheat Flour dust 2	435
3.	Wheat Flour dust 3	420
4.	Wheat bran 1	440
5.	Wheat bran 1	520
6.	Semolina dust	660
7.	Zinc oxide	780
8.	Wood waste dust	760

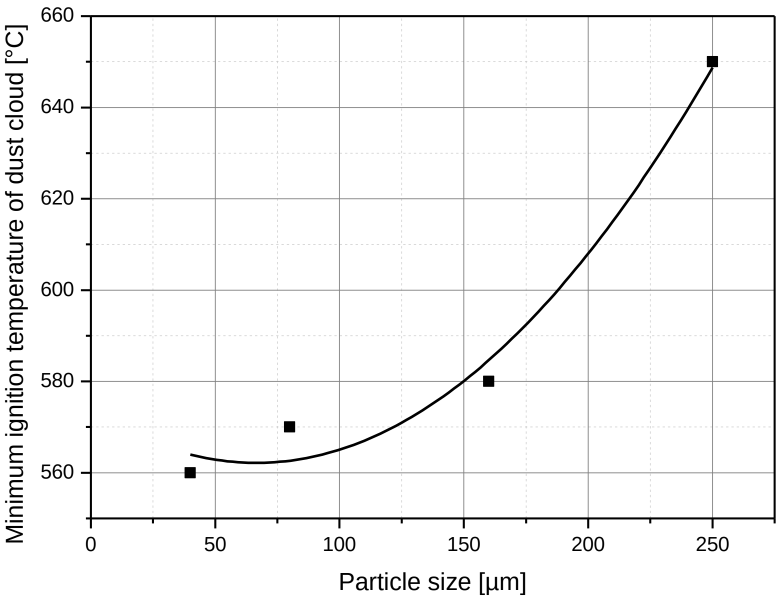

Fig. no. 3. The variation of the minimum ignition temperature of coal dust cloud function of particle size

From the chart one can observe that the temperature variation in small particle is practically negligible, the difference experimentally obtained being 10 °C, but for the larger particle, respectively 250 micrometers, difference is one noticeable, almost 100 °C compared to the obtained temperature at the lowest particle size. The minimum ignition temperatures of the the combustible dusts tested in the present work are in good agreement with literature data. The test results validate the method and the working mode, the testing procedure being proposed for SR ISO 17025:2005 accreditation within the competence domain of the Group of Laboratories of NRDI GLI INSEMEX Petrosani.

4. Conclusions

In order to assess the risk of explosion, to prevent unwanted events and to increase the level of explosion protection in industrial applications it is necessary to know the characteristic parameters of mixtures of air - combustible dusts.

The knowing of the minimum ignition temperature at which a dust cloud ignites is necessary in order to prevent the risk of explosion due to the presence of hot surfaces. Hot surfaces are able to initiate dust clouds existing in industry (ovens, burners, various dryers, housings of electrical equipment). In addition, hot surfaces can be generated by the overheating of components or mechanical parts of the equipment. Working temperature is generally restricted to two-thirds of the minimum ignition temperature of the dust. Ignition temperature is influenced by the size distribution of dust. Some extremely fine powders may have ignition temperatures so low as to be regarded as pyrophoric powders.

For a specific powder, the parameters are influenced by the concentration of explosive dust-air mixture, the moisture content and particle size of the powder. Studies in connection with the dependence of the particle size of the powder for a few types have shown that there is the characteristic diameter in the minimum ignition temperature that is no longer dependent on the particle size.

Experiments were performed to determine the minimum ignition temperature of the dust cloud chosen for each particle size. It was noted that the temperature variation in small particle is practically negligible, the difference experimentally obtained being 10 °C, but for the larger particle, respectively 250 micrometers, the difference is one noticeable, almost 100 °C. The results obtained are in good correlation with the literature data. The testing procedure is in this way proposed for SR ISO 17025:2005 accreditation within the competence domain of the Group of Laboratories of NRDI GLI INSEMEX Petrosani

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7th International Multidisciplinary Symposium

„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Methods and tools for determining air-flow in industrial ventilation installations

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Abstract

A ventilation system is defined by the exchange of air between the inside and outside environment in order to create ambient conditions as close as possible to the thermal comfort conditions required. Calculating the required air flow for ventilating a room can be quite challenging, and a wrong choice may lead to its inefficiency. Before installing a fan, there has to be analysed the space in which it has to be used and the method for compensating exhausted air (mechanically using another fan or naturally by dimensioned grids). For some rooms it is very challenging to calculate the air flow required for ventilation. It has to be calculated both for summer and for winter situation. Industrial ventilation and cooling systems aim to ensure air purity conditions and the proper microclimate for the activity carried out by the humans and for the type of technological process. Achieving these requirements contributes to maintaining the work capacity, to removing occupational diseases, to increasing the work productivity, quality of products etc.

Keywords: industrial ventilation, explosive and/or toxic atmosphere, microclimate, air flow

1. Microclimate conditions

Industrial buildings usually include large spaces with various sources of harmful agents. Type of sources and their location depends on the technological process of each division. (Olga Bancea, 2009) In order to dilute harmful agents, to maintain environmental conditions necessary for safety at work and to achieve the microclimate required by the production process, large volumes of air are circulated through the industrial ventilation systems.

Structuring industrial ventilation systems requires thorough knowledge of the technological process (Alexandru Cristea, 1971), of machinery and their location, nature and quantity of harmful agents, environmental conditions required in terms of technology and safety at work. Computation bases and considerations in the field of apartment, administrative and cultural buildings remain valid in the case of industrial ventilation systems, with a number of particularities:

- When adapting a ventilation system, beside the constructive architectural constraints, also technological, operational restrictions and restraints related to the possibility of equipment placement emerge;
- In ventilated spaces, besides heat, humidity and CO_2 other harmful agents are released.

2. Applicable ventilation systems

The adopted ventilation system must take account of the technological process, density of sources, and propagation of harmful agents and the intensity of harmful agent’s release. Systematic natural ventilation – in case of heated workshops without release of noxious vapours, gases or dust with high heat releases and less releases of moisture, mainly applied in the form of mixed ventilation or along with other systems. General exchange mechanical ventilation – applied when there occur releases of harmful substances and the systematic natural ventilation is insufficient. Local exhaust ventilation – used in order to improve working conditions in certain areas adjacent to sources of heat, strong radiant sources or to prevent entry of cold air through exterior doors.

Local air intake ventilation - when there are concentrated sources of harmful releases and general ventilation is insufficient even in large volumes of air. Local absorption and exhaust ventilation - for example in industrial ablutions.

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Emergency ventilation - automatically turns on in case of large accidental releases of harmful substances occurrence as a result of technological equipment failures. Industrial air-conditioning- is required by the manufacturing processes, the need for precise conditions, in case of high precision processing, testing, and calibration.

3. Air properties

Air is the agent through which all ventilation and conditioning processes are accomplished. (Matthew I. Moraru, R, et al., 2000) As such, its properties directly influence the quality and quantity of phenomena participating in this process. In ventilation and air conditioning techniques, properties of interest are the chemical, thermodynamic and hygienic ones. Air is a mixture of gases, each having different physical and chemical properties. The main components of air are oxygen and nitrogen, besides which rare gases such as argon, neon and helium are present in low percentages and a variable content of carbon dioxide.

The pressure exerted on a gas consist of the atmospheric pressure and additional pressures such as those produced by fans and compressors. Airflow means performing mechanical work involving energy consumption (power). This power can be supplied by a machine such as a fan or other sources such as heat.

4. Ventilation niches

Local ventilation systems (Doru C., C. Lupu, Gheorghe I, 2013; Niculescu, N., Duta, Gh., Stoenescu, P., Cold, I., 1982) can be classified according to the nature and spreading manner of harmful releases, type and size of equipment, particularities of technological processes, constructive composition of premises, etc. Depending on how they provide local working conditions we may have:

a. Local exhaust ventilation installations - in situations in which ensuring microclimate conditions require the use of air jets in the form of air showers or air curtains;

b. Local absorption ventilation installations - when harmful substances are concentrated, their entrapment is performed on-site by:

- Open devices: hoods, marginal aspirations;
- Semi-closed devices: ventilation niches;
- Closed devices: casings;

Local absorption and exhaust ventilation installations - are systems that locally entrap harmful substances, if for the equipment housing cannot be performed in current work conditions, by creating, through air jets discharged on one side and entrapped on the opposite side, a curtain above the source which to limit the spreading of harmful substances and to provide the air's directed movement into a geometrically space confined or not; the system is used for: industrial ablutions, drying tunnels, electrolysis tanks. Ventilation niches may be found in the form of work benches, shaded on three sides, having a working space and access in the front, open / closed during operation/use. Niches can be of laboratory or industrial type.

Depending on inside air directing manner, dictated by density of released harmful substances in relation to inside air density, we may have:

- Niches with absorption openings at the top (figure 1a);
- Niches with absorption openings at the bottom (figure 1b);
- Niches with absorption openings at the top and at the bottom (figure 1c, d).

Ventilation niches can be made of blackboard, zinc-plated sheet, stainless steel, plastic, glass, polystyrene reinforced with glass fibre, etc., depending on the aggressiveness of entrapped harmful chemicals.

In premises having more niches, depression conditions between rooms will avoid spreading the released harmful substances, or mixing with various other harmful emissions. Measures taken are intended for avoiding explosive, flammable or highly corrosive mixture. The best solution would be for each niche to be backed by a compensation fan or air treatment assembly. The economic version is accepted, by grouping niches on exhaust systems with joint groups for compensating locally evacuated air, but while ensuring differentiated depression conditions between premises.

In Figure 1, the represented laboratory niche has the following components: 1- work bench; 2- niche body; 3- partition; 4- sash window; 5-upper absorption opening; 6-bottom absorption opening; 7-additional absorption hole; 8- technological fluid connections (water, gas, compressed air etc.)

For local absorption niche type devices, the question of determining air speed in the niche's free section rises, provided that these concentrations of noxious substances released in counter current to the air flow do not exceed, past the worker, the allowable concentration value.

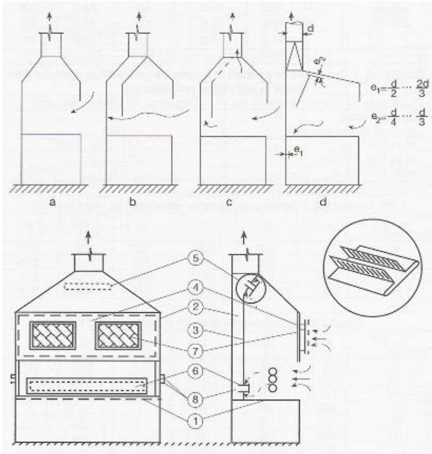

Fig. 1 Types of ventilation niches

If the concentration of harmful substances in the niche is known, denoted by y_0, absorption speed v will be measured, satisfying the condition that, at a distance x=a, the value y_a of allowable concentration is observed. (Figure 2)

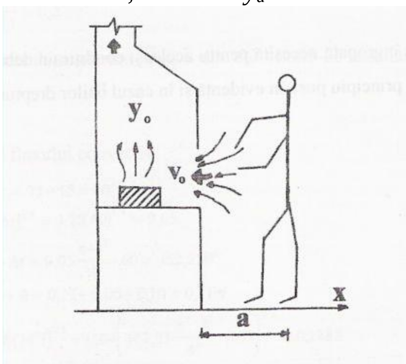

Fig. 2 Niches calculation scheme

The concentration of harmful substances within the niche y_0 depends on the flow of pollutants released, the internal volume and the niche's aerodynamics. Working conditions require distance between worker and niche (denoted by *a*) and the requirements for health and safety at work require an allowable concentration value y_a.

$$y_a - y_0 e^{-\frac{v}{A}a} = 0 \qquad or \qquad v = \frac{A}{a}\ln\frac{y_0}{y_a} \tag{1}$$

According to this equation, for slowing down the absorption and airflow speed, diffusion coefficient A and concentration of harmful substances in niche y_0 will have to decrease, because increasing the distance and allowable concentration y_a cannot be achieved in working conditions, with respect to work safety.

A decrease in concentration of harmful substances within the niche can be provided, if an evacuation by absorption is achieved, differentiated depending on density and ascending forces of harmful releases. Another solution to reduce the concentration is to increase the niche's volume or to input additional air at the bottom of the niche, but provided that there is no leakage of pollutants within it. The kinetic energy of internal air currents has an influence on the diffusion coefficient A and on the turbulences around the absorption opening of the niche. Local turbulence can be attenuated by installing aerodynamic edges on the absorption opening's contour. The ventilation system will have to be linked with the movement of air currents caused by movement of workers, machinery, equipment and convective currents produced by heat sources. For industrial departments having specific indoor air turbulence, diffusion coefficient A, after *Elterman* is:

$$A = 2{,}5\varepsilon^{\frac{1}{3}} d^{\frac{4}{3}} \tag{2}$$

where:
- ε - represents the room's specific kinetic energy based on the weight of air in the room in m^2/s^3;
- d – equivalent diameter of the niche's absorption opening in m.

For open hoods, air velocity in the absorption section plan can be determined based on the following approximate data, which must also be verified with the equal velocity curves:

- for entrapping water vapour v = 0.3 m / s;
- for entrapping gases and vapours whose allowable limit concentration is higher than of 0.1 mg / l, v = 0.5 m / s;
- for entrapping polluted air with a temperature of 30 ÷ 70 ° C, v = 0.7 m / s;
- for entrapping air polluted with toxic substances or when the temperature exceeds 70 ° C, v = 1 m / s.

5. Air flow measurement tools

The main parameters involved in the definition of ventilation and air conditioning installations are: air pressure, air velocity, temperature and humidity.

The air pressure is measured with the U air gauge, micro air gauge with liquid and with pressure probes or tubes.

The flow rate is a parameter characteristic for fluids in motion, and represents the quantity of fluid passing per time unit through the area unit.

For measuring flow we can use:

- Frontal measuring systems with differential pressure cells,
- Systems with electromagnetic transducers,
- Variable area measurement systems,
- Positive displacement measurement systems,
- Turbine transducers systems,
- Ultrasonic transducers systems,
- Vortex extinction transducers systems,
- Thermal transducers systems,
- Coriolis transducers systems, etc.

Flow measurements are related to the principle of mass conservation, showing that a static mass which enters a system in a time unit is equal to the mass exiting the system, in the same time unit.

Flow measurements refer to fluids, flow of solids being measured by weighing and counting. Fluids whose flows are measured may be liquid, gas, steam and suspensions.

Flow rates are measured in open or closed ducts, except gas flow rates, which are measured only in closed ducts.

6. Conclusions

Ensuring the microclimate conditions which are appropriate for work carried out by people or technological features of the process, consists in maintaining or limiting to specific values the agents which guarantee environmental quality of an industrial site. The microclimate of a premise involves maintaining to specific values the following parameters:

Thermal comfort agents: air temperature, relative humidity, air velocity, mean radiant temperature, clothing thermal resistance;

Secondary agents: air cleanliness, ionization degree, noise, biological factors, lighting level, radiations.

In industrial departments in which are released concentrated harmful substances, local entrapment systems can be applied or they can be endued with absorption, exhaust or absorption and exhaust devices. These systems limit the spreading of harmful substances and ensure air parameters in the work area. The solution of increasing the ventilation flow in order to achieve allowable concentrations of harmful substances in the work area generates high air velocities and risk of spreading harmful substances throughout the entire volume of the hall.

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Increasing the capacity of theoretical and practical training for intervention and rescue personnel in toxic/ explosive/ flammable environments by using chemical protective equipment

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Abstract

In order to protect health and safety at work, Member States of the European Union must implement the minimum requirements imposed by European Directives (aimed at the harmonization of conditions for use of chemicals) under Article 137 (ex 118A) of the Amsterdam Treaty. Currently, nationally, no such approach for use of chemical protective equipment by intervention and rescue personnel in chemical toxic / flammable / explosive environments is developed. In this respect, the paper represents the result of research work conducted within the National Program highlighting the importance of using chemical protective equipment by intervention and rescue personnel, with protective breathing apparatus placed both inside and outside the suit. The purpose of this paper is to present the inset of such equipment during rescuers training and for various types of intervention, where this would be appropriate, under specific procedures that comply with usage / handling / dressing and undressing procedures. Importance of the paper resides in the protection of intervention and rescue personnel against hazards for safety and health in case of interventions in toxic /explosive /flammable environments.

Keywords: intervention and rescue personnel; toxic/ explosive/ flamable environments; chemical protective equipment

1. Introduction

The chemical protective equipment is a personal protective and impermeable protection to gas equipment. The equipment must be chosen in accordance with the purposes of protection, ergonomic conditions and must fit the wearer.

Personal protective equipment includes any equipment intended to be used by workers to protect them against dangers related to safety and health at work. Personal protective equipment should be used only after all other measures have been taken against remaining potential dangers. When working with harmful, medium or high toxicity chemicals, human health is subject to high risk. The quality of materials and protection equipment design are specific to working conditions depending on the concentration and toxicity of chemicals that may occur. It must be emphasized that these protective equipments do not always work against industrial toxic chemicals. Efficacy is determined by the materials, type and level of exposure and duration of exposure.

2. Mechanisms that cause harmful effects caused by chemical agents

Chemical agents may have harmful effects on the human body, either directly or through generating some form of energy that can prove harmful to human health. In the first case, for a chemical agent to be able to directly harm the body, it is absolutely necessary (but not sufficient) that its molecules make contact with the body concerned.

Injury can occur quickly or immediately after contact (acute effect) or may occur in the long term, normally due to repeated exposure over time (chronic effect).

From another point of view, damage can occur at the point of contact between chemical and body (skin, respiratory system, digestive system), in which case we speak about local effects, or can occur after a process of absorption and

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distribution in the body, in more areas, irrespective of where the contact occurred (systemic effect). The local effects may be, for example, irritation of the respiratory tract caused by inhalation of ammonia or skin burning caused by contact with sulphuric acid. Some examples of systemic effects may be liver damage caused by inhaling certain solvents or neurological damage caused by inhaling mercury vapours. In the second case, the adverse effect is caused by the energy released as a result of combustion or explosion of chemical agents capable of causing such phenomena.

Fires in the workplace can cause serious injuries to workers, especially if appropriate emergency measures are not taken; almost invariably, they cause serious damages to business assets. Explosions occur when there is a sudden reaction of oxidation or decomposition caused by an increase in temperature, pressure or increases in both parameters at the same time. Because they are virtually instantaneous, explosions generally have very serious effects both on individuals and premises.

Because of the destructive potential of explosions, the European Union issued Directive 94/9/EC (Government Decision no.752/2004) concerning protective equipment and systems intended for use in potentially explosive atmospheres and Directive 1999/92/EC (ATEX) (GD no. 1058/2006) on work in explosive environments, the latter Directive leading to publishing of a good practice guide by the European Commission.

3. Characteristics of chemical protective equipment

Personal protective equipment (PPE) includes any equipment intended to be used by workers to protect them against dangers related to safety and health at work.

Because of chemical agents that may occur in workplaces it is necessary to use chemical protective equipment when working with medium or high toxic harmful chemicals, because human health is at particular risk.

Main features to be met by safety equipment are:
- Permeation
- Degradation
- Penetration

Permeation is the process by which a chemical dissolves or moves through a molecular-based material. In most cases, there will be no visible evidence on a material, of chemicals penetrating it. Penetration time and permeation are most commonly used result to evaluate the chemical compatibility of the material.

The permeation rate is a function of several factors, such as: chemical concentration, thickness of material, moisture content, temperature and pressure. Most test equipment is made with 100% chemical compounds over a period of prolonged exposure. The time required for the chemical to penetrate the material represents the detection time. However, the effects of temperature and pressure may increase permeation and reduces the magnitude of this safety factor, such as, for example, small increases in the ambient temperature can significantly reduce the penetration time and protective properties of a protective clothing’s material.

Degradation involves physical changes in a material because of chemical exposure, use or environmental conditions (e.g., sunlight). Most common observations of material degradation are discoloration, swelling and loss of physical strength or deterioration.

Penetration is the movement of chemicals through zippers, seams or imperfections in a protective clothing material. NRDI INSEMEX Petrosani acquired two chemical protective equipments within a National Project intended to be used both in training conducted within the Institute’s training facility and in case of damages occurring in toxic / flammable / explosive environments.

4. Types of chemical protective equipment

Depending on type of construction, chemical protection equipments are divided into two categories:
- Simple chemical protective equipment without the use of protective breathing apparatus.
- Complex chemical protective equipment using filter protective masks and protective breathing apparatus.

The most complex chemical protective equipments are:
- Chemical protective equipment used with breathing apparatus worn outside the protective suit.
- Chemical protective equipment used with breathing apparatus worn inside the protective suit.

If using type appropriate respiratory protective equipment, protection time provided depends on:
- Nature of chemical in the working environment;
- Aggregation state of chemical (gas or solution);
- Risk level, respectively concentration of chemical in solution or atmosphere;
- Additional superficial mechanical aggression;
- Working environment temperature.

Chemical protective equipment with outside protective breathing apparatus

This equipment provides excellent protection against industrial chemicals, biological agents, and war toxic substances (Figure 1).

Fig. 1. Chemical protective equipment with breathing apparatus worn on the outside protective suit

It is made from D-mex material, providing a unique resistance to various substances, excellent protection to mechanical stress as well as protection from liquefied gas and fire. It also protects against dangers that may arise from working with hazardous substances.

The material is antistatic (D-mexTM), providing strength and excellent protection against chemical and mechanical influences, is composed of five layers and its reliability has been tested using hazardous substances. The medium layer is made of fabric resistant to tearing; inside and outside there is a layer of extremely robust elastomer as well as a barrier layer, highly resistant to chemicals. Thus, the chemical protective equipment maintains full protection performances even in case of damaged outer layer.

Components:

• Valve having a cooling effect on the body and additional breathing air from external sources;
• Socks with elastic edge that can be worn with protection boots ensuring maximum comfort for the wearer;
• Gloves which provide very good mechanical and chemical protection;
• Rubber ring for fitting the super-glove on the cuff;
• Boots made of nitrile-P, material that provides excellent protection against penetration, cutting and abrasion.

Chemical protective equipment with inside protective breathing apparatus

This type of chemical protective equipment provides excellent protection against industrial chemicals, biological agents and war toxic substances. It can also be used in potentially explosive environments and when handling cryogenic substances (Figure 2).

Fig. 2. Chemical protective equipment with breathing apparatus worn on the inside

This type of protective equipment is made from D-mex material, providing a unique resistance to various substances, excellent protection to mechanical stress as well as protection from liquefied gas and fire. It also protects against dangers that may arise from working with hazardous substances.

D-mex material is composed of five layers. Among the five layers, the middle one is a tear-resistant fabric. Over the entire equipment, both inside and outside, there is a special elastomer layer and a barrier layer, which are resistant to chemicals. This special coating allows the suit to retain all its protective ability even when the outside material is damaged. Electrostatic properties of the chemical protective equipment make possible the use of equipment in potentially explosive areas classified as zone 0. If a spark reaches this material, the ignition delay and self extinguishing material protects the wearer from severe burns. D-mex ™ material is flexible, making possible the handling of liquefied gases such as ammonia at a contact temperature of -80 ° C.

Chemical protective equipment is used to protect when handling toxic or hazardous materials.

It comes with an adjusted for height support for assembling the pressure gauge or bodyguard system within the wearer's field of vision.

Components:

• Boots made of nitrile-P, material that provides excellent protection against penetration, cutting and abrasion
• Gloves that combine resistance to cuts with protection against chemicals;
• Socks with elastic edge that can be worn with protection boots ensuring maximum comfort for the wearer

5. Conclusions

Currently, nationally, no approach for use of chemical protective equipment by intervention and rescue personnel in chemical toxic / flammable / explosive environments is developed. Internationally, concerns in this area mostly fall under the head of research departments of companies producing equipment for protection in chemical, toxic / flammable / explosive environments.

Chemical protective equipment with breathing apparatus worn both on the outside and on the inside of the protective suit will be used both in training conducted within the Institute’s training facility and in case of damages occurring in toxic / flammable / explosive environments. Analysis and systematization of chemical protective equipment led to the fact that the most useful, practical and complex chemical protective equipment for rescue / intervention staff are:
• Chemical protective equipment used with breathing apparatus worn outside the protective suit.
• Chemical protective equipment used with breathing apparatus worn inside the protective suit.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH"

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Methodological critical issues for the assessment of the environmental impacts from transport of marble: a case study

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Abstract

The marble mining is very important for the Italian economy and has important traditions, especially in some areas. Among these, there is the area of the Dolomites in Val Venosta, located in Trentino, one of the North-East Italian regions. In many cases, these quarries are very old and often are located in areas with high natural value. This work regards two quarries, which are located within an important national park. The need to reduce the environmental effects related to the traffic of trucks used for the transport of marble from the quarries to the processing plants has led us to make assessments on the methodology to apply. This paper presents the methodological approach identified to determine the best technical solution among several alternatives regarding the transport of marble. The validation of the methodology has its natural outlet in the application to a real case, subject of another article. Some considerations on the replicability of the approach are included too.

Keywords: atmospheric emission; environmental balance; impact assessment; marble; protected areas; traffic.

1.Introduction

This work concerns the description of the methodological approach regarding how an environmental assessment relating to the transport of marble from quarries can be developed. We looked at two quarries (Weißwasser in Lasa and Mitterwandl in Covelano) located in Val Venosta, a beautiful area in the Stelvio National Park (Trentino, Northern Italy). The marble extracted from both the quarries is delivered to two processing plants located in the same valley.

The presence of the two quarries within such an important national Park is justified by the fact that they are very old quarries, whose construction is much earlier than the establishment of the Park. Moreover, the presence of the marble quarries also has important social and economic implications, giving work to many people. Of course, the current legislation prohibits the opening of other new quarries in the protected area.

The transportation of marble from Lasa quarry is made by cableway, train and an inclined plane; it is made by trucks from Covelano quarry.

The problem that has been addressed is the environmental compatibility of quarries, without considering the ones of mining of marble activities, but taking into account only those concerning the transport of marble from the quarries to the processing plants.

In particular, the more interesting and critical case concerns Covelano quarry. In fact, the transport of marble from Covelano is carried out only with tucks passing through the winding roads of the area.

It is clear that the transport of marble with trucks has strong environmental implications, but there are also economic factors that can lead to change the way of transport in other solutions. The alternative solution that has been considered is the one that provides for the use, at least for a portion, of the transport of marble coming from the system of Lasa

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quarry. The Lasa quarry is very old and, in particular, the inclined plane is an extremely interesting solution from the mechanical engineering point of view. Of course it requires a safety management with specific expertise.

Thus, the first solution of the comparison regards the route travelled currently by the Covelano company trucks. The second one considers the combined use of trucks, railways, cableway and the inclined plane.

Normally, when we have to consider alternative solutions, there are several approaches that can be adopted. A possible approach is the use of decision support systems (DSSs) that consist of several sub-models, each one facing several aspects in a manner usually simplified; a sub-model can assess the environmental implications, other the economic costs, another the compliance and enforcement with respect to current regulations, etc. However, an approach of this kind often suffers the simplifications that are not always appropriate to consider the small-scale problems.

Another possible approach is the life cycle analysis (LCA), which, once bordered the field of investigation, considers the different environmental effects and combines them into broad groups of parameters related to various environmental issues. This approach is suitable, but needs a very detailed analysis of the emission factors.

The methodological approach proposed here can be considered a base for the development of systems that apply the DSSs or LCA. However, its completeness from the environmental point of view allows getting to be suitable to make choices between alternative solutions.

Therefore, we set the comparison of solutions, considering only the environmental effects of the transport of marble and considering a number of compartments which are important for the local context in which the analysis was done. So, we considered the environmental elements as the most important for the potential nuisance in a such important park: atmospheric emissions, noise and vibrations, light pollution and the effects on flora and fauna.

2.Current situation and alternative scenarios

Some details regarding the two quarries are shown in the following table 1.

Table 1. Characteristics of the two quarries

	Covelano	Lasa
Capacity fixed by concessions	5000 m^3/year	5000 m^3/year
Working period	Summer time	All year
Transported quantity in blocks	2.000 m^3/year	2.000 m^3/year
Debris quantity reused on site and/or deposited on site	3.000 m^3/year	3.000 m^3/year
Number of travels	4 downhill + 4 uphill (empty)	
Altitude	2.165 m a.s.l.	1.555 m a.s.l.
Transport	Trucks	• cableway (length 1,350 m; altitude difference -195 m; payload 20 t); • upper railway (narrow-gauged diesel/electric railway; length 1,800 m; altitude difference -25 m); • inclined plane (inclined elevator rope, on rails; length 950 m; altitude difference -475 m; payload 20 t); • lower railway (narrow-gauged diesel/electric railway; length 800 m; altitude difference -5 m).

The two alternative solutions proposed to move the marble from Covelano quarry to the processing plant, located in Silandro, 690 m a.s.l.), are: solution 1 – only trucks for about 17 km of road, most inside the park; solution 2 – trucks for about 16 km + cableway for 1.2 km + train for 1.25 km and inclined plane for 0.85 km.

3.Description of the method

With respect to solution 1 the transport analysis shows that the activity involves the transit of eight trucks per day: four travel downhill with full load and four travel uphill unloaded. With solution 2, the marble is initially transported by truck along a forest track and later carried downstream through the cableway, two railway stretches and down the slope; the latter is currently used by Lasa quarry. We hypothesized that the load capacity of a railway car is comparable to the load capacity of a truck; therefore, the use of Solution 2 involves eight additional journeys with the train; four outbound and four return.

3.1. Length of the routes

We compared the route length, travelled by truck both in terms of total emissions and as percentage of emissions released within the protected area of the National Park of Stelvio.

3.2. Emissions into the atmosphere

The pollutant emissions into the atmosphere by truck transport were estimated using standardized emission factors, according to the COPERT methodology. COPERT is a software tool adopted world-wide to calculate emissions from road transport (Ciuta et al., 2012; Torretta et al., 2012; Carletti et al., 2013; Gavanas et al., 2014; Istrate et al., 2014; Lozhkina and Lozhkin, 2015; Feng et al., 2015). The daily emission, on the single road section, was estimated as follows:

$$E_i = \sum_c FE_{i,c} \cdot L \cdot N_c \qquad (1)$$

where:

E_i: emissions of the pollutant "i" [gd^{-1}];

$FE_{i,c}$: emission factor for the pollutant "i", relevant for the vehicle class "c" [g km^{-1}];

L: average trip length [km];

N_c: number of daily transits for the vehicle class "c" [d^{-1}].

The key element for the evaluation is the emission factor $FE_{i,c}$, which expresses the vehicle emissions for every kilometre travelled. The emission factors may depend on additional parameters:

4. type of vehicle (engine, weight);
5. type of gear (average speed, engine temperature, cargo condition, road slope);
6. registration (reference standard of registration).

For this study, the emission factors developed in the COPERT IV methodology were used (Emisia, 2015). For the calculation, heavy diesel Euro IV vehicles weighing between 16 and 32 tonnes were considered (as these are currently used by the companies). It was assumed that these vehicles follow the road from the quarry with full load downhill and drive back empty uphill. "Hot" emission factors were taken into account, while "cold" (i.e. at engine start) emission factors were neglected. The average speed was assumed to be 15 km h^{-1} on average on the forest tracks, 30 km h^{-1} on asphalted roads with full load and 40 km h^{-1} on asphalted roads in case of empty trucks. Finally, the emission factors were assessed on the route slope. For the cableway and inclined plane the emissions were considered as zero as they are electrically powered. In absence of specific data, diesel fuel railway tractors were considered as heavy-duty vehicles for what pollutant emissions is concerned. NO_x, PM_{10} and PM_{30} emissions were estimated for the two solutions. PM_{30} can be considered a good proxy for total suspended particles.

3.3. Wear of brakes, tyres and road surface

In addition to the exhaust emissions, the wear of brakes, tyres and road surfaces also needs to be considered. The order of magnitude of dust generated in this way is comparable, and in some cases greater, than the amount emitted by the exhaust (Duong and Lee, 2011; Chandra Verma et al., 2015). Also in this case, as with the exhaust emissions, the COPERT IV methodology was used, described below (Emisia, 2015).

Brakes' and tyres' wear

PM_{10} emissions on the road section are defined by the relation:

$$E_{PM10} = \sum_j N_j \cdot L_j \cdot EF_{TSP,s,j} \cdot f_{s,i} \cdot S_s(V) \qquad (2)$$

where:

N_j: number of the vehicle class "j";

L: average trip length [km];

$EF_{TSP,s,j}$: emission factor for the total dust, relevant for the vehicle class "j" [g km^{-1}];

$f_{s,i}$: Total Suspended Particulate (TSP) mass fraction attributable to PM_{10};

$S_s(V)$: correction factor according to the average vehicle speed.

As regards the tyre wear of heavy vehicles, the emission factor is estimated on the basis of the following formula:

$$EF_{TSP,T,HDV} = \frac{N_{axis}}{2} \cdot LCF_T \cdot EF_{TSP,T,PC} \tag{3}$$

where:

$EF_{TSP,T,HDV}$: emission factor [g km^{-1}];

N_{axis}: number of vehicle axis;

LCF_T: correction factor related to the cargo= $[1.41 + (1.38 \cdot \%_{cargo})]$;

$EF_{TSP,T,PC}$: emission factor of light vehicles = 0.0107 g km^{-1}.

60% of the total dust is considered as PM_{10} fraction ($f_{s,i}$); 1.39 is the correction for speed lower than 40 km h^{-1} (EMEP-EEA, 2013).

The formulation for brake wear calculation is similar:

$$EF_{TSP,B,HDV} = 3.13 \cdot LCF_B \cdot EF_{TSP,B,PC} \tag{4}$$

where:

LCF_B: correction factor related to the cargo = $[1 + (0.79 \cdot \%_{cargo})]$;

$EF_{TSP,B,PC}$: emission factor of passenger vehicles = 0.0075 g km^{-1}.

98% of the total dust is considered as PM_{10} fraction ($f_{s,i}$); 1.67 is the correction for speed lower than 40 kmh^{-1} (EMEP-EEA, 2013).

Wear of road surface

PM_{10} emissions on the road section are defined by the relation:

$$E_{R,i} = \sum_j N_j \cdot L_j \cdot EF_{R,j} \cdot f_{R,i} \tag{5}$$

where:

N_j: number of vehicle class “j”;

L: average trip length [km];

$EF_{R,j}$: emission factor for the total dust, relevant for vehicle class “j” [g km^{-1}];

$f_{R,i}$: TSP mass fraction attributable to PM_{10}.

In this case the emission factor for heavy duty vehicles is 0.760 g km^{-1}, 50% of which is the estimated to be PM_{10} (EMEP-EEA, 2013).

3.4. Generated impact

The calculation method was used to estimate the exhaust emission. This impact is fairly limited because of the low number of transits. In the estimation of the emitted particulate, the dust from the road surface from the vehicle transit needs to be considered especially for the dirt tracks. The particulate estimation was calculated using the United States Environmental Protection Agency (EPA) methodology (AP42), in which emissions data from productive activities are collected (EPA, 2015).

In general terms, the amount of resuspended material depends on the amount of material present on the road surface and continuously recirculated in the surrounding environment. In the evaluation, two different algorithms were applied for tarmac and dirt tracks. Emissions from resuspension along tarmac road surfaces can be assessed specific emission (g km^{-1}) by means of the following empirical relation:

$$E = k(sL)^{0.91} \cdot (W)^{1.02} \tag{6}$$

where:

sL: road surface silt loading [g m^{2}];

W: average weight of the vehicles on the road [t];

k: particle size multiplier for particle size range and units of interest (3.23 g km^{-1} for PM_{30}) [g km^{-1}].

In relation to the vehicle weight, loaded trucks downhill (32 t) and unloaded trucks uphill were separated.

Emissions from resuspension along dirt track surfaces (g km^{-1}) are imputable to wheel action on the road surface and to the effect of turbulence generated behind the vehicle, both keeping the material in suspension. These contributions are estimated according to the following empirical relation:

$$E = k\left(\frac{s}{12}\right)^{a} \cdot \left(\frac{W}{3}\right)^{b} \tag{7}$$

where:

s: surface material silt content (5-15%);
W: average weight of the vehicles traveling on the road [t];
k, a, b: coefficients for PM_{30} $(a = 0.7; b = 0.45; k = 1{,}381 g km^{-1})$.

3.5. Traffic and intersection with footpaths

Presently long stretches of the road cause difficulty in vehicles intersection. The road is also used by other users; this simultaneous usage was assessed and the critical points were identified. In addition, the radius of curvature in a forest track is in some cases pretty small, thus impacting on the transit of heavy-duty vehicles. In addition, the possible intersection of routes travelled by the marble trucks and footpaths was considered, given the high environmental and touristic significance of the area.

3.6. Noise

The noise caused by the vehicles used for the transport from Mitterwandl quarry was estimated for both the solutions on the basis of the most sensitive elements affected by the transit (van Langevelde et al., 2009). The unit of measure that was used are the A-weighted decibels (dBA).

Solution 1

Along Route 1 two inhabited buildings were most affected, with eight trucks passing by on average each day: four travelling downhill with full load and four uphill with empty load. The noise emission was estimated using an analytical model, developed by the Italian National Research Council. This simple formulation method (Cocchi et al., 1991) takes into account the specific geometrical-environmental characteristics of the analyzed site and the traffic counts. The formula for the calculation of the emitted equivalent noise level (L_{Aeq}) is:

$$L_{Aeq} = 35.1 + 10log\left(Q_l + 8Q_p\right) + 10log\left(\frac{25}{d}\right) + \Delta L_v + \Delta L_f + \Delta L_b + \Delta L_s + \Delta L_g + \Delta L_{vb} \tag{8}$$

where:

Q_l: traffic flow in one hour related to light vehicles [veh h^{-1}];
Q_p: traffic flow in one hour related to heavy vehicles [veh h^{-1}];
d: distance between the middle of the road and observation point on the road's edge;
ΔL_v: correction due to mean flux velocity defined in Table 2;

Table 2. Correction factor due to mean flux velocity.

Flux mean speed [km h^{-1}]	ΔL_v [dBA]
30-50	+0.0
60	+1.0
70	+2.0
80	+3.0
100	+4.0

ΔL_f: correction for the presence of reflective façade near the observation point $(+2.5dBA)$;
ΔL_b: correction for the presence of reflective façade in the opposite direction to the observation point $(+1.5dBA)$;
ΔL_s: correction for the road's surface type defined in Table 3;

Table 3. Correction factor for the road's surface.

Road's pavement	ΔL_s [dBA]
Smooth Asphalt	-0.5
Rough Asphalt	+0.0
Cement	+1.5
Rough pavement	+4

ΔL_g: correction for the road's gradient greater than 5%. The correction value is $+0.6dBA$ for each % gradient over 5%;
ΔL_{vb}: coefficient taking into account the presence of traffic jams $(+1.0dBA)$ or slow traffic $(-1.5dBA)$.

<u>*Solution 2*</u>

Most of the route of solution 2 is within the Stelvio Park, far away from inhabited buildings. The marble is carried downhill by the forest road, cableway, upper and lower railways and down the slope to the industrial area of Lasa and then to the Covelano factory. Along Route 2, the two most affected inhabited buildings are located close to the lower railway stretch. The impact on noise was not considered, being negligible with respect to the traffic induced noise impact on the main road in the municipality of Lasa. The small number of trucks (eight per day) is, therefore, not significant. The noise produced by the train was estimated by means of the Schall03 method (Bundesbahn-Zentralamt, 1990), the German regulatory standard. According to this method the reference noise level (L_{Aeq}) is given at a point located at a distance of 25 m, at a height of 3.5 m above ground level, due to the transit of a disc-braked train per hour, characterized by a length of 100 m and a speed of 100 km h^{-1}, and with average conditions of the rail surface. Some corrections have to be made in order to consider the actual values of convoy length, speed and of the real distance from the source. The formula used to calculate the L_{Aeq} is:

$$L_{Aeq} = 51 + D_{FZ} + D_D + D_{l,v} + D_{Fb} + D_s \tag{9}$$

where:

D_{FZ}: effect of type of vehicle;
D_D: effect of brakes (disc or cast-iron brakes);
$D_{l,v}$: effect of length and velocity of train;
D_{Fb}: effect of track type;
D_s: effect of distance.

The results were compared with the formula adopted by the French Centre Scientifique et Tecnique du Bâtiment (C.S.T.B.) (Gabillet and Van Maercke, 1995), which takes into account the train and rails characteristics. Only the noise emitted by the wheels on the rails was considered, since the vehicles drive very slowly. Results thus obtained do not differ appreciably from the previous formulation.

$$L_{Aeq} = 15 - 13log(d) + 10log\left(a\frac{\sum^n Lv^2}{b}\right) \tag{10}$$

where:

n: traffic flow in one hour related to passing trains [train h^{-1}];
d: distance between the lane centre and observation point on the road's edge [m];
L: length of the train [m];
v: speed of the train [km h^{-1}];
a: effect of track type;
b: effect of railcar type;

3.7. Vibrations

The vibrations generated by the passage of vehicles can be a source of significant impact, in particular in the case of laden trucks. UNI 9614 standard (vibration measurements in buildings and annoyance evaluation) is the reference defining criteria for the measurement of vibrations and the assessment of their effect on buildings (Ente Nazionale Italiano di Unificazione, 1990). The definition of allowable limits is determined according to two time periods: daytime, from 7:00 am to 10:00 pm and nighttime, from 10:00 pm to 7:00 am. The analysis highlighted that the most sensitive elements affected by the transit were located near Lasa (Solution 2) and Covelano (Solution 1) because the buildings are closer. The vibration was then calculated at these points, directly at the side of the road.

Solution 1

The Rudder formula (Boniotto, 2010) was used to estimate the vibrations generated by the passage of trucks. This relation is efficient for tarmac regular roads with a uniform surface roughness and thus the acceleration level, at a specified distance from the road, can be calculated. The acceleration level, at a 2 m distance from the side of the road, can be estimated according to the following formula:

$$L_0 = -4.155(PSR) + 17.2log(V) + 10log(W_G) + 52 \qquad dB_{\Re}10^{-6}ms^{-2} \tag{11}$$

where:

PSR: effect of spectral power density of roughness;

V: speed [km h^{-1}];

W_G : gross weight of the vehicles traveling the road [t];

3.8. Flora, fauna and water

The impact that the two solutions may induce on vegetation is primarily due to the vehicle emissions, mainly the dust resuspension (Mitchell et al., 2015). In this study, the effects on vegetation can be quantified on the basis of the track length located in the Stelvio National Park. The impact on the fauna inhabiting the natural park is modest in both solutions since the traffic is limited (eight trucks a day). It is also reasonable to assume that the fauna have adapted to the presence of the forest road. However, the vehicles may be a source of noise and vibrations; moreover illumination may be poorly tolerated by particular types of animals. Finally, there is a risk of direct collision between vehicles and animals, which could lead to dangerous manoeuvre by the truck drivers. However, safety aspects are beyond the scope of this study. Finally, in order to assess the impact on public drinking water sources, the intersections between the two solutions and the protected areas were investigated. The route 2 doesn't have any intersection with water protection areas, whereas the first solution intersects for a few hundred meters a water catchment area, thus showing a higher although not worrying impact on this field.

3.9. Other aspects

The presence of an unconventional system of transport in one of the two scenarios gave also the opportunity to analyze the safe and security aspects of the approach, taking into account the criteria adopted in this sector and the present regulations.

Concerning the replicability of the present comparative study, an analysis of the effort to have available the necessary information has been made in order to understand which is the context suitable to perform the calculations.

4.Conclusions

The study was aimed at setting up a methodology with the purpose of the comparison between two alternative technical solutions. The methodology consisted, first, in choosing the only aspect of the environmental implications. Among these those relating to the most important environmental items in a context like that of study, as an important park area, were selected. Among the various environmental media, of course, are of considerable importance especially those related to air quality, noise, vibration, the flora and fauna. The goal of this work has been to set an approach considering the specificity of the site (gradients of altitude, lengths of paths, use of braking systems, energy consumption, etc.). Moreover, the effectiveness of the methodological system that has been set, must be verified in a practical application that refers to a case study. That will be made in a following article on the two cases described.

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Underground climatic monitoring and modeling: Are we missing something?

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Abstract

There are many instruments on the market and possibilities available to measure and assess the underground ventilation and environmental parameters. These options include small handheld units for spot measurements, data logging type monitors and real-time monitoring systems (e.g. fiber optic). Selecting the most appropriate climatic monitoring system depends mainly on the purpose of climatic monitoring, the magnitude of the mines’ heat load, monitoring locations and cost. However, there are several occurrences that cannot be captured when simple spot units are being used for climatic monitoring purposes. This includes the “*thermal damping effect*”, time-dependent dynamic heat exchanges between the ventilating air and surrounding environments, as well as unknown sharp temperature increases during production cycles. These elements are particularly important to predict the underground climatic conditions in future underground mines. Even if these phenomena are identified and quantified based on in-situ measurements, the key question still remains: How can we take them into account at the modeling phase through the use of standard mine ventilation and climatic simulation programs such as Climsim™, Ventsim™, Vuma™ and MULTIFLUX™ ?

This paper aims to discuss the importance of continuous climatic monitoring in underground mines based on observations of the above-mentioned phenomena and highlight whether these cases have noticeable impact on the overall climatic conditions in underground mines. Discussions will be based on over six months of climatic data, which was collected at an underground mine in the State of Nevada, USA. Multi-channel climatic monitoring units were installed along vertical and horizontal airways from surface to the lowest production level of this mine. The monitoring units were installed in key locations to measure critical ventilation and climatic parameters needed for modeling work. Comparisons were performed between the ventilation and climatic data collected underground and parameters generated by ventilation and thermal models through the use of simulation techniques. Finally, the importance of developing a time-dependent dynamic ventilation-thermal-humidity (VTH) model was analyzed and discussed. This dynamic VTH model will be used to assess various cooling strategies and identify the most effective cooling and refrigeration methods, which can be economically employed in deep and hot mines.

Keywords: Underground mining; climatic conditions, continuous climatic monitoring; tansient heat exchange processes, thermal damping effect.

1. Introduction

Base and precious metal mines in the US are becoming deeper, more productive, and increasingly mechanized. These mining trends will cause the underground environment to become hotter and more humid. A deterioration of the climate experienced within these workings can adversely affect the health and safety of the workforce. Underground mines are now being operated at considerable depths of over 2,000-3,000 m (6,600-9,900 ft). In addition, the presence of heavy production equipment has significantly improved development advancements and production rates. However, this has been achieved at the cost of increased emissions such as: dust, gases, heat and humidity (Kocsis & Hardcastle, 2010).

Mine intake air temperature gradually increases as a function of depth and the length of air travel through the underground opening. The main cause of increased heat transfer to the ventilating air is due to the increase of strata temperature as a function of depth, which is also known as the “geothermic gradient”, and the thermal properties of the surrounding rock formations. Other sources of heat, which can be transferred to the mine air are: auto-compression, mining equipment, explosive detonation, human metabolism and the influx of thermal water.

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The evaluation progression of an underground environment includes extensive monitoring of temperature and humidity with adequate thermal management protocols established for each underground mine (Carpenter et al., 2015). Climatic monitoring of the underground environment is necessary in order to assess the working conditions, develop an appropriate heat control strategy, and validate mine ventilation-climatic models.

To manage and control the underground climate in respect to safety, health, and cost, it is important to incorporate time-dependent heat transport processes in climatic models, so that any unusual activities and rapid changes can be taken into account when designing the ventilation system. This information is critical, particularly in cases when the environmental parameters are close to their threshold limit values. Furthermore, changes in temperature, humidity and gas concentration in an underground mine can cause an unbalanced condition for a certain period of time. Consequently, a time-dependent control of ventilation and cooling will be required to optimize the ventilation network (Danko, 2013).

This paper aims to highlight observations and recorded occurrences at an underground precious metal mine in the State of Nevada, through the use of continuous climatic monitoring units during a 6-month time frame. Throughout this paper, we will discuss the underground mine environment; the various heat sources that contribute to the total heat load of the mine; and the monitoring program that was used at our partner mine. The importance of diurnal and seasonal variations of surface ambient parameters will be emphasized such as diurnal and seasonal changes in the dry-bulb (T_d), wet-bulb (T_w) and barometric pressure (BP). The successive variation of an underground mine's intake air parameters and their impact on the mine's overall work conditions will be considered first as the focus of the discussion.

2. Underground Mine Thermal Environment

The surface air temperature can significantly influence the temperature of the ventilating air delivered along underground openings during particular seasons of the year, and may also depend on the altitude of the mine as well. Surface fresh air downcasting vertical airways (e.g. shaft) to the underground workings, through either natural or mechanical ventilation, will experience a compression. When air flows downward, some of its potential energy is converted into enthalpy, which produces an increase in pressure, internal energy, and consequently, temperature. Heat exchange between the intake air and strata can be positive (from strata) or negative (from intake air) depending on the temperature of the air entering the shaft. However, the increase in air temperature due to depth alone for any given vertical airway is certain and independent of frictional effects.

Heat exchange occurs between the ventilating air and the rock surface along vertical airways and throughout the mine. Conduction is the means by which heat is transferred from the virgin rock to the mine workings. Two processes are involved: the conduction of heat through the surrounding rock mass towards the mine excavations, and the transfer of this heat from the excavations' walls to the ventilating air and water flowing through the excavation. This process is strongly dependent on surface conditions and the nature of the mine atmosphere. Electrical and diesel equipment also increase the heat load of a mine and result in an increase of air temperature and humidity. Other sources of heat, which can be transferred to the mine air are explosive detonation, human metabolism and the influx of thermal water.

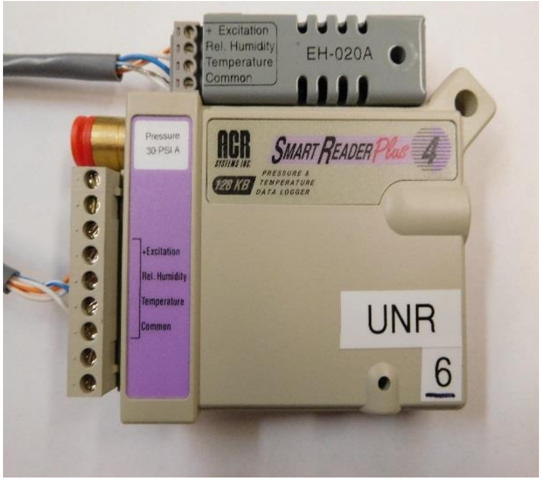
Modeling the environment in an underground mine is very important for many reasons. It allows us to understand and quantify the major heat sources and heat transfer processes, thus helping us to develop heat mitigating methods in problem areas. The prediction of harmful work conditions, as the heat sources move or change is also made possible through climatic modeling. It also presents the interface to trial and design of ventilation systems (primary & auxiliary), which can alleviate heat problems.

Deciding between different heat mitigation techniques can significantly influence the operating cost of a mine. Because every mine is unique, it is essential to monitor the climatic conditions in order to select the most appropriate method of cooling. A majority of the time, adjusting the auxiliary ventilation system in the problem areas can effectively dilute the contaminants, lower temperature and humidity, and ultimately ensure adequate work conditions. If the required air is more than what the existing primary system can supply, other measures may need to be taken in order to increase airflow delivery to production areas. This may include the need to reduce airflow delivery to temporarily inactive areas and increase the air volume to the desired area by varying the resistance of active/passive regulators, adding booster fans, or upgrading the surface fans. As a last resort, cooling or refrigeration methods may be employed.

3. Continuous Climatic Monitoring Systems - The Monitoring Plan

To assess the atmospheric and underground environmental conditions at one of our partner mines in Nevada, ACR multi-channel climatic monitoring units (see Fig. 1) were installed along the vertical and horizontal airways from surface to the lowest production level. The climatic data collection program monitored both the primary and auxiliary ventilation systems in order to: 1) determine the heat load and temperature change from auto-compression and geothermic gradient; 2) identify and quantify the "*thermal damping effect*" and the "*thermal flywheel effect*", particularly along the intake shaft; 3) gather adequate data for the development and calibration of steady state and dynamic ventilation-thermal-humidity (VTH) models; 4) quantify the heat generated by the auxiliary fans, mining equipment and strata; and 5) develop an effective ventilation and climatic monitoring program for our partner mines. During this project, twelve (12) multi-channel data loggers were used along with several hand-held instruments (e.g.

VISALA™, Kestrel™, FLUKE™, anemometers, barometers) in order to examine the accuracy of the these data loggers and perform ventilation and climatic spot measurements throughout the mine. Equipment activity logs were also obtained from the mine, whereby equipment location and type of work (i.e. drilling, mucking) were indicated at one minute intervals. The activities were sorted by location and time, so that they would correspond to the climatic data obtained. This was used to identify periods of time that corresponded to the mining cycle.



ACR Smart Reader Plus 4 Specifications	
Temperature	Temperature range: -40 ˚C to 70 ˚C Accuracy: ±0.2 ˚C Resolution: 0.07 ˚C
Pressure	Pressure range: 0 to 200 kPa (absolute) Accuracy: ±0.5% at 25 ˚C Resolution: 0.1 kPa
Relative Humidity	RH range: 10% to 90% Accuracy: up to 5% (measured at room temperature)

Fig 1. ACR Smart-Reader Plus with 4 multi-channel data logging capability

3.1. Climatic data collection within the primary ventilation system

The main purpose of climatic data collection within the mine's primary ventilation system was to determine the amount of heat generated from auto-compression, geothermal gradient, groundwater and strata. The collected data was also used to develop and calibrate ventilation models, which were provided by the mine. ACR multi-channel data loggers were installed along vertical and horizontal airways from surface to the lowest level of the mine, along the main haulage drifts, and throughout the exhausting system. These small size data loggers continually recorded the dry-bulb temperature (T_d), relative humidity (RH), and the barometric pressure (PB) at one-minute intervals for two weeks at a time. From these parameters the wet-bulb temperature (T_w) was then calculated. During this time, we also conducted spot measurements throughout the mine using hand-held climatic and ventilation instruments. These measurements allowed us to assess whether the climatic data loggers have the ability to accurately measure, collect, and transfer climatic and ventilation data to be used for monitoring and modeling purposes. The primary ventilation system was divided into three main zones, as shown in Table 1.

Table 1. Climatic data collection plan at the primary ventilation system

Locations	**Purpose**	**Monitoring Plan**
<u>Zone 1</u>: At the top and bottom of the intake shaft and exhaust shaft. <u>Zone 2</u>: From the bottom of the intake shaft to the lowest production area. <u>Zone 3</u>: From the lowest production area to the bottom of the exhaust shaft.	1. To quantify the heat generated from auto-compression, strata (geothermic gradient), and groundwater. 2. Develop and validate/calibrate the dynamic ventilation-thermal-humidity (V-T-H) model. 3. To identify and quantify the "*thermal damping effect*" (TDE). 4. To understand transient heat exchange processes between the intake air and the surrounding environment.	Install twelve (12) ACR units throughout the mine's primary/auxiliary ventilation system following the direction of the intake air to record climatic data at one-minute interval for a 2-week time frame. Perform spot measurements of climatic parameters and surface rock temperatures to assess accuracy and validate continuous measurements. Perform ventilation surveys to measure the air volume and the barometric pressure at the locations where ACRs were installed.

Comparison between spot measurements and continuous monitoring indicated that there are several occurrences which cannot be captured when simple spot units are being used for climatic monitoring purposes. This includes the "*thermal damping effect*", dynamic heat exchanges between the ventilating air and surrounding environments as well as unknown sharp increases in temperature during production activities. These elements are particularly important to accurately predict the underground climatic conditions in future mines.

4. The "Thermal Damping Effect"

Temperature damping is caused by heat capacity or the rock mass that stores and then transfers heat to a medium such as the mine air, and consequently influencing its temperature and moisture content. The process by which exterior temperatures and the heat flow affect a closed environment can be referred to as the "*thermal damping effect*." For example, at the top of the shaft during summer the dry-bulb temperature (T_d) on surface fluctuates widely from a high temperature of 33 ^{0}C during a sunny midday to a low temperature of 19 ^{0}C in the middle of the night. However, the bottom of the shaft will experience a much smaller temperature fluctuation. Basically, the wall of the shaft acts as an energy reducing mechanism and reduces the amplitude of the temperature wave (Danko, 2013).

During the day, the elevated dry-bulb temperature (T_d) of the intake air in the shaft, which in addition is heated by auto-compression has higher values than the "virgin rock temperature" (VRT) of the surrounding rock formations. Consequently, sensible heat is transferred from the intake air into the surrounding rock, actually cooling the air. However, at night there is a greater potential for the heat to flow from the surrounding rock formations into the ventilating air, increasing the air temperature. Furthermore, the point (e.g. depth) where heat flow reverses down the shaft can vary continuously. We recognize this phenomena as the "*thermal damping effect*" (Fig. 2 and Fig.3).

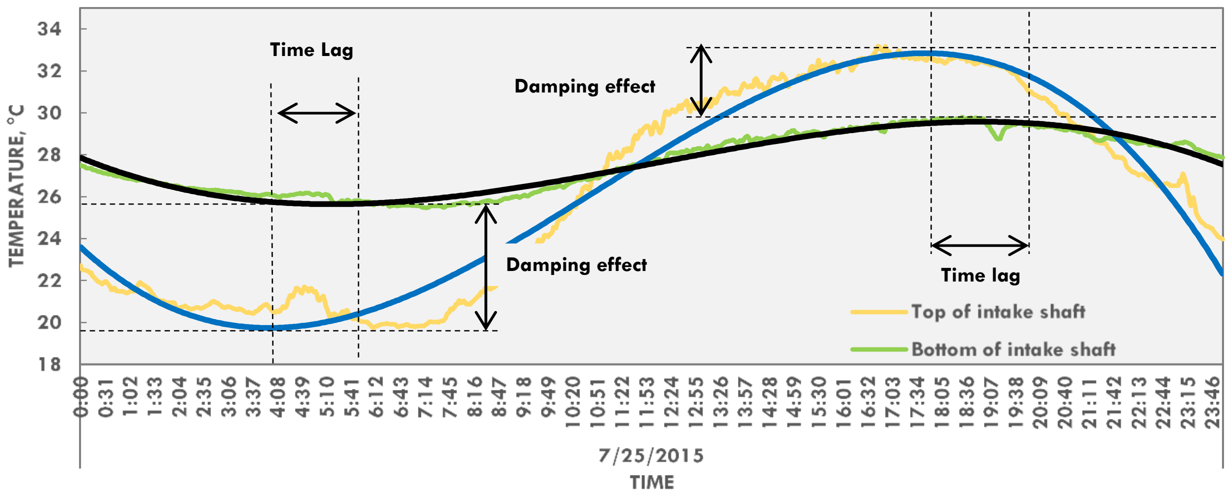


Fig. 2: Dry-bulb temperature (T_d) damping in the intake shaft

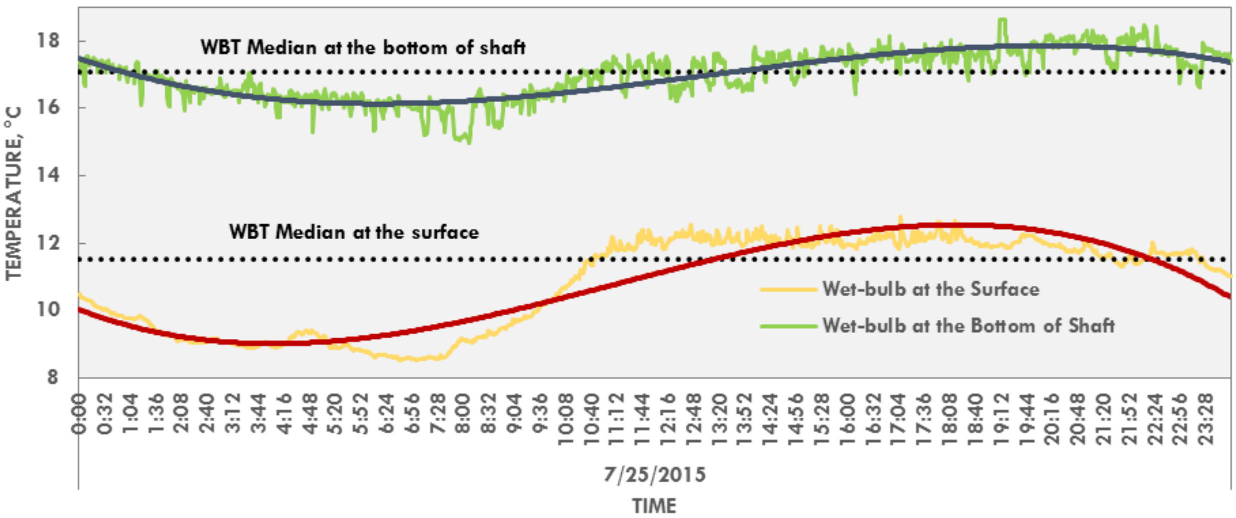


Fig. 3: Wet-bulb temperature (T_w) damping in the intake shaft

The "*thermal damping effect*" of the air temperature depends on several parameters including the variation of intake air temperatures (T_d and T_w), air volume, contact distance, surface wettedness and the virgin rock temperature. For instance, the thermal damping along an intake ramp connecting two levels/sublevels is much higher than the thermal damping of a similar air volume travelling through a vertical airway (e.g. shaft). Longer the intake airways, the thermal damping is much higher. This is why the air temperature at some point of the mine's return system, which is located at a significant distance from the collar of the intake shaft is not affected by daily temperature variations (see Fig. 4).

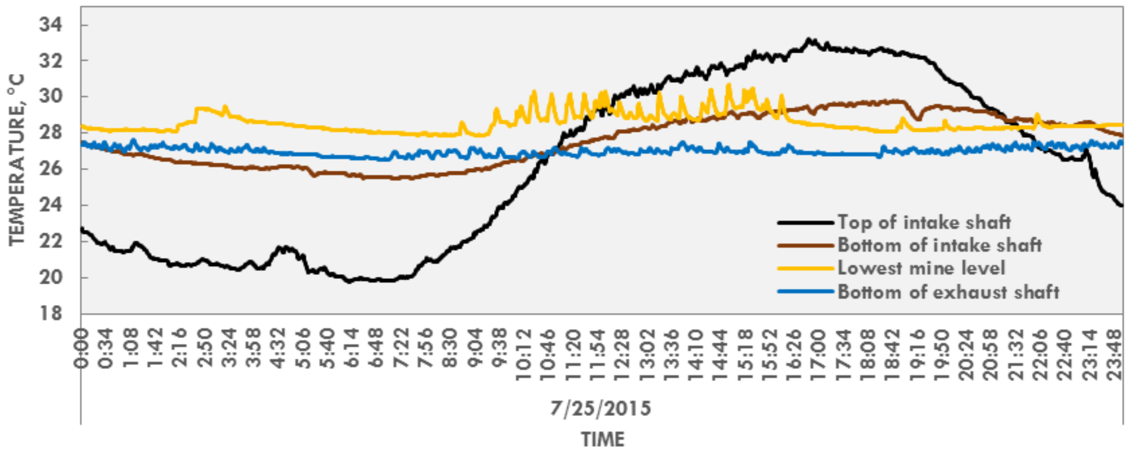


Fig. 4: The thermal damping effect depends on travel time and distance; air temperature at the bottom of the exhaust shaft is nearly constant

There are many standard mine ventilation and climatic simulation programs, which available to conduct heat studies and predict the climatic conditions for yet undeveloped orebodies. Most relevant transport processes for heat and humidity can be modelled with one of these software packages. However, short-time variations (e.g. hourly or daily) and to some extent seasonal temperature changes can induce significant modelling errors if the strata heat does not follow a true instantaneous heat flux model. As shown in Fig. 2 and Fig. 3, daily ambient temperature variations at the bottom of the intake shaft can be much less than at the top of the intake shaft, depending on contact distance and time.

To assess the accuracy of the standard ventilation modeling software, the intake shaft at our partner mine was modelled using Climsim^{TM} and Ventsim^{TM}. A comparison between measured climatic values at the bottom of the intake shaft and parameters generated by ventilation and climatic models are shown in Fig. 5. This figure demonstrates that current commercial ventilation software packages do not take into account the "*thermal damping effect*" along vertical airways. Consequently, the models predict same diurnal temperature variations without considering the time lag at the bottom of the intake shaft as for the top of the intake shaft. The MULTIFLUX^{TM} model with its time-dependent solution engine has the ability to take into account the "*thermal damping effect*" and the associated time lag (Danko, 2013). It shall be mentioned that the program is not yet commercially available.

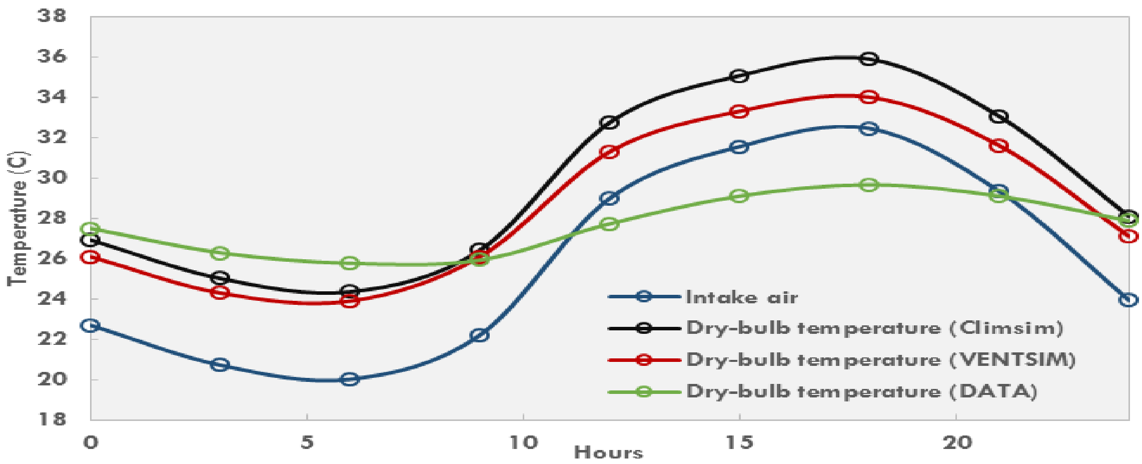


Fig. 5: Comparison between measured values and variations of ambient temperature at the bottom of the intake shaft predicted by climatic models

5. Transient Heat Exchange Processes and Irregularities in Underground Climatic Conditions

To understand and model heat and humidity transport, all major heat sources in an underground mine need to be identified and accurately quantified. There can be a considerable difference in the spectrum of the heat and mine power source distribution from mine to mine due to many factors such as: depth, mechanization, power sources, geothermal activity and rock thermal properties (e.g. conductivity and diffusivity). The key element in understanding and designing an effective ventilation system with the ability to provide adequate working conditions is that an underground mine is never at steady state. There are always transient heat exchange processes between the mine air and surrounding environments. When air descends a vertical opening (e.g. shaft or raise), heat exchange occurs between the fresh air and the shaft's wall. It was illustrated in a previous section that the intake temperature varies by time. Consequently, there is a phase shift in the periodic temperature variation along the airways relative to the variation in air temperatures.

This transient heat exchange and phase shifts occur throughout the mine from the bottom of the intake shaft to bottom of the exhaust shaft. Therefore, to underground and accurately model the climate in deep mines, any heat added to the system, removed from the system should be studied in transient state. As an example, we can mention the heat added to the mine air by an auxiliary fan. When an auxiliary fan is "ON", the heat generated by the fan increases the temperature of the air inside the auxiliary duct, the temperature of the duct itself, and the surrounding ambient. The temperature of the ventilating air can increase by as much as 7 ˚C, depending on the size of the fan and its efficiency. When the fan is turned "off", heat is transferred from the surrounding rock to the cooler air, causing the air temperature to rise until a balanced temperature is achieved. Getting to temperature equilibrium may take up to several hours, depending on the rock thermal properties and fan configuration. For example, Fig. 5 shows that fresh air is picked up from the ramp and delivered to the face of a dead-end development through a flexible fabric duct under the assistance of a 100 hp auxiliary fan. When the fan is "on", the heat generated by the fan increases the air temperature by 5 ˚C. However, when the fan is "off", air temperature still increases by approximately 1 ˚C for a few hours when air passes the motor casing of the fan and along the auxiliary duct.

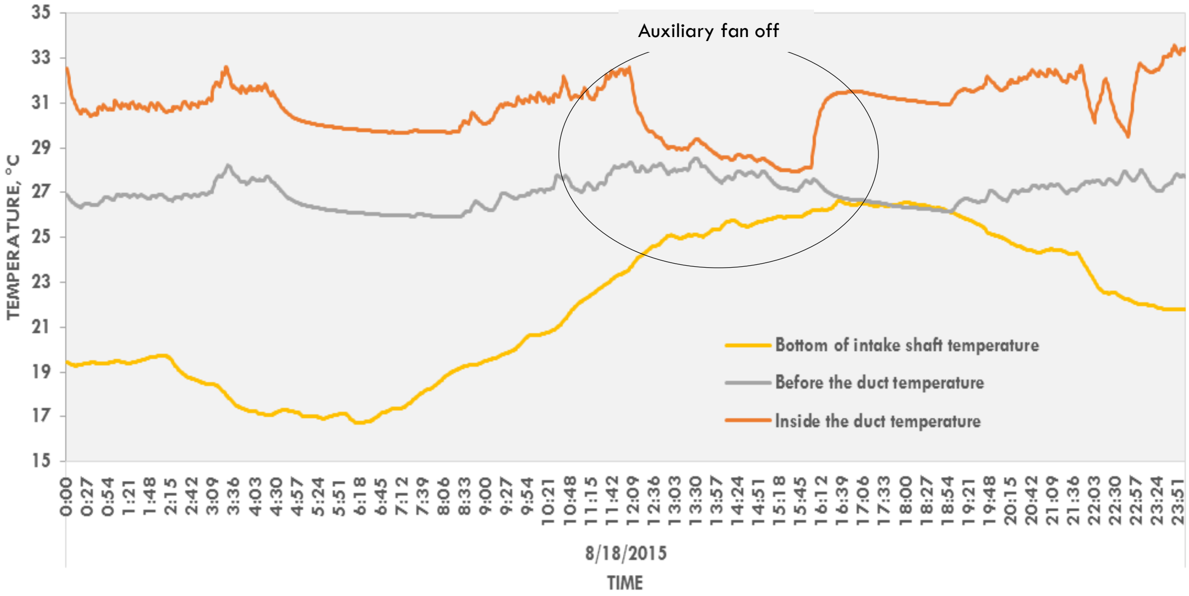


Fig. 5: Intake air temperature is raised by 5 ˚C when the auxiliary fan is "on", and by 1˚C when the auxiliary fan is "off".

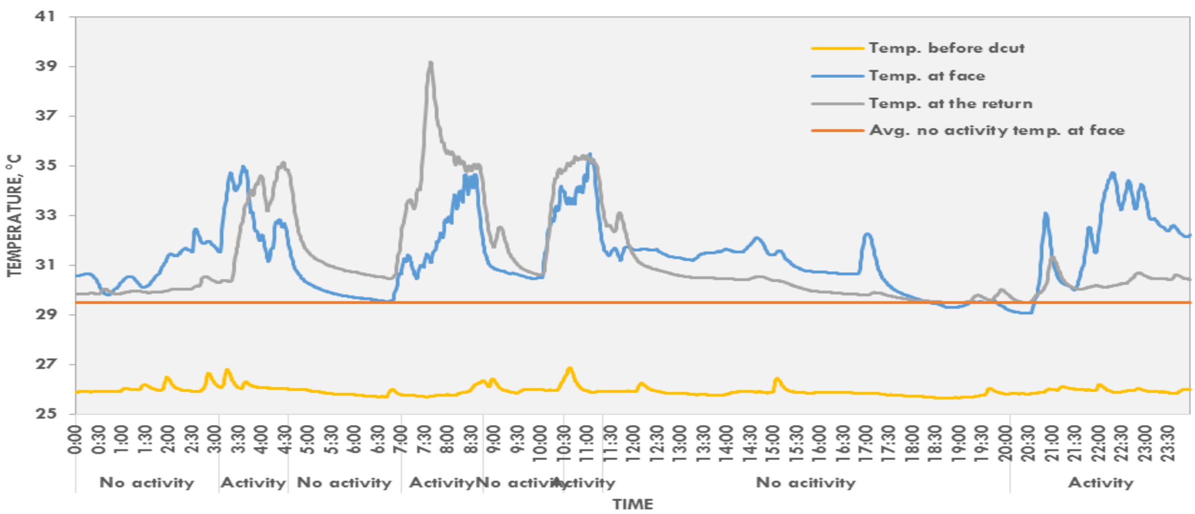


Fig. 6: Time-dependent heat exchange processes between the ventilating air and surrounding environment when there is an activity

Fig. 6 shows the dry-bulb temperature variation in a production area at one of our partner mines in Nevada. The baseline equilibrium temperature at this location (no activity) is approximately 29.5 ˚C. It can take several hours to get to the baseline equilibrium temperature when there is an activity at this location. Fig. 6 also shows that heat load may accumulate in an underground environment for relatively long period of time.

Consequently, the time-dependent heat exchange process between the ventilating air and the strata must be studied and modeled. To assess transient heat transport processes and to take into account their impact on the mine climate, a dynamic "ventilation-thermal-humidity" (V-T-H) model should be developed and validated using measured climatic data. It is impossible to immediately sense the un-balance of the system due to its slow development, which is masked by large daily temperature changes.

6. Discussions

There are many standard mine ventilation and climatic simulation programs on the market, which can be used to model complex transport processes for heat and humidity, and to ultimately predict the climatic conditions for future underground mines. Successful validation/calibration of the numerical models against field measurements enables us to accurately simulate the environment being studied. Consequently, a comprehensive strategy of climatic monitoring for in-situ data collection is critical.

Assessments of climatic conditions showed that the underground mine environment is rather a complex system. The mine is never at steady state and there are always transient heat exchange processes between the ventilating air and surrounding environments. There are several important occurrences, which cannot be captured when simple spot measuring units are used for climatic monitoring purposes. These include the "*thermal damping effect*", dynamic heat exchanges between the ventilating air and surrounding environments and unknown sharp increases in air temperature during the mining cycles. It is therefore critical to incorporate time and phase changes throughout the mine. This study shows that hourly, daily and monthly temperature changes at surface itself can produce significant modelling errors. The fundamental difference between simulated and measured climatic parameters is the result of the dynamic time delay of temperature spikes along pathways of the ventilating air due to the "*thermal damping effect*". The presence of various heat sources throughout a mine can also change the system.

It is critical to incorporate irregularities into the measured data, so that any unusual activities and rapid changes can be taken into account when designing primary and auxiliary ventilation systems. There are unknown sharp temperature fluctuations and data irregularities at different locations of an underground mine. Temperature fluctuations can be a result of gas inflow from the rib or back, ore oxidation, auxiliary fans, mining equipment, groundwater, etc. The climatic conditions of an underground mine cannot be accurately modeled and predicted using theoretical solutions and steady-state modeling techniques. The effect of dynamic and time-dependent heat exchange processes between the strata and the mine air cannot be calculated and be taken into account when modeling complex underground production workings by means of standard climatic programs. The accuracy in predicting the climatic conditions in future underground mines is critical, particularly in cases when the environmental parameters are close to their threshold limit values (TLV). Continuous climatic monitoring systems are the most suitable tools, which can be used to identify and quantify these occurrences in underground mines.

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Quantification of the environmental impacts in the transportation of marble: a case study

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Abstract

Marble quarrying is extremely important for the Venosta Valley in northeastern Italy. Two quarries are currently in use and most of the routes used to transport the marble to the processing plants are within the boundaries of a protected area: the Stelvio National Park. In this study, two transport solutions from one of the two quarries were quantitatively analysed. One solution considers the exclusive use of trucks, whereas the second considers the combined use of trucks, two railway stretches, a cableway and an inclined plane. For both of these solutions the environmental compatibility and sustainability were evaluated in terms of the main potential sources of environmental impact on air quality and on groundwater, and the possible effects on humans, flora and fauna. Different methodologies previously set, were applied, depending on the means of transport considered. The analysis showed that the second solution is more environmentally compatible. Considerations on the replicability of the calculations are included too.

Keywords: atmospheric emission; environmental balance; impact assessment; marble; protected areas; traffic.

1.Introduction

This study focuses on the transport of marble from a quarry in the Venosta Valley, located in the protected area of the Stelvio National Park, to the processing plant. Two active quarries are located along the south side of the Venosta Valley and deliver the extracted blocks to two processing plants, located in the valley bottom. In one quarry (Covelano), only trucks are used along forest and municipal roads. In the other quarry, Lasa, the marble is carried downstream using an old transport system, designed in the early decades of the last century. This consists of a combination of cableway, train and inclined plane, thus without the use of trucks.

The fact that the quarries are located within the Stelvio National Park increases the environmental significance of the case, if compared to quarries in unprotected areas. This applies both to mining operations and to material transport. When the Stelvio National Park was established in 1935 it was decided to prohibit mining in the whole protected area. However, since marble quarrying predated the park institution, these specific quarries have always been considered as an exception. With regard to the transportation, however, working technologies change and economic conditions have been modifying the necessities and methodologies. Since much of the transport route is within a national park on forest tracks, the environmental compatibility of the proposed solutions and their sustainability need to be deeply evaluated.

The first solution regards the route travelled currently by the Covelano company trucks. The second one considers the combined use of trucks, railways, cableway and the inclined plane. Thus, the historical transport system, currently used only by Lasa company, was considered in the analysis of this solution.

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The main potential sources of environmental impact, both on air quality and groundwater and the possible effects on humans, flora and fauna were analyzed. Some elements of the transport system were already identifiable as potentially critical or at least in conflict with other land-uses. This does not imply that they are absolutely unacceptable, nevertheless they need at least to be quantitatively assessed and evaluated.

For both solutions, the following impacts were evaluated: atmospheric emissions and dispersion; traffic; interference with footpaths and water protection areas; noise and vibrations generated by vehicles. In addition, the impacts on flora and fauna were qualitatively estimated. Particular attention was given to the atmospheric emissions since not only exhaust emissions were considered, but also emissions from the wear of brakes, tyres and road surfaces and emissions from resuspension.

2.Materials and methods in short

2.1. Current situation and description of solutions

A detailed description of the methodology is reported in a previous article (Ragazzi et al., 2016). Here the main aspects are reported for an easier reading.

In the municipalities of Lasa and Covelano there are four marble quarries, two of which are currently operative. Mitterwandl quarry is situated in the Covelano area, approximately 2,165 m above sea level. Because of its elevation, quarrying is possible only during summer, when no snow is present. Since 2005 the marble has been transported downstream exclusively by trucks.

Weißwasser quarry is situated in the municipality of Lasa, approximately located at 1,555 m above sea level. The quarry is operative all the year round and the marble is transported downstream with a special infrastructure system (Fig. 1), starting directly in front of the entrance to the quarry. This system is composed of:

7. a cableway (length 1,350 m; altitude difference -195 m; payload 20 t);
8. an upper railway (narrow-gauged diesel/electric railway; length 1,800 m; altitude difference -25 m);
9. an inclined plane (inclined elevator rope, on rails; length 950 m; altitude difference -475 m; payload 20 t);
10. a lower railway (narrow-gauged diesel/electric railway; length 800 m; altitude difference -5 m).

Fig. 1. Lasa’s transport infrastructure system (www.lasamarmo.it).

For both active quarries (Mitterwandl and Weißwasser), the mining concessions provide approximately 5,000-6,000 m^3 per year. Roughly 40% of this volume is transported downstream as marble blocks, approximately corresponding to 2,000 m^3. The resulting debris is deposited entirely on site. In Lasa quarry, the debris is partially reused in tunnels and excavation, while in Covelano quarry there is a waste management based on accumulation in an open site, with some washout problems.

There are two transport solutions considered. *Solution 1* involves the transport of marble blocks exclusively by truck from the Mitterwandl quarry (2,170 m above sea level) to Silandro (690 m above sea level), via the village of Covelano. The route is along forest tracks and municipal roads for a total of about 17 km, most of which in the Stelvio National Park. *Solution 2* exploits a multimodal transport from the Mitterwandl quarry, through Covelano and Lasa for a total distance of about 20 km.

2.2. Elements of interest

With respect to solution 1 the transport analysis shows that the activity involves the transit of eight trucks per day: four travel downhill with full load and four travel uphill unloaded. With solution 2, the marble is initially transported by truck along a forest track and later carried downstream through the cableway, two railway stretches and down the slope; the latter is currently used by Lasa quarry. We hypothesized that the load capacity of a railway car is comparable to the load capacity of a truck; therefore, the use of Solution 2 involves eight additional journeys with the train; four outbound and four return.

<u>*Length of the routes*</u>

We compared the route length, travelled by truck both in terms of total emissions and as percentage of emissions released within the protected area of the National Park. The estimated values are reported in the following Table 1.

Table 1. Details of total route length of the two solutions.

Route length [m]	Solution 1	Solution 2
• Total length	17,110	20,455
○ inside the Park boundaries	14,387	9,375
• Length travelled with trucks	17,110	17,160
○ inside the Park boundaries	14,387	6,830
○ of which not asphalted	11,380	6,830

Route 2 is 3 km longer than the one adopted in the solution 1; however both routes are approximatively equivalent in terms of mileage only covered by trucks. Finally, considering only the part of the routes within the National Park, Solution 1 is more than twice as long (14 km compared to 6.8 km).

Regarding the environmental effects, the emission factors used in this study are listed in Table 2.

Table 2. Methodological aspects.

Environmental item	Method
Emissions into the atmosphere	The pollutant emissions into the atmosphere by truck transport were estimated using standardized emission factors, according to the COPERT methodology (Ciuta et al., 2012; Torretta et al., 2012; Carletti et al., 2013; Gavanas et al., 2014; Istrate et al., 2014; Lozhkina and Lozhkin, 2015; Feng et al., 2015). For this study, the emission factors developed in the COPERT IV methodology were used (Emisia, 2015).
Wear of brakes, tyres and road surface	The COPERT IV methodology was used (Emisia, 2015; Duong and Lee, 2011; Chandra Verma et al., 2015). The particulate estimation was calculated using the United States Environmental Protection Agency methodology (AP42), in which emissions data from productive activities are collected (US-EPA, 2015).
Traffic and intersection with footpaths	Presently long stretches of the road cause difficulty in vehicles intersection. The road is also used by other users; this simultaneous usage was assessed and the critical points were identified. In addition, the radius of curvature in a forest track is in some cases quite small, thus impacting on the transit of heavy-duty vehicles. In addition, the possible intersection of routes travelled by the marble trucks and footpaths was considered, given the high environmental and tourist significance of the area.
Noise	The noise caused by the vehicles used for the transport from Mitterwandl quarry was estimated for both the solutions on the basis of the most sensitive elements affected by the transit (van Langevelde et al., 2009). The noise emission was estimated using an analytical model, developed by the Italian National Research Council. This simple formulation method (Cocchi et al., 1991) takes into account the specific geometrical-environmental characteristics of the analyzed site and the traffic counts. The noise produced by the train was estimated by means of the Schall03 method (Bundesbahn-Zentralamt, 1990), the German regulatory standard. The results were compared with the formula adopted by the French Centre Scientifique et Tecnique du Bâtiment (C.S.T.B.) (Gabillet andVan Maercke, 1995), which takes into account the train and rails characteristics.
Vibrations	The vibrations generated by the passage of vehicles can be a source of significant impact, in particular in the case of laden trucks. UNI 9614 standard (vibration measurements in buildings and annoyance evaluation) is the reference defining criteria for the measurement of vibrations and the assessment of their effect on buildings (Ente Nazionale Italiano di Unificazione, 1990). In particular, the Rudder formula (Boniotto, 2010) was used to estimate the vibrations generated by the passage of trucks.
Flora, fauna and water	The impact that the two solutions may induce on vegetation is primarily due to the vehicle emissions, mainly the dust resuspension (Mitchell et al., 2015). In this study, the effects on vegetation can be quantified on the basis of the track length located in the Stelvio National Park.

3.Results and discussions

Table 3 shows the total exhaust NO_x emissions and the total PM_{10} emission (exhaust pipe, brakes' and tyres's wear, road resuspension), emphasizing the amount emitted in the park for both solutions.

Table 3. Total exhaust daily NOx emissions and total daily PM_{10} emissions (exhaust + wear) [g d^{-1}].

	NO_x		PM_{10} (exhaust + wear)	
	Total emission	In Park	Total emission	In Park
Solution 1	567	504	22.8	19.9
Solution 2	562	294	21.6	9.4

The gaseous exhaust emissions of vehicles are directly proportional to the distance covered, as well as the dust particle effects produced by the wear of brakes, tyres and road surfaces. In these cases, the estimates on the entire routes are similar for both transport solution, whereas the estimate of emissions within the confines of the park are certainly in favor of Solution 2.

Also with regard to the amount of resuspended material, the distance covered is crucial, especially for what dirt track is concerned. Solution 2 is therefore clearly more suitable, thanks to the shorter route driven on dirt roads.

Air pollution in the surroundings of the roads was also calculated. Concentrations were estimated using a Gaussian dispersion algorithm model (Benson, 1979). In the calculation a conservative approach was followed, calculating resuspension during the transit of a loaded truck, when the emission effect is maximum.

The evaluation of the area of influence of the induced impact was carried out considering the distance around the road, where the dust mean concentration does not exceed a reference level of 5 μg m^{-3}. The distance was conservatively estimated when the emission is higher, namely four times a day in correspondence of the trucks transit. Reference distance results to be about 49 meters for forest-dirt roads, about 16.5 meters for forest -asphalted roads and 15 meters for tarmac roads in open environment.

The impact on traffic is insignificant for unrestricted roads because the additional transit number is small (eight trucks per day). On parts of the forest road inside the park, circulation is restricted and therefore only a few problems in vehicles crossing on the route remain. In terms of the transit difficulty, a sharp bend in Solution 1 was considered too complicated. Disturbance for walkers is greater for Solution 1, which is used as a path for more than 4 km, against 350 m in Solution 2.

Noise and vibrations difficulties were not significant. In both cases, the noise daily emission limit value is 55 dB(A) and the nighttime emission limit value is 45 dB(A). In terms of vibration, according to the UNI 9614 (Ente Nazionale Italiano di Unificazione, 1990), the limit values are 80 dB in the vertical direction and 77 dB for the horizontal one. In terms of noise for Solution 2, the results are negligible (average of 33 dB(A)). Along Solution 1 there are two isolated buildings which, given the surrounding silence, from where it was possible to hear the vehicle transition. Considering that transport takes place during the day, the estimated value (average of 43 dB(A)) is lower than the limit values. Also the vibration values, measured at the more vulnerable places in Covelano, are lower than the limits (73 dB(A)).

Potential effects on flora and fauna are expected in the proximity of the routes, especially for the flora on dirt roads. In both cases, the greatest impact is for Solution 1 because it involves a longer trip in the park.

The last analyzed aspect concerns the interactions with water catchment protection areas. While Solution 1 does not intersect the studied area, Solution 2 passes through two protected areas. This, however, does not generate problems because the roads are well maintained. Potential contamination of water springs was ruled out because excavations or other interventions dangerous for the water contamination on Route 2 are not necessary.

The replicability of the approach needs a detailed knowledge of the territory where a case study must be developed. Indeed the length of alternative pathways must be quantified in details. Moreover, the replicability is feasible in a European Union region as many tools and regulations characterizing the adopted methodology have been set for such a context.

4.Conclusions

We assessed the sustainability of the quarrying and transport of marble in a protected area of great environmental significance. The sustainability was considered only under the environmental aspect, neglecting the economic and social aspects. The focus was in fact to identify, from an environmental point of view, the lower negative impact out of two technical solutions for the transport of marble.

The analysis of the considered indicators shows that Solution 2, covering the combined use of trucks, railways and cableway, has the lower environmental impact.

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Professional risk management for work equipment in wood and metal processing industry

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Abstract

In order to prevent accidents and occupational diseases in the workplace, it is necessary to ensure the control of risks in specific activities for metal and wood processing, by means of risk management through modern tools to ensure a prerequisite for increasing the competitiveness of employers on market economy. Managing the risk management on the specific activities of metal and wood processing and work equipment used by workers, at designers and manufacturers level, provides the necessary conditions to put on the market safe products with an appropriate safety level for intended use conditions, established by specific prevention tools in order to guarantee technical and environmental requirements, including appropriate measures and means of protection. The professional risk management of work equipment used in specific activities in metal and wood processing, at employers and users level, provides the necessary conditions for the use of safe and compliant work equipment. The research study aimed to identify and to analyze the hazards and professional risks associated to work equipment, in terms of history of operations of maintenance and repairs, in use and after upgrades. The results of the research consisted in developing of some tools on effective management of professional risk.

Keywords: risk, safety; work equipment; management; industry;

1. Legal requirements on work equipment from the metal and wood processing industry

European directives adopted by the European Commission established a framework of minimum requirements for the safety of workers at work (EU-OSHA URL). These directives are applied also to activities with work equipment, from metal and wood processing industry, Framework Directive is the basic regulation which includes requirements for employers to carry out a risk assessment in the workplace. It contains general principles of prevention, sets out employers' obligations related to risk assessment, elimination of risk factors and accident, information, consultation, balanced participation and training of workers and their representatives.

The European Commission has drawn up a guide on risk assessment at work in order to support employers and workers to implement risk assessment requirements of the Framework Directive 89/391/EEC. Guide falls maintenance workers as "workers who may be at increased risk." Based Framework Directive, was adopted a series of specific directives, all showing relevance to working with this equipment work safely, and many of them include specific provisions and requirements to eliminate hazards from the workplace.

The European Commission has drawn up a guide on risk assessment at work in order to support employers and workers to implement risk assessment requirements of the Framework Directive 89/391/EEC. The Guide cover the maintenance workers as "workers who may be subject to increased risk." Based on Framework Directive, it was adopted a series of specific directives, all of them showing relevance for working safely with this work equipment, and many of them include specific provisions and requirements to eliminate hazards from the workplace.

The modern economy is the result of industrialization and economic and social progress, requiring modern working facilities and equipment, upgraded, ensuring high economic efficiency. For the use of work equipment in terms of economic performance and at maximum safety level, it is necessary to ensure, in use, the conditions set by the manufacturer regarding the commissioning, use and to provide working operations and appropriate interventions using safe working conditions and to guarantee the technical and environmental requirements, including appropriate measures and means of protection against accidents and professional diseases. (INCDPM 2015).

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Work equipment must be designed and constructed so that to be able to fulfill their function and can be used, adjusted and maintained without workers are at any risk when these operations are carried out as required by the manufacturer and taking into account any misuse that may be expected and foreseeable. Work equipment must be supplied with all the essential special equipment and accessories so that it can be adjusted, maintained and used safely.

Identifying, analyzing and assessing the risk of accidents and professional diseases caused by work equipment are basic tools of risk management, to manage, to reduce and to eliminate the risk by technical and organizational measures. The benefit of risk assessment is: it allows identification of problems faced by workers and allows preventive measures.

In order to manage the residual risks identified at equipment work, employers must comply with Romanian regulations on granting PPE at work. Before choosing PPE, the employer must carry out an analysis and assessment of the hazards in the workplace, which cannot be avoided by other means.

Taking into account the residual hazards identified and body parts subject to risk of injury or professional diseases, by completing the evaluation sheet model presented in Annex no. 1 of GD nr.1048/2006, can be identified the assortment of required PPE. Industrial activities that use work equipment for metal and wood processing industry can be managed also through the instruments of prevention of occupational risks for work equipment used in metal and wood processing industry, as tools to control occupational hazards to SMEs.

2. Statistics of accidents at work in the woodworking industries and metals

Statistical data on accidents at work nationally produced in Romania, are based on Labour Inspection activity reports for 2008 -2013 and NIS data from 2008-2012. Also, the statistical data provided by Eurostat and analyzes made on the basis of the SEAM methodology (European Statistics on Accidents at Work) may identify work accidents due to maintenance operations in several European countries (Antonov et al. 2015). Accidents have a tendency increasingly more likely not to occur during normal operation, but during repair, maintenance, cleaning, adjusting, and etc. activities.

Form the data provided, is estimated that approximately 15-20% (depending on country) of all accidents and 10-15% of all fatal accidents are related to maintenance operations. According to existing data on EUROSTAT, fig. 1 shows the distribution of work accidents in the EU (INCDPM, 2015).

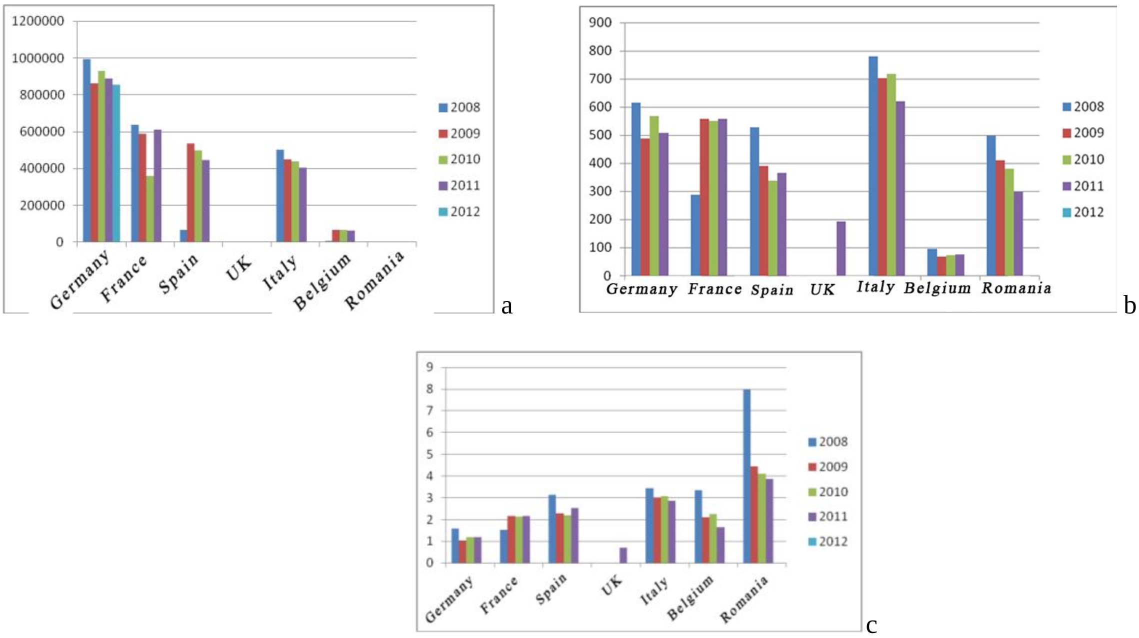


Fig 1. a) Accidents at work (total) in 2008-2012; b) Fatal accidents at work in 2008-2012; c) Share of accidents at work in 2008-2012

2.1. Accidents at work in the maintenance activity at EU level

At the level of 2003-2007, from statistical data on work accidents in the maintenance activity products in Europe. Thus it can be seen, from the Eurostat data, throughout the four years that most EU countries recorded accidents in the maintenance activity. The distribution of fatalities registered in the EU and fatalities recorded in the maintenance activity is presented in the fig. 2 (OSHA, FI OSHA 90, OSHA Report).

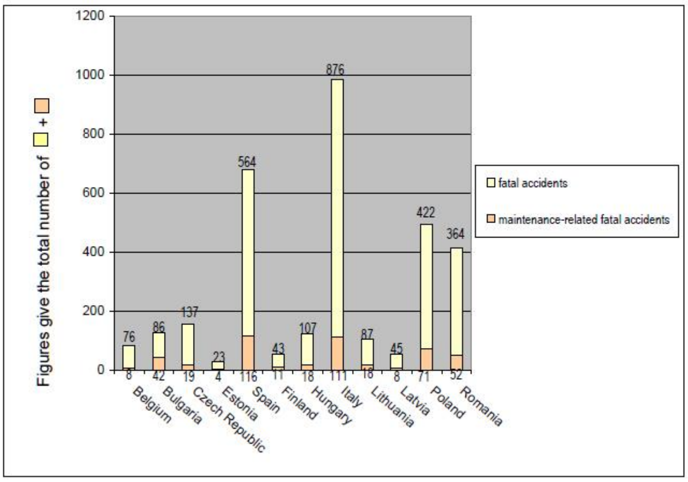


Fig. 2 Fatal accidents related to maintenance operations in selected European countries, 2006

2.2. Work accidents in maintenance activities at national level

After processing statistics on work accidents produced at national level, in fig.3 and fig. 4 are shown the distribution of work accidents in Romania, due to interventions at machines. Statistical data on work accidents produced at national economy in Romania, based on Labour Inspection activity reports for 2008 -2013 and data provided by NIS, for 2008-2012 (INCDPM, 2015 INS-TEMPO 2014, Antonov et al., 2015). Thus, in fig 3 it can be seen that over the five years, maintenance activity - category recorded under "Repairs, maintenance and installation of work equipment", recorded work accidents.

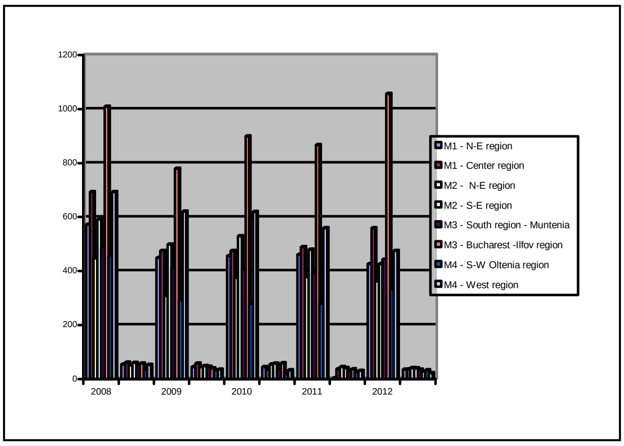


Fig 3. Total accidents at national level on macro regions

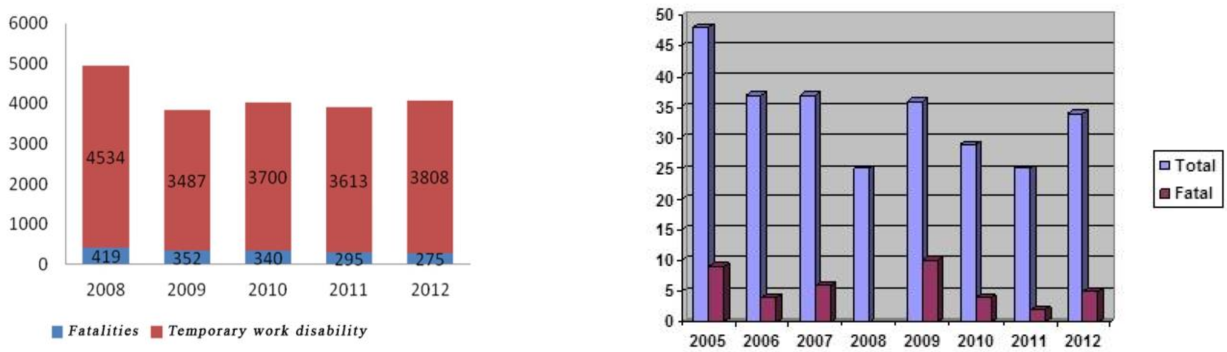
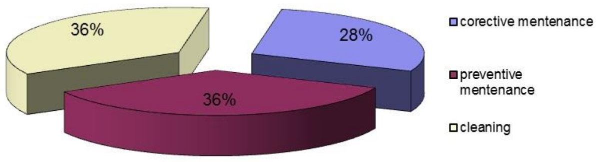


Fig. 4 Total accidents at national level

From statistics collected during 2005-2009 for example, in Vrancea County there were recorded in maintenance activities a number of 200 accidents, of which 35 were fatal and 20 with disability. Out of 200 accidents, 41 accidents at work were recorded in maintenance activities, and of these, five accidents resulted in death, and 5 with disability.in Vrancea County were recorded in maintenance activities a number of 200 accidents, of which 35 were fatal and 20 with disability.

From a total of 200 work accidents, 41 accidents were recorded in maintenance activities, and from these, five accidents resulted in death, and 5 with disability. From occupational accidents related to maintenance, 18 accidents occurred in activities of corrective maintenance, 10 during preventive maintenance activities and 10 in the cleaning activities (machinery, equipment, buildings) (INCDPM, 2015, Anghel Valentina - EUROACADEMIA URL). In fig. 5 is shown these shares.



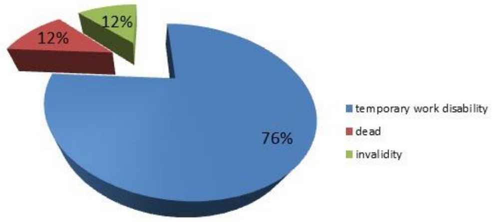


Fig. 5 (a) The share of work accidents by type of maintenance, Vrancea county; b)Share of consequences of accidents at work in the maintenance activity, Vrancea County;

3. Professional risk management work equipment in metal and wood processing industry

In order to prevent work accidents at workplace it is necessary to ensure control of risks in specific activities for metal and wood processing industry. This is achieved through an appropriate risk management by means of modern tools of prevention which can ensure prerequisite for increasing competitiveness of employers in the market economy.

Managing the risk management on the activities of specific metal and wood processing industry and work equipment used by workers starting from designers and manufacturers, provides the necessary conditions to put in to market safe products with an appropriate level of safety when there are used in intended conditions established by specific prevention tools in order to guarantee technical and environmental requirements, including adequate measures and means of protection.

Professional risk management activities specific to the work equipment used in metal and wood processing industry, to the employers and workers, ensure the necessary conditions for the use of safe and compliant work equipment.

Any machinery must fulfil all applicable requirements, which means that first at all must fulfil all general requirements indicated in Chapter 1 of Annex 1 of GD nr.1029 / 2008, amended and supplemented.

To determine whether a requirement is applicable or not, it is necessary to take into account the structural characteristics (type of control system, whether has a chair or not) or functional role (the materials being processed) and, by default, the risks it may generate. Secondly, it should be identified if the machinery is kept within the categories specified in chapter 2 ÷ 6 and, if so, to follow and comply with these requirements. (INCDPM, 2015 Antonov et al., 2015).

Applicable regulations provide essential health and safety requirements applicable to machineries where is performed adjustment, maintenance, repair and cleaning operations, including operations that occur after some events, overhauls and upgrades.

Managing risk management related to maintenance activities of work equipment designed for use by workers at starting from designers and manufacturers of work equipment, provides the necessary conditions for puting into market of safe products with a appropriate level of safety when there are used in intended of use conditions laid down by the technical Paper / Manual / Guidelines. (INCDPM, 2015 Antonov et al., 2015).

In terms of legal references mentioned above, the research study treated a number of general issues relating to the quality, reliability and maintenance activities. Quality - determinant factor of change and knowledge-based economy in the durable development –is a prerequisite for increasing the market competitiveness of employers.

The main characteristics of the market economy is treated the companies as forefront of economic activity, on the assumption that if the companies are profitable, everyone involved are positively affected, including the national economy, an approach that has proven its effectiveness in practice in a capitalist economy.

The economic development of countries with market economies - although they are confronted with not a few economic and social problems - higher than those so-called communist, is the best proof of this.

Consequently, judgments, decisions and major actions are designed and applied to the whole country, starting from the premise that efficiency is the key of national economic development as a whole and not organizations that form it (Constantin Oprean et al., 2011).

The company is a complex system, it contains the human, material, financial and information resources, each of them being composed from a considerable variety of items. Maintenance activity carried out at company level is considered a factor in promoting the competitiveness of companies in the market and has the following main objectives:

- preventing accidents and maintain in expected operating conditions of work equipment, as long as possible;
- increasing the availability of work equipment and its components, based on the production lines by making only interventions strictly necessary;
- extending the operation time of work equipment by increasing work quality and assuming the responsibility of the personnel involved in this activity, by individualizing tasks related to the technical condition analysis of work equipment, devices and materials, establishing the necessary activities, scheduling and execution thereof;
- increasing the economic efficiency by improving work equipment reliability and respectively decreasing the number and duration of outages, unplanned repairs and reducing their costs.

Maintenance is essential to ensure continued productivity, to manufacture top quality products and to maintain the company's competitiveness.

This also has an impact on safety and health at work. First, a good maintenance is essential to maintain the safety and reliability of work equipment and environment. Secondly, maintenance itself is a high risk activity and should be performed safely, with adequate protection of workers and other persons present in the workplace (INCDPM, 2015 Antonov et al. , 2015).

The maintenance activity carried out correctly and on time, improves the availability of machinery and work equipment from the company, maintaining the level of reliability at good rates that allow continuity of the production process and increase overall duration of life. Maintainability and maintenance of systems are closely linked to the availability and reliability of the system, as shown in fig. 6 (P.Tuşaliu, 2011)

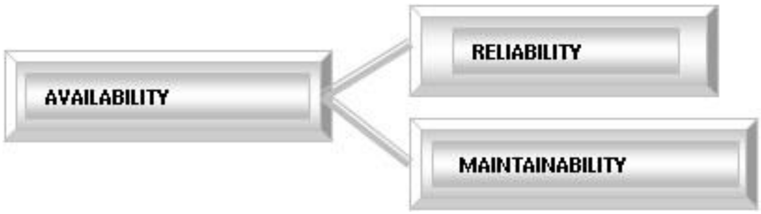


Fig. 6. The connection of the three terms: availability, reliability and maintainability

The availability and maintainability of the system (ease of disassembly of any component), depends on the existence of spare parts necessary for repair and service activity both in warranty and after this period. Also maintainability of a repairable system also depends on the activity of maintaining characteristics quality, called maintenance activity.

Reliability of the products is defined as safety in their operation, availability of the products consisting of reliability to which it added its maintainability.

Noncompliance which the production factors present duration of the availability of the system influences the out of services for the work equipment, so its damage.

Predictive maintenance approach for work equipment compares the trend of the measured parameters with technological limits aimed to detect, analyze and correct potential problems before they occur. Predictive maintenance management requires testing and monitoring other factors on work equipment.

Maintenance management of work equipment is done by collecting and processing data, requiring development of intervention sheets of maintenance and the history of maintenance, technical papers which monitors the behaviour in operation, creating the history of failures, detailed description of the fault, intervention, data collection etc., elements that can ensure proper communication and collaboration relations between production department and the maintenance department. Fault analysis in terms of identifying the causes of failure, nature and their consequences to avoid their repair is also an important issue in the operation of work equipment.

In this context, management of maintenance is done in order to ensure the safety of workers during operations carried out, and by the measures adopted after identifying hazards and occupational risks of accidents and professional diseases associated to this activity carry out to work equipment in use, in terms of historical operations, adjustment, maintenance, repair and cleaning, including the situations that occur after some events, overhauls and upgrades. Risk identification and assessment allows employers to focus on critical points found throughout the lifetime of work equipment, including in maintenance activity.

Important elements in the process of risk assessment of work equipment are: technical data, details about the events during the lifetime of the work equipment (faults, failures, incidents, upgrades, etc.).

The limited availability of technical data and events related to the history of work equipment, information needed for assess and technical diagnose, conducting the technical expertise is the starting point for developing software for maintenance activities on the management of work equipment.

Maintenance activities can be managed and through both the technical tools of prevention used in procedures for conformity assessment, accreditation, technical diagnostic and / or compliance, and by specific software instruments that enable effective tracing of planned maintenance activities, record the performed operations on each piece of work equipment in which it operates.

Conclusion

By providing a level of confidence and to guarantee the safety and health of workers by preventing the accidents and professional diseases, a subsidiary objective of the Europe 2020 strategy, the research study aims to develop requirements and modalities for the implementation of the provisions relating to conformity assessment and occupational safety measures harmonized with the EU legislation on work equipment used at workplaces.

The study aimed to identify and analyze hazards and professional risks associated to work equipment, in terms history of maintenance and repairs operations, in use and after upgrades.

The results of the research consisted in the development of effective technical tools on management of professional risk.

These tools are designed to manage maintenance activities of work equipment in metal and wood processing industry in use, to prevent work accidents and professional disease, allow the necessary conditions for improving the safety of workers at workplace.

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Landscaping solutions of tailings ponds of thermoelectric power plants using vine plants

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Abstract

At national level, Romania, face major landscaping problems of areas affected by industrial redevelopment. In case of Thermoelectric Power Plants, most affected large areas of land are occupied by ponds related to Thermoelectric Power Plants. Upon completion of the submission of slag and ashes, ponds should be rearranged and reintroduced in the natural cycle. These activities require significant additional costs. A solution to redevelop tailings ponds could be reusing land for productive purposes. In this paper we propose to study how vine plants are growing on the areas of Thermoelectric Power tailing ponds.

Keywords: vine plants, rearranged, slag and ashes

1. Introduction

One of the sources of electrical energy is burning solid fuels in Power Plants. Thermal Power Plants, like any existing anthropogenic activity, is a source of environment pollution. Thermal Power Plants pollution affect all environment components, in particular the main elements: water, air and soil.

Currently 29% of electricity produced in Romania is obtained by burning coal in Thermoelectric Power Plants.

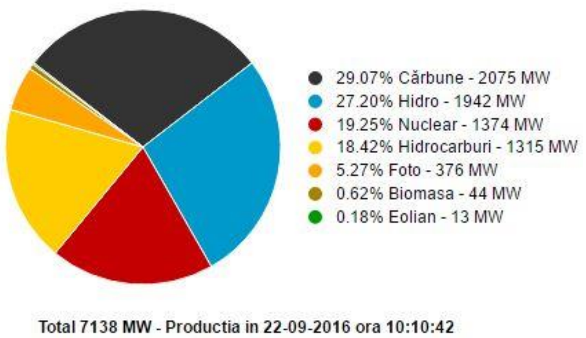

Fig. 1. Instant consumption of electricity in Romania

By burning coal, Thermal Power Plants, are releasing on chimney gases from combustion, and waste resulting from combustion represented by ash and slag, which are deposited in tailing ponds. Waste in the form of slag and ash of combustion are hydraulically transported as slurry in settling ponds for each thermal power plant. Although tailing ponds are a major source of environmental pollution, the last stage of the process flow, slag and ash storage is necessary and mandatory.

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Ponds occupy large areas of land. By making these deposits, the lands on which are located ponds, during the time they are used, they have another destination from baseline.

Upon completion of tailings ponds must be reintroduced in natural circuit. One of the phases of redevelopment is the stabilization of tailing ponds surfaces and prevent currents of air to lead dust on them.

2. Theoretical consideration

Redevelopment of degraded land from anthropogenic activity is based on a complex of works that relate primarily to redevelopment areas affected. By redevelopment work must be created a new economic potential of the area.

Reconstruction of areas must become an integral part of the anthropogenic project activity. Ponds of the power plants produces on a number of effects on land such as:

- changing the landscape of the region and strong influence and systematic flora and fauna
- reducing agricultural and forestry activity by occupying land devoted to these purposes
- changing hydrological conditions by diverting river works
- changes in technical infrastructure and social
- environmental pollution

There are three types of interventions for environmental recovery of the affected land:

- reconstruction of the landscape as it was before degradation
- seeking a re-use destinations, offer it new forms of land use
- systematization of the affected areas provisional, pending the final decision taken by law enforcement.

The affected areas are within at least one of the types of environmental recovery mentioned above. A solution for the upgrading of the tailing ponds of power stations can be productive recovery. Affected areas can be redeveloped and agricultural crops, vines or fruit trees after restoring topsoil layer from the surface reconstruction of irrigation and drainage system. Also in this category are arrangements for cattle, irrigation or fish farming. In the first case solutions are interventions to recreate an environment suitable for pasture and facilities; second and third case requires appropriate precautions to avoid water pollution. In this paper we intend to present a solution for the upgrading of the tailing ponds of Thermal Power Plans with productive vineyards.

3. Vine

Grapes are adapted to a wide variety of soil types and can be grown successfully on soil not suitable for many other crops. Grapevines are long term plants that can live between 50 to 100 years. Strong, edible fruit likely won't appear for anywhere from 1-3 years. Before growing wine grapes, must know the chemical and physical properties of the soil.

Soils can have the following problems:

Low organic matter content: soils are naturally low in organic matter, and years of heaving grazing, cropping and ploughing will further degrade them. Low fertility: their natural fertility is not adequate to support a high-yielding, intensive horticultural crop such as grape.

Table 1. Ideal vineyard soil properties.

Soil property	**Ideal range**
pH	6.0–7.0
Exchangeable Na	<7.0%
Exchangeable Ca	65%–75%
Exchangeable K	3%–10%
Bray P	>20 mg/kg
Topsoil organic matter	3%–6%
Total N	0.1%–0.2%
Density	<1.4 g/cm3 in the surface
Free rooting soil depth	0,5m

Almost no natural soils have these characteristics. Nitrogen is the most important nutrient in managing vines. Excess N results in excessive vegetative vigor at the expense of flowers and fruits. Nitrogen deficiency interferes with fermentation time and wine quality. Potassium K is rarely needed in heavier soils but may need attention in lighter soils.

Most important macro elements (required in higher amounts) – Nitrogen (N) – Phosphates (P) – Potassium (K) – Calcium (Ca) – Magnesium (Mg) – Sulfur (S) • Most important micro elements (required in small amounts) – Iron (Fe) – Boron (B) – Manganese (Mn) – Zink (Zn) – Copper (Cu).

In the worst soils, the roots of the grape vines are forced to seek nutrients for sustenance. The lack of water at the right time creates vine stress that force the development of the grapes instead of the leaves and canopies. This helps produce smaller berries with higher juice to skin ratios and naturally brings about lower yields. This creates a wine with more concentration and flavor. The type of soil best suited for grapes used to produce wine effectively regulates the amount of water the vines are able to reach at the right times.

4. Case Study

One of the ponds of the power plants is Caprisoara Valley tailing pond, pond of Thermal Power Plant Paroseni. In order to achieve the proposed study was taken slag and ashes from the tailings pond, and has been planted vine plants.

To study the behavior and way of plant development vines we planted two types of vines: a white variety vine and red - both planted in ash taken from the pond of the Thermal Power Plant Paroseni, and also in soil around them. Due to weather conditions in the Jiu Valley we chose two varieties of vines resistant to low temperatures and freezing. Vine Vitis used is 'Boskoop Glory'.

"Boskoop glory" is a disease resistant, cold-tolerant grape variety from the Netherlands. It is a hybrid between Vitis vinifera and Vitis labrusca. It was developed in the 1950s at Wageningen where American vines had been planted. It is therefore assumed to be a spontaneous crossing of two species from the vineyard. This variety usually ripens fruit in late August or early September and is resistant to fungal diseases and frost. It is a popular table grape in the Netherlands and it is popular among gardeners in the Netherlands, England, Germany and much of Northern Europe. The flavor is very aromatic and juicy.

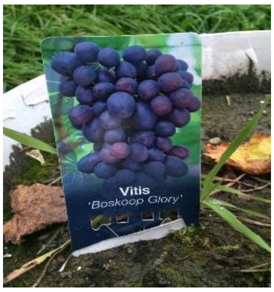

Fig. 2. Vitis "Boskoop Glory"

Fig. 3. Vitis "Vroege van der Laan"

White vine used is Vitis "Vroege van der Laan"

Vitis 'Vroege van der Laan' is a white grape, yellow, which is particularly suitable for growing outdoors. It belongs to old varieties. The plants are strong and quite resistant to fungal diseases. He is considered one of the best white grape for our outdoor climate. "Vroege van der Laan" always comes at a good production. Grapes ripe in late September-early October. The production is moderate to good. Although grapes are good to eat, they are mainly used for the production of juices and white wines. We used 4 vines of each variety, and were planted in pairs into garden soil in containers and two others has been planted in tailings taken from tailing pond. Plantation was performed in June 2015.

Vitis "Boskoop Glory" planted in soil | Vitis "Boskoop Glory" planted in tailings | Vitis "Vroege van der Laan" planted in soil | Vitis "Vroege van der Laan" planted in tailings

Fig. 4. Vine plantation

For winter climatic conditions to not affect the growth of plants, containers where have introduced into the ground.

At the beginning of the growing season of 2016 vines budded without being affected by climatic conditions in the Jiu Valley. This goes to make fruit after the first 12 months after planting.

Vitis "Boskoop Glory" – Grapes from the sample planted in soil

Vitis "Boskoop Glory"- Grapes from the sample planted in taillings

Vitis "Vroege van der Laan" - Grapes from the sample planted in soil

Vitis "Vroege van der Laan" - Grapes from the sample planted in taillings

Fig. 5. Vine grapes at 12 months after plantation

Vines grown in tailing container is less developed than in the soil, which is normal due to the lack of nutrients in the soil. It is noted that plants have not been helped with any nutrients. Can be notice differences in both cases the number of leaves on the stem and quantity of grapes. Grape production is half if the vine in ash and slag in comparison with those grown in soil. Production can be increased by adding nutrients.

One solution for productive re-cultivation tailings ponds of Thermal Power Plants could be areas under vine cultivation. Our solution is one with effectiveness and economic investment required for cultivation can be recovered by selling the final products (grapes, grape juice or wine).

Conclusion

Tailing ponds of the Thermal Power Plants should be rearranged after completing their exploitation. One of the methods of recovery tailings ponds is productive recovery. Tailing ponds can be planted with vines according to the study conducted. Due to lack of nutrients vine is less developed as both the fruit and the leaves, which does not stop the cultivation of these areas with vine plants. To increase productivity plant vineyards, they can be helped with different nutrients and fertilizers.

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Open pits productivity control along with iron ore products demand variation

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Abstract

This article includes consideration of the issue concerning open pits (which are the part of one Mining & Benefication Complex) productivity determination in the context of varying demand of iron ore products. One of the problems regarding iron ore deposit mining at the current stage of open mining development presented in this work. It includes the following: mines operate with a constant operational capacity while iron ore products price and demand significant variation is observed in mineral markets. It is almost impossible to predict these variations in the longer term, because they mainly depend on global economy condition, political situation in the country, etc. Under these conditions the productivity of mine is to be adjusted to varying external conditions during its entire life time. The productivity is to be managed at the level of one open pit or group of them which belong to one Plant as well as at the level of Company Group with one owner in order to get the maximum profit. The productivity reallocation method, when iron ore products demand is varied, was developed for the group of open pits which are the part of one mining & benefication plant. By the example of Annovsk and Pervomaysk mines which belong to Severnyi GOK, there was ore mining productivity reallocation done without any changes in general strategy for final product production. Ore mining productivity reallocation between Pervomaysk and Annovsk mines just by 1 m. in favor of Pervomaysk mine will allow increasing the profit of Severnyi GOK by 96 m.UAH.

Keywords: open-cast mining, mines goup,open pits productivity for ore mining, mining operations mode;

1. The issue and its relation with scientific and practical targets

One of the most important conditions for any deposit efficient mining is justified determination of its operational capacity. At that the productivity of ore mining refers to strategical design solutions (Arsentiev, 2008), which are very hard to be changed in case of necessity.

Operation in the contest of market economical relations puts mining plants in dependence on global mineral market situation, which is characterized by significant variability over the last ten years. Periodically there are economy slowdowns and recoveries and economic crisis- these aspects impact on mining plants and separate mines operation. Due to that the objectives of local mining plants have been changed. Ensuring of competitiveness which depends on mining strategy became a priority.

When designing the mines, one of the main targets is to ensure its stable and continuous operation. At that the life time of mine is 40 or more years. Within such time period significant changes in machinery, process, economics, mining conditions, related to mining operation degradation, occur. Over this time the significant price and demand variation for iron ore products is observed. It is almost impossible to predict these variations in the longer term, because they mainly depend on global economy condition, political situation in the country, etc. Therefore when mines operate with a constant operational capacity, there are additional expenses related to storing of unsold final product in warehouses- in the period of demand decrease. Plants also lose the opportunity to increase the profit when demand is increased due to impossibility of production active intensification to cover the market demand. Productivity of mine is to be adjusted with varying external conditions over the period of its life time (Kosolapov and Ptashnik, 2011). It means to increase economical efficiency of mining is possible by implementation of flexible changes in mining volumes when demand is varied. If the Plant owns several mines than the productivity of each one is to be defined based on the best performance of Plant.

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2. Unsolved issue description

Mineral demand increase brings to production volume increase (at that there is no change in stripping ratio). Demand decrease causes mining volumes decrease, equipment, buildings and facilities downtimes, manpower reduction, and equipment utilization time decrease. At the same time in order to decrease production cost the stripping ratio is decreased. However, the current methods for mining operations planning don't include any changes in mine productivity for ore extraction within long periods of deposit development. In addition there are no mechanisms for justified selection of open pit production capacity and operation mode, considering their interrelation along with iron ore demand variation. It causes changes (increase or decrease) in primarily scheduled volumes of minerals and waste extraction. Respectively, actual mine productivity can be different from designed one due to changes of iron ore price, demand, financial and technical condition of Plant. As a result, there is a delay in stripping operations, unscheduled temporary non-operational walls generation because of failure to follow the law of well-proportioned operations and mine development, and also, generation of temporary non-operational walls in operational zone which is unacceptable. Time to time it is required to reconsider previous designs due to deviation between actual state of mining operations and design solutions (Romanenko et al., 2012). Therefore, it is necessary to adjust mining operations to variable market conditions. Due to that the issue comes up how to schedule and change the strategy of mining operations development (prospective depth of mine, mining operations mode, ore extraction productivity) if the product demand is varied?

3. Task setting

Therefore, the following target was set– to develop the method of productivity reallocation between mines which are the part of the one Mining & Benefication Plant. The methodology considers interrelation between mining operation mode and ore extraction productivity along with variation of iron ore product demand.

4. Material presentation and results

In order to adjust ore extraction productivity to product demand increase or decrease, it is first required to define the mine maximum productivity based on mineral availability and also economic possibility, i.e. investments availability for plant capacity increase. In this case for each open pit there can be defined a scope of possible operation options which includes two ultra ones (Blisnyukov et al., 2013; Bliznyukova, 2014):

- Mine operation with minimum stripping ratio and low ore extraction productivity.
- Mine operation with maximum ore extraction productivity and high stripping ratio.

Within the possible options for ore extraction productivity and mining operation mode the best option of their combination is selected for long or entire period.

As an example, let's consider the easiest case of deposit development by mines group: Pervomaysk and Annovsk open pits which belong to Severnyi GOK. Here ferrous quartzites are extracted for further processing at Plant and production of iron ore concentrate. Considering mining and economic possibilities of Plant and concentrate demand in local and external markets, in 2008 Design Institute together with the Plant has established the strategy for ore mining for the next 30 years:

- For Pervomaysk mine – 23 m. t/y;
- For Annovsk mine – 10 m. t/y.

Stripping operation scopes which ensure the productivity achievement are:

- For Pervomaysk mine – 17,71 m. m^3/y (n=0,72 m^3/t);
- For Annovsk mine – 15,8 млн. $м^3$/год (n=1,55m^3/t).

Iron ore concentrate demand can be decreased or increased. Therefore, apart from the strategy for ore extraction and concentrate production, defined by Design Institute, changes of net present value (NPV) based on concentrate production enforced changes for both cases were studied (Blisnyukov et al., 2014). At that, the issue of ore extraction productivity set level achievement was first considered, taking into account the current condition of mining operations in open pits and also operations mode change depending on ore extraction productivity change (Vilkul et al., 2013). Calculation results are shown in the table 1. In addition the calculation results are presented in diagram 1.

Table 1.Initial data and Severnyi GOK profit calculation results

Items	Pervomaysk mine					Annovsk mine				
	A_{p1}	A_{p2}	$A_{p.стр}$	A_{p4}	A_{p5}	A_{p1}	A_{p2}	$A_{p.стр}$	A_{p4}	A_{p5}
1. Ore extraction volume, m. t/y (Ap)	21	22	23	24	25	8	9	10	11	12
2. Concentrate output, fraction (γ)	0,42	0,42	0,42	0,42	0,42	0,38	0,38	0,38	0,38	0,38
3. Concentrate production volume, m. t/y (Ak)	8,8	9,2	9,7	10,1	10,5	3	3,4	3,8	4,2	4,6
4. Stripping ratio, m^3/t	0,65	0,69	0,72	0,75	0,81	1,65	1,71	1,83	1,95	2,06
6. Net present value, billion, UAH (NPV)	4,41	4,57	4,74	4,91	5,02	1,1	1,21	1,28	1,34	1,4

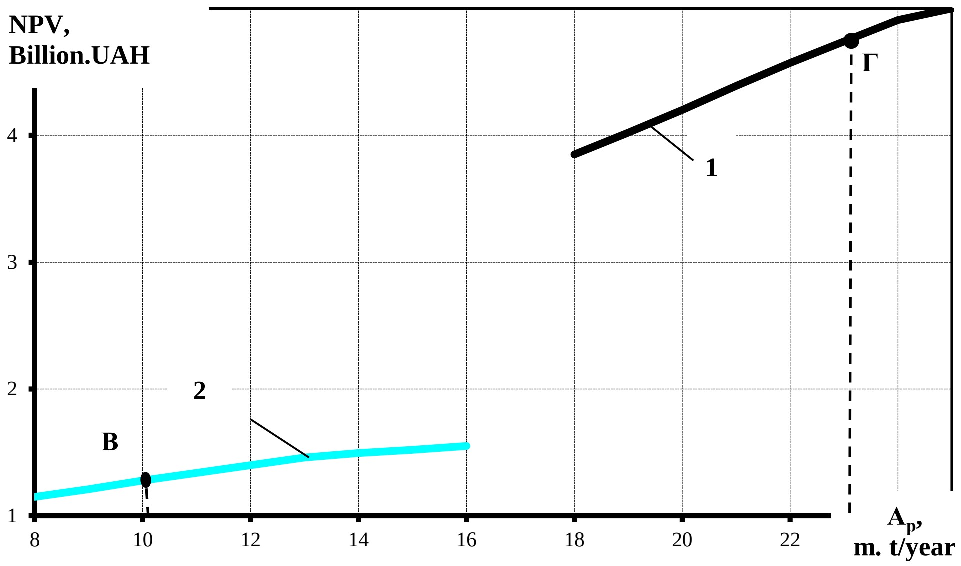

Fig. 1. Changes of economic NPV, complex evaluation figure of mining operation mode and productivity depending on ore demand from PJSC «SEVGOK»: 1 – Pervomaysk mine; 2 –Annovsk mine

Points B and Г in this diagram characterize technological and economic figures of mines operation with ore extraction productivity, which is set in the strategy of Plant:

- For Pervomaysk open pit – Ap = 23 m. m^3/y, n_p=0,72 m3/t, γ_p=0,42;
- For Annovsk open pit – A_A = 10 m. m3/y, n_A=1,83 m3/t, γ_A=0,38.

In the picture 1 it's obvious that along with productivity of Pervomaysk and Annovsk mines increase (line 1 and 2), despite stripping ratio increase, there is a profit increase from concentrate production. Lines 1 and 2 slopes are different. It means that the same increase of ore extraction volumes from Annovsk and Pervomaysk mines won't ensure the same increase of NPV for Plant. Slope of curves shows that the more is slope angle, more revenue will be obtained by Plant from the same increase of mine productivity.

Point Ap (crossing point of coordinate axes) in the picture 2 characterize lack of productivity increase (ΔAp=0) from designed one for Annovsk and Pervomaysk open pits and respectively zero increase of NPV versus plan (ΔNPV =0).

In picture 2 it's obvious that Pervomaysk mine operation with any combination of mining operations and mine productivity is better than optimal combinations of the same parameters for Annovsk mine.

Pervomaysk mine productivity increase by 1 m.t/y will bring to NPV increase by 200% versus this figure increase for Annovsk mine. At the same time along with ore mining decrease by 1 m.t/y in Pervomaysk mine, net profit loss will be also higher. Therefore in case of consideration the issue of mine designed ore mining productivity reduction (less than 33 m.t/y), first of all it is required to decrease productivity of Annovsk mine. In case of ore mining productivity increase (more than 33 m.t/y), first of all it is required to increase Pervomaysk mine productivity up to maximum possible volumes and then, if it isn't enough, to increase productivity of Annovsk mine.

In case of ore mining productivity reallocation without any changes in general strategy for final product production, it is required to consider that net profit change won't be even to ore mining productivity: net profit is changed the least when mine productivity is increased than when it is decreased.

At the ore extraction productivity increase in Pervomaysk mine by 1 m.t/y, increase of NPV will be 155 m.UAH. At the same time, at ore extraction productivity decrease in Annovsk mine will cause loss of NPV for this mine by 56 m. UAH. The difference between increase and loss of NPV by ore mining volumes reallocation by 1 m.t/y for Plant will be - 177%; by 2 m. t/y will be - 63%; by 3 m. t/y will be - 19%.

Based on abovementioned, it is obvious that the ore extraction designed productivity in the volume of 33 m.t/y is better to fulfill by increasing the productivity of Pervomaysk mine by 1 m.t/y and decreasing the productivity by the same value in Annovsk mine. Then, ore extraction volumes will be reallocated as following: Pervomaysk mine – 24 m. t/y, Annovsk mine – 9 m.t. /y.

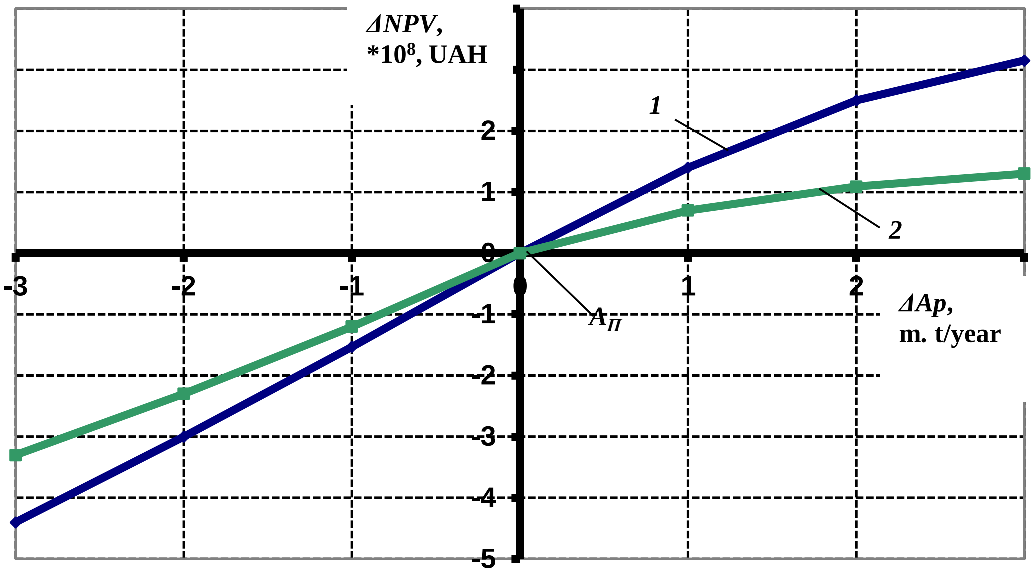

Fig. 2. Change of annual NPV of Plant ΔNPV depending on change of ore extraction productivity ΔAp in mines: 1 – Pervomaysk mine; 2 –Annovsk mine

5. Conclusions

There is a method developed for mines (which belong to one Plant) productivity for ore extraction reallocation, considering the interaction of mining operations mode and ore mining volumes along with iron ore product demand variation. It is proved that the best reallocation for Severnyi GOK is the option when Pervomaysk mine operates with the maximum productivity and Annovsk mine ensures productivity of 9 m.t/y which is required to complete the strategy of Plant.

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Solutions to increase the sustainability level of mining activities

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Abstract

Establishing and implementing the best solutions and strategies to increase the sustainability of mining industry is one of the main concerns of specialists and responsible companies that want to operate according to the highest standards, ensuring the reduction of negative impacts on natural and socio-economic environment. Intensifying the development of mining, while improving the environmental sustainability as well as the economic and social development of the society must be carried out by considering a range of practices and measures. For high efficiency, the sustainable practices must be established and applied for each stage of the mining process. In this paper, the focus is on key issues that involve reducing the mining impact on the environment, in main stages of its life cycle.

Keywords: environment, impact, mining, strategy, sustainable development;

1. Introduction

The role of mineral resources in society is extremely important, and mining is an activity essential to the economic development of society. Most of the mineral resources consumed by the contemporary society are non-renewable. The exception is represented by metals, which can be considered to be renewable, meaning that they can pass through recycling processes so that they can be reused. However, there must be found ways to meet the requirements of the Brundtland Report which includes ensuring "the possibility of future generations to meet their own needs".

The need to redefine and extrapolate the concept of "sustainable development", so as to include in his sphere the mining industry, is ever greater, as it is more clearly that to cease all mining activities is not a feasible option, given that mankind needs and will further need mineral raw materials. Up to now there is no accurate delineation of how mining can contribute to sustainable development.

Theories on the sustainable exploitation of minerals are not relevant when investing in temporary mining projects that will only function as long as they are economically viable. Mining in the context of sustainable development implies a performing management and the assumption of commitments to improve the environment, economy and society throughout the project until the closing and post-closing stages of the activities.

2. The objectives of sustainable development in mining

According to the literature, the objectives of sustainable development for the mining industry are the economy, environment and community. A missing, but essential, element is safety and health, which should receive more attention in this area of industry than in any other, because the risk of accidents is much enhanced by the existing conditions. The second missing element concerns the mining processes of extraction, transport and processing of mineral resources which need to peak efficiency. Thus, it suggests the importance of monitoring at micro level, at the site of individual mine, so that it can be established if the technological processes of the extraction and processing are effective and whether resources are managed sustainable or not. (Auty and Mikesell, 1998).

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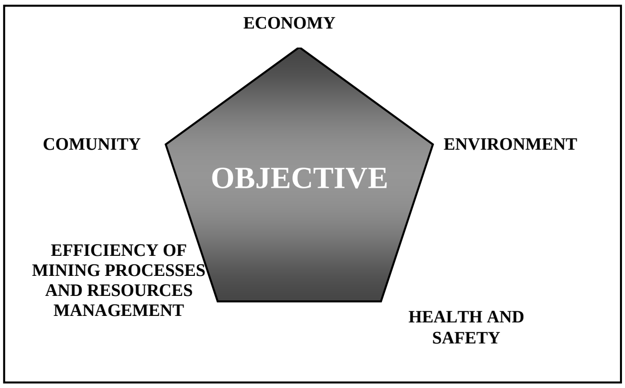
Adopting modern technologies in the conduct of mining activities can lead to achievement of impressive performances, especially in terms of process efficiency, health and safety and environment. (***, 2006)

Thus, emphasis on meeting the five objectives of sustainable development (Figure 1) in mining is essential.

Fig. 1 Objectives of sustainable development in mining



Efficiency is the basis of any sustainable benefit obtained for the community. Therefore, the mineral resource which is "owned", in most countries by the state, is operated on behalf of the community, there being an immediate connection between it, the economy and the environment. (Laurence et al., 2011)

Economic development - the main purpose of resources exploitation is to generate long-term welfare, minimizing costs and maximizing profits. Mining sector can bring significant gains by increasing employment, creation of new infrastructure, from which can benefit the general population.

Local communities - in most cases, the community does not support, but opposes to resource exploitation, causing clashes in trying to stop the development of mining activity. Many mining companies have found as a solution the education, training and employment of local people. Interactions between the mine and the community ensures knowledge, for those directly affected, regarding the project, its advantages and disadvantages, gains and losses at the local level, leading to community development in line with its vision.

Environment - mining generates huge amounts of waste that needs to be stored having a strong negative impact on long term as a result of occupying lands that once had a certain function, and restoration of their productivity in the short term, it is almost impossible. It is very important to avoid or minimize the environmental impact, and this can be done by adopting environmental management practices and taking action during the planning and operation stages.

Health and safety – concern for safety of employees in the mining industry must occupy first place because of the increased risk of accidents. Working conditions should be optimal so as to avoid or minimize the possibility of occurrence of unfortunate events that can endanger the lives of employees. Proper management of risks in the mining industry brings benefits both for the employee (health maintenance) and the employer (increasing productivity and quality).

Efficiency of the mining process - mining industry is facing many challenges in terms of activity management, given that producers aim, primarily, profit growth. A mining exploitation must be efficient in terms of resource exploitation and management, so specialists from different fields need to work together to determine the optimal methods of extraction. Advanced technologies are already a chapter of great interest in many fields, not only in terms of economy and society, but also of environmental protection, producing major changes in industries.

3. Mining – generator of sustainable development

To enhance the development of mining while improving environmental sustainability, economic and social development in this sector, the following practices and measures must be considered: reducing consumption of energy and water; reducing the surfaces of land affected by mining and urban development; prevention of environmental pollution; reducing the industry's environmental impact; organizing the closing process of mining unit and recovery of the affected land; increase the reuse and recycling of products; conservation of natural resources; reinvestment of profits in order to enhance the sustainability of mining and to ensure the premises of sustainable development of the area; ensuring safety and health of employees. For high efficiency, sustainable practices must be established and applied for each stage of mining activity. By lifecycle analysis there can be identified those particular issues that have a significant environmental impact. Thus, the focus is on key issues involving reduction of the impact of mining on the environment in the main stages of its life cycle.

3.1. Exploration stage

In the exploration stage, the environmental impact is relatively low given the small size of land surfaces that are disturbed. Even if the exploration process has a relatively small global impact, it intervenes in natural processes occurring in local ecosystems, causing negative effects on the environment, such as: noise and vibration, dust, fragmentation of the ecosystem and the migration of certain species of life forms, appearance of solid waste, etc. As a result, it requires the development of sustainable practices right from the stage of exploration of the deposit, such as access roads recovery and recycling of drilling mud.

3.2. Opening stage

In the opening stage of the project many changes in the local ecosystem takes place as a result of: occupation of large areas of land for mining, aquifer dewatering, deviation of rivers, deforestation, the extraction topsoil and overburden. Sometimes, in the circumstances of the discovery of very rich deposits even resettlements are required. The effects of these anthropogenic interventions causes major changes and a negative impact on the environment and local communities: environmental pollution through exploitation activities, loss of biodiversity, fragmentation of ecosystems by developing transport routes, climate changes at the local level due to deforestation and modification of hydrological regime, impaired health, loss of natural, cultural and traditional assets in case of resettlements. In order to compensate the negative effects of future projects, there should be established practices during opening works that reduces the impact on the environment. These practices include:

- recovery and conservation of topsoil - important stage in mining, given that soil is an essential resource for sustaining life and the duration of its regeneration is very high;
- the use of timber coming from deforestation for the community;
- forest regeneration - by initiating projects involving afforestation of land areas at least equal to those occupied by forests cleared to release land for mining;
- create waterproof screens for mining exploitations operating under the protection of dewatering systems in order to reduce the distance of lowering the groundwater level in adjacent areas;
- involvement of mining in the development of local community by initiating projects that can increase employment and improve the living conditions, by providing jobs for residents, building schools, hospitals, places for cultural activities, development of access roads, accessibility to all utility networks, etc.

3.3. Exploitation stage (extraction, transport, storage)

Exploitation and processing of extracted materials, is the main stage of the entire mining project and involves the extraction, transport and deposition of waste rocks, transportation and storage of useful substances and raw material processing. This stage occupies the longest periods of time around the mining activity and has a high degree in which the environment and communities in adjacent areas are affected as a result of numerous operations carried out in order to extract and process minerals.

Among the solutions for increasing sustainability of mining projects in the operational phase are mentioned:

- rational exploitation and capitalization as complete as possible of the deposit, by applying methods and technologies to minimize reserves losses; spraying water on the work fronts and industrial roads to reduce dust content in the air;
- implement a sustainable transport system that effectively utilize the facilities of the morphology of the land (using for this purpose the level differences between the position of working fronts and mining mass deposits; (www.treehugger.com)
- rehabilitation of land while exploiting - immediately after release of land areas from their technological tasks, by gradually opening the deposit, on relatively small surfaces, enough to provide the necessary space and to allow advancement towards a new exploitation front; (Fodor and Lazăr, 2006)
- rational management of waste and by increasing its recycling and reuse;
- reducing energy consumption and thus emissions of greenhouse gases must be an explicit goal of mining management; purification and/or water treatment before their release into natural water courses;
- ensuring maximum efficiency in operation of machinery and equipment throughout the activity.

3.4. Closure and post-closure stages

Mine closure and post-closure should be planned at the earliest stage, when it also guarantees the financial resources needed in this process. The common practice is to abandon the mine at the end of the production cycle, thus transferring the burden of damages on the environment and society upon local communities, and on future generations (or in other cases the closure of mining towns located remotely simultaneously with the closure of mines) (Bastida and Aguado, 2008). Mine closure should be planned from the beginning of the project, ensuring that the soil and structures are restored for other destinations after mine closure and the development of a alternative economic base. In these stages can be implemented numerous measures to ensure support for the sustainable development of the mining area, including:

- release of land from its technological tasks and decommissioning of premises, use of functional equipment in other mining areas, recovery, reuse and/or recycling of component parts from machinery and building materials (glass, iron, bricks, etc.);
- restoring groundwater regime either by filling the remaining gaps with water, over the initial hydrostatic level, thus speeding the moistening of the soil in adjacent areas; either by shielding the mining area and by injecting water outside the perimeter, through a reverse dewatering process;
- recovery and ecological restoration of degraded land, which is a complex process of stabilization, improvement and revegetation of degraded lands so that they can be reintroduced in the natural or economic circuit;
- maintenance and post-closure monitoring aims aspects such as: the evolution of air quality, water quality discharged from the mining area and emissaries in which they discharge, leakage of acidic substances, soil and vegetation quality, noise and vibrations levels during closure and rehabilitation, stability and lands surface state within waste deposits;
- reuse of lands is an important aspect of sustainable development and ensures the economic development of the affected area;
- use of premises available to support economic reconstruction by creating new businesses, to support environment reconstruction, economic development of the region and providing new jobs for unemployed people;
- reuse of waste rocks containing no harmful elements as filling material for building embankments or damming natural or artificial slopes; development of sustainable activities taking first into account all the possibilities offered by the land and the views and needs of local communities.

4. Conclusions

In the minerals sector, sustainable development means that investments in such projects must be financially profitable, technically adequate, ecologically reasonable and socially responsible. Companies involved in extracting non-renewable resources are under great pressures that are based on implementing the concept of sustainability into processes and operations of strategic decision-making. Thus, responsible companies have developed a number of initiatives to ensure an economic sound management of environmental impact and social responsibility. At the same time, relations between government, industry and other stakeholders must be productive e.For a mining exploitation to become sustainable, it is not mandatory that each operation to be subjected to immediate changes, because to do so may require allocating and mobilizing new resources, such as people and money. It is sufficient for processes and operations to be improved in terms of sustainable development at least as it is allowed in the first phase, so as to obtain a satisfactory benefit, following that along with the development, other sustainable operations to be implemented. Thus, the best way for coexistence of mining industry with the environment in order to achieve a sustainable development of society in all aspects, is the establishment and implementation of best sustainable practices applied in conditions of maximum security which are focused on obtaining favorable results in terms of economy, environment and community. At the same time, mining must meet the expectations of the local community and must facilitate it's the strong and durable development.

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Implementation of sustainable practices in the lignite open pit Rosia de Jiu

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Abstract

Exploitation of lignite in Rosia de Jiu open pit can be included in the broad concept of sustainable development through the development and integration of practices that lead to minimizing the environmental impact of mining operations. In this paper are analyzed solutions such as: rational exploitation of the deposit, reducing water and energy consumption, reducing the amount of affected land, preventing environmental pollution and ensuring the rehabilitation and reuse of degraded land. Thus, the land affected by mining can be reused for the development of sustainable activities in order to obtain the best results in terms of environment, community and economy.

Keywords: environment, land rehebilitation, land reuse, open pit, sustainability

1. Introduction

Rosia Jiu open pit, through its location in the region, the morphology of the terrain, the size of the mining area, the development of mining works, large volumes of industrial reserves, difficult geomining and hydrogeological conditions, relatively high reports between overburden and lignite, represents a base study for analyzing operating practices and reusability of the land after the closure of mining activities in the context of sustainability.

In Rosia Jiu open pit, the first mining works were started in 1973. After more than four decades of exploitation there were extracted over 100 millions t and in 2015 the available reserves were estimated at 21.5 million t.

Mining can become sustainable through the development and integration of practices that lead to minimizing the environmental impact of mining operations. These practices include measures to reduce consumption of water and energy, the amount of land affected, prevention of environmental pollution and measures for closure and rehabilitation of the area so that the land affected by mining can be reused for the development of sustainable activities in order to obtain the best results in terms of the environment, community and economy. (Laurence et al., 2011)

2. Implementation of sustainable practices throughout the lifecycle of the open pit

Since mining activity in Rosia de Jiu open pit is viable for another decade, it requires the implementation of sustainable practices in relation to the exploitation of the resource available, to be effective, primarily in terms of environmental protection, health and safety of population, but also economically.

2.1. Rational and total exploitation of the lignite deposit

Complete extraction of lignite reserves and the quality of the extracted coal, are priority issues concerning the rational exploitation of deposits. In these circumstances, recovery of coal from the final slopes of the pit and from thin layers is in question.

In the first case, the method of extraction with Auger-Mining type drills can be applied. It consists in drilling of large diameter executed in the definitive slopes of the open pit, allowing recovery of coal at the rate of up to 60%,

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reserves which, under current operating conditions, remains untapped, representing also a financial loss. (Lukhele, 2002)

Coal mining from the final slopes of the open pit is conducted after sizing the drilling holes and security pillars, very important for the stability of the slope. After extracting the coal, the remaining holes in the slopes will be filled with sterile material from waste dumps.

In the second case, it is recommended the use of surface combines, which, due to the configuration of the extraction system have a higher degree of selectivity than conventional extraction machinery (bucketwheel excavators, mechanic shovel excavators, backhoe excavators etc.). By using surface combines, layers with small and very small thickness can be extracted selectively without lowering productivity. The extracted material is loaded and transported by trucks. (Lazăr, 1998)

The use of surface combines, in particular for the extraction of thin layers, has two important advantages:

- due to substantially reducing operating losses, the recovery of reserves is increased by 25%;
- separate extraction of sterile insertions with small thickness considerably improves the quality of extracted coal, leading, among other things, to a reduction in processing costs.

The technique of extracting coal by milling gives the material a particle size less than 150 mm, which corresponds to the requirements imposed by transport on conveyor belts and requirements imposed by power plants.

Other advantages of surface combines, in terms of beneficiaries include: creating a clean working surface; the possibility of depositing directly the sterile derived from insertions; ability to use the equipment not only for extraction but also as auxiliary equipment.

2.2. Implementation of water spraying devices mounted on bucketwheel excavators

Following the operations needed to extract the resource, results large amounts of dust that lead to degradation of air quality. This in turn leads to increased risk of illness to employees and local communities situated at relatively small distances from Rosia open pit (Farcasesti Moşneni village at about 250 m, Rosia village and residential area of Rovinari town at about 700 m).

Splashing water on sterile materials and lignite, manipulated in the open pit, from excavation to deposition, aims to reduce the amount of dust and particulate mater from air, by maintaining a sufficient humidity of materials that do not allow to be driven by wind. (forum.bulk-online.com)

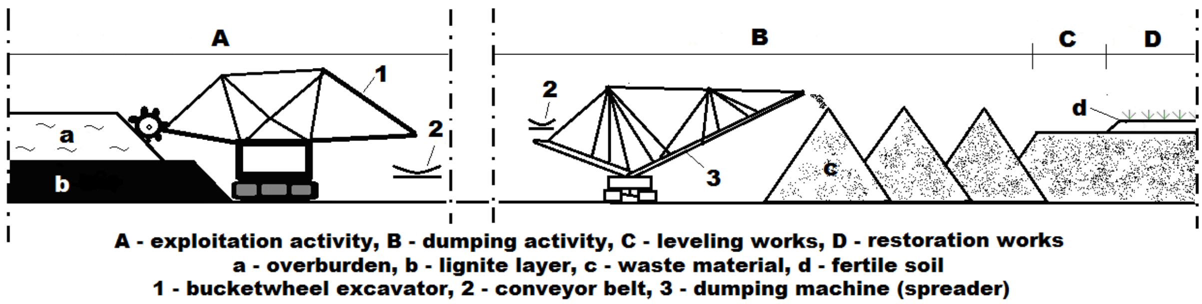
The method consists in implementing sprayers mounted on bucketwheel excavators, dumping machines (spreaders), loaders and on conveyors.

The advantage of this system is represented by the reduction of the amount of dust and particulate maters in the atmosphere, with the possibility of using poor quality water. The costs to implement this system in Rosia de Jiu open pit are relatively low and the benefits are considerable.

2.3. Restoration of land while exploiting

In order to recover and reuse lands affected by mining from the operating stage, restoration of land is recommended to be carried out while exploiting (fig. 1), by the immediate start of reconstruction and rehabilitation processes of the areas freed from their technological tasks. (Nyari and Lazăr, 2016)

Fig. 1. Restoration of land while exploiting



This practice presents important advantages, such as reducing the period of rehabilitation of the area of land affected after closure of the open pit, reducing the degree of pollution of the environment, gradual reintegration of land in the adjacent landscape and the possibility to reuse of the rehabilitated land for other purposes.

2.4. Reuse of waste material

Waste rock resulting from the extraction of lignite in Rosia de Jiu open pit, are made of clay, sand and gravel and they contain no hazardous substances. The waste material can be used as filler in the construction of highways and the rough fraction can be used as embankment to protect riverbanks, to ensure the stability of natural and artificial slopes and reinforce dams. The advantages are represented by the reduction the amount of waste material deposited and thus the surfaces of natural lands occupied, and by the reduction of the amount of construction materials exploited.

3. Implementing sustainable practices after cessation of mining activities

Lignite resources from Rosia de Jiu open pit are sufficient only for the next 10 years. Given the fact that the local economy will be affected by its closure, is essential to recover the affected land and return it to the natural or economic circuit.

In this regard, the paper analyzed three land reuse solutions that can contribute to sustainable development of the region (that can be adapted for other similar regions):

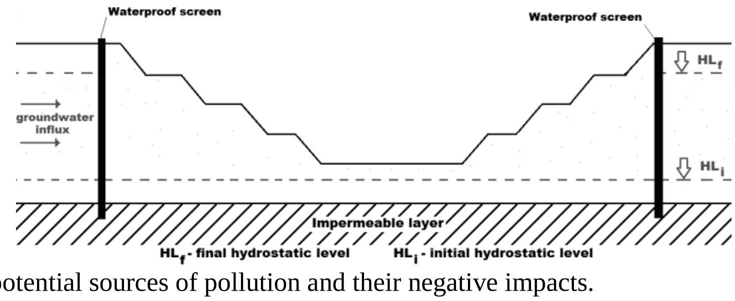
- reconstruction and ecological rehabilitation of degraded land;
- construction of a photovoltaic park;
- implementing a system for collecting and recycling municipal waste.

By 2015, the open pit occupies 392.3 ha, the interior dump 573 ha, and the exterior dump 493 ha. It was chosen for the photovoltaic park to be constructed on the interior dump and in the open pit, while the remaining premises in the mining perimeter to serve for collection and recycling of municipal waste. Since the exterior waste dump is already restored (forestry plantation), it is recommended the maintenance and monitoring of the works.

3.1. Reconstruction and ecological rehabilitation of degraded land

After exploitation works, the land must be released from its technological tasks and of the decommissioned constructions at risk of collapse or that can not be used in future economic activities. Before the land is reused, its rehabilitation and recovery is necessary, through a complex process that involves insurance of physical, chemical and biological stability of the degraded land, reshaping the land in order to increase the stability of the pit and waste dumps slopes and its reintegration in the adjacent landscape, deposition of a layer of topsoil and its amendment in order to improve soil quality and, not least, revegetation of the land depending on the type of reuse. Recovery and rehabilitation of land in the mining area of Rosia de Jiu open pit, for the development of a photovoltaic park, does not require special environmental conditions. There are needed stabilization, leveling, reshaping and terracing works to reduce the inclination of the open pit's and dump's slopes, so that rolling or collapse of rocks are not be triggered, and at the same time to ensure the location and optimal operation of photovoltaic panels. Minimal recovery processes are sufficient, which involves improving environmental quality, so that adjacent ecosystems and local communities are not affected. Taking into account the proposals for future activities, it is recommended grassing of the land with an important role in erosion control and soil binding. However, in marginal areas, it is recommended the plantation of vegetation curtains for land protection against wind erosion, land stabilization and improvement of water regime. Revegetation is made after a layer of topsoil is deposited and amended order to improve quality and ensure optimal conditions for maintaining the vegetation. To restore the hydrostatic level of groundwater in adjacent areas and to protect the remaining hole in which the photovoltaic park will be constructed it is suggested the construction of waterproof screens around the mining perimeter (fig. 2). Recovery of the hydrostatic level by natural means may take a long time, but there is the possibility of accelerating this process by injecting water behind the impermeable screens, through a reverse dewatering process. (www.geoengineer.org)

Fig. 2. Restoration of hydrostatic level of groundwater using waterproof screens



After the land is recovered, it requires maintenance and its necessary to monitor the environmental components, to determine and eliminate potential sources of pollution and their negative impacts.

3.2. Construction of a photovoltaic park

Lignite exploitation was the basis for production of electricity, at national level, by its integration in the National Energy System, for supply of industry and population. With the closure of Rosia de Jiu open pit, but also from other lignite open pits in the country which have reserves available for the next 20-40 years (as a result of the mining sector restructuring process), reduces the amount of lignite extracted and thus the amount of electricity produced from it.

Solar energy is the energy produced directly by the transfer of light energy radiated by the Sun and can be used both for domestic consumption to generate electricity or to heat the air inside buildings and nationally, through the occupation of large areas of land in order to supply the National Energy System. Solar panels generate electricity and, at the same time they store energy in batteries to be used when solar energy is inefficient.

Given that solar potential in Romania has remarkable values and that in most developed countries in Europe (even in those with solar potential lower than in Romania) electricity production based on energy of sunlight is successful, it can be stated that the development of a large photovoltaic park in our country, would be a major step towards sustainability. In this regard, an important aspect is the represented by the insurance of environmental and community protection.

For the case study of Rosia de Jiu open pit, it can be considered as an advantage the possibility of occupying a large area of land, approximately 1,000 hectares (considering the space available currently and extension until closure), given that one of the largest solar parks in Romania occupies an area of approximately 150 ha (near Sebiş, Arad county), and the largest photovoltaic park in the world, located in the Mojave desert, California, occupies an area of 1600 ha.

Each element of the complex that constitutes the photovoltaic park has a well defined role:

- photovoltaic panels capture solar energy;
- energy is taken up by a junction box from a series of panels;
- the generator connection box takes energy from more junction boxes;
- energy is transformed from DC to AC by a triphasic inverter;
- through an electrical station the energy is transmitted to the National Energy System. (www.anpm.ro)

The construction of the photovoltaic park involves the following: construction of access roads for maintenance processes and enclosure fences, installation of steel structures, cables and panels, mounting connecting stations and transforming stations with inverters.

In 2011, the company BoDean operating in quarrying, was the first company in the world that functioned entirely on electricity produced by its own system of photovoltaic panels mounted on the closed and recovered steps of the open pit. (www.rockproducts.com)

Starting from this idea, for Rosia de Jiu open pit is proposed installing the panels on the steps exposed to the south, where the incidence of sunlight is highest, and on the interior waste dump so that solar radiation is perpendicular on the solar collector. On slopes with northern exposure are recommended to fit the connecting stations and transforming stations with inverters, and the unoccupied surfaces should be grassed or even planted with trees or shrubs, if they do not jeopardize the smooth operation of photovoltaic panels (fig. 3).

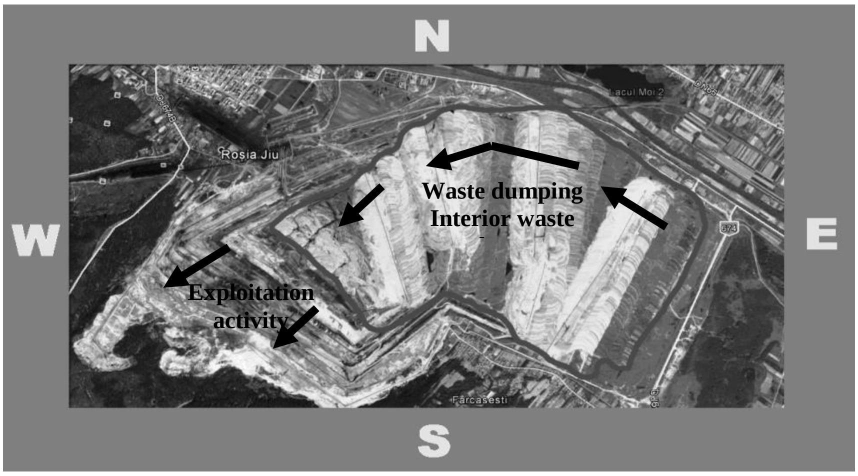


Fig. 3. Surfaces available for the construction of the photovoltaic park depending on their orientation

Given the approximately 1,000 hectares at disposal, and taking into account both the variability worldwide of the percentage of actual occupation of the land by panels and other structures necessary for the development and optimal operation of the park, namely 35 - 90%, and morphological conditions of the land occupied by Rosia de Jiu open pit, it is proposed the minimum effective occupation of the land (with the possibility of increasing the occupancy) as follows:

- ≈300 ha - photovoltaic panels;
- ≈50 ha - connecting station, substation and inverters, driveways for maintenance works and fences;
- ≈650 ha - green spaces.

Recently in Romania, in Timis county, was built a photovoltaic park on an area of 44.14 ha (located within the locality Bencecu de Sus) which consists of 84,480 photovoltaic panels, with an installed capacity of 20 MW, the contribution to the National Energy System is estimated at 25,628 MWh/year (25.6 GWh/year). Compared to these values, results that the area available in Rosia de Jiu mining perimeter (1000 ha, of which 255 ha actually filled with panels), involves the installation of approximately 1.7 million photovoltaic panels with an installed capacity of 374 MW, which under a clear sky at a rate of 40-50% per year and an average of 9 hours of light per day, would allow to supply the National Energy System with approximately 500-600 GWh/year.

The advantages are considerable and include: regenerative capacity of the resource, production of electricity without negative environmental impacts, long life, easy operation, high resistance.

The disadvantages are represented by the impossibility to provide constant energy due to the alternation of day and night or on cloudy days, the high cost of installation (with the advantage of generating free of costs electricity through the system's lifecycle) and occupation of large areas of land.

Even if initial investments are impressive, such a project can provide large amounts of electricity, and the costs can be balanced over time. This system significantly reduce harmful gas emissions resulting from electricity generation in traditional power plants and, not least, being clean energy, participates and supports the sustainable development of the society.

3.3. Construction of a municipal waste recycling center

Increasing recycling of reusable materials reduces the consumption of natural resources and, therefore, the level of pollution of the environment. Municipal wastes consist of: paper, cardboard, plastic, glass, aluminum, wood, electrical and electronic equipments, waste from parks and gardens, biodegradable fractions and waste from construction and demolition. Recycling from waste involves an intermediate processing of materials (sorting, shredding and/or compaction), transport, recovery of materials and final processing.

The center for municipal waste recycling will occupy the existing premises and will manage waste from nearby localities. Premises available from Rosia de Jiu open pit occupy about 6 ha and can be used in carrying out sorting, crushing and baling. Transporting them to entrepreneurs specializing in recovery and final processing of waste can be done by rail or road. Development of the collecting infrastructure must be made so that the value of recovered materials to cover the costs of collecting, processing and transport.

To increase the degree of recycling is recommended to implement efficient systems or centers of selective collection of municipal waste in each locality, as well as educating, encouraging and empowering people regarding the need for recycling. Waste collection can be done by taking waste directly from the manufacturer (collected on categories) by a company that processes them, either by transporting waste to collection centers by the producers themselves.

The main advantages consist in conservation of natural resources and reduction of waste storage facilities. A complex center for collection and recycling of household waste can contribute to the sustainable development of society through the application of appropriate management and waste processing practices, having positive effects on the environment, community and local and even national economy.

3.4. Alternative solutions for land reuse

Implementing the solutions listed above is a correct and rational choice, allowing the reuse of the land affected, bringing benefits to local communities through the production of renewable energy, replacing the amount of energy produced from lignite, when mining operations in Rosia de Jiu open pit will stop, but also by encouraging recycling and reusing of waste, actively participating in resources conservation and reduction of municipal waste deposited.

A major problem is that the mining basin is part of an agricultural area with high productivity while being an area with high potential of solar energy. Conditions in the location and morphology of the land, the adjacent ecosystems and communities, allows reusing the land for other purposes. Here are some alternatives:

- *Productive reuse.* The land affected by mining is part of highly productive farmland. Before starting lignite exploitation activities, the mining area was occupied lands destined for forestry and agriculture (arable and grassland), so when the approved of exploitation rates are achieved, the land may be remodeled and reconstructed, so it may go back into the productive economic cycle.
- *Recovery for recreation and leisure*. The land, being near inhabited areas, can be reused for recreation and leisure. The residual hole of the open pit will be filled with water to create a mirror of water (lake) and in parallel with the construction of specific structures for the upcoming destinations (which can be a place of picnic, camping, sports etc.) will recreate the natural landscape with green areas, forests, positive landforms and various elements

necessary in shaping the landscape. In this case, the construction of underground waterproof screens is no longer required.

- *Recovery for controlled landfill.* Uncontrolled growth in the quantity of household and/or industrial waste requires the allocation of new spaces for storage. Storing waste on land areas already degraded is a rational choice, especially where there is a residual hole, whose physical, chemical and biological characteristics allow its use for this purpose in conditions of maximum security for the environment and community. (Lazăr, 2010)

So choosing the best solution requires numerous ecological, economic and technical analyzes and studies, consultation of local communities being essential, so that the type of reuse chosen to have the capacity to meet their needs, bringing long-term benefits.

4. Conclusions

Sustainable development aims at the constant improvement of quality of life and well being of present and future generations by empowering society, creation of sustainable communities able to manage rationally natural resources and promoting the reduction of the ecological footprint. This can be accomplished by encouraging reduction of resource consumption, increasing recycling and reuse of waste and minimize the extent of damage and pollution of the environment by applying the best practices of mining and management of natural resource.

A mining exploitation must be efficient in terms of resource management, so it needs a mining management team composed of experts from different fields to work together in adapting, changing and modernizing technologies and current practices, leading the development of a eco-efficient mining, satisfactory in terms of profitability and gentle in terms of environment and community.

For choosing solutions to reuse lands affected by mining there are necessary ecological, economical and technical analyzes and surveys, to establish exactly what is the best solution. For the reuse of land it is essential to consult local communities, so that the type of reuse will have the ability to meet their needs, bringing long-term benefits. The solutions presented are fair and reasonable options that can be applied globally, allowing exploitation of mineral resources by applying sustainable industrial practices and recovery and reuse of land, after reaching operating quotas, for activities capable of reaching the primary objective: sustainable development.

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The use of Petri networks in modeling the producer-consumer relation for determining the capacity of coal deposits from lignite open pits

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Abstract

The main purpose of an open pit activity is the extraction and capitalization of coal by delivering it to the customers. The coal from open pits is transported through belt conveyors from excavators and delivered through high capacity vehicles into stores following the methodology of depositing in successive layers using vehicles type KSS or ASG. The storage capacity is given by the open pit production amount and by coal grit. Considering the requirements for designing a new coal store for an open pit, the paper will study the possibility of using Petri networks for modeling the producer-consumer relation. The producer process (coal extraction technologic lines) creates coal – measured in tonnes – is buffered, while the consumer process (delivery to customers) waits until the production gets buffered, gets it and delivers it to the customers. This problem involves an object with two ways access – a buffer object. In case of the producer-consumer problem for the extraction and storage, we know that the buffer between the producer and the consumer is finite, as it there are only n locations for coal stoage. Therefore, the producer cannot always cannot operate so fast as much as he wants and he needs to wait if the consumer is slow and the buffer is full.

Keywords: management of mining production, coal storage capacity, process technology open pits, producer-consumer problem, Petri net, producer-consumer mode, Production management features of lignite mining pits;

1. Production management features of lignite mining pits

Management involves combining mining production and use in the production of material, financial and human, in order to extract a certain amount of coal, a certain quality, deadlines and minimal cost of production. Management is based on mining production techniques, applied correctly, can prove useful to verify the efficiency of work processes of extraction, storage and delivery to consumers of coal production. Also, production management techniques can be used to correct errors that occurred in the production process to ensure the production rhythm. One of these techniques is the use of mathematical models based on Petri net capacity rating of coal deposits (Bărbulescu C., Bâgu C., 2002).

It involves those decisions on performance requirements and desired levels of production carried out of the system. Then it comes to the decision on the number and location of necessary equipment, technologies of extraction of coal and methods of management and control to be used. Second, ensure that the functioning of the production system to meet the performance criteria set. Here are summarized planning and production management, inventory management and quality control of coal shipped coal. To achieve the basic goal of production management - ensuring the efficiency of production, general manager, managers of manufacturing activity, heads of production lines should organize a close collaboration with the departments in charge of designing the production process (coal-mining) development process technological choice of tools and materials management, recruitment and training of production staff, to unite and to train everyone to contribute and collaborate in open pits out the production (Fodor D., Predoiu I., 2015).

2. Determination and use of production capacities in quarries

As in any economic unit Industrial maximum use of production capacities is of particular importance, the manager must organize and track how they know, use and evaluate the production capacity and on this basis to improve the

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substantiation of plans and rational use of the machines in technological lines and machinery for extracting coal from the deposit. In the study using coal pits as complete production capabilities is based on knowledge and rigorous determination of the size of that capacity for technological lines machines from coal extraction and storage. Production capacity to establish relationships include some factors with decisive influence (work feature size and degree of use, reaction yield, etc.) that are specific to each pit coal.

Size production capacity of the machine is determined by machine production base and features his work and the technical manual intensive or extensive. Differentiation and rigorous determination of the sizes of these elements presents special importance since they directly reflect the level of production capacity set.

The synthesis of all calculations relating to the production capacity of equipment that is focused on the situation syntheses production capacity. It is drawn up for each link of the production process that have established production capacity, ie extraction process streams for coal deposit career and coal pits as a whole. By correlations are established in cases synthetic production capabilities can detect and size differences in capacity to the rings that control the production process, and on this basis can orient the necessary measures or the use of surplus capacity, more especially to eliminate shortfalls, the narrow places in the production process.

Demands placed before careers coal causes a considerable increase in quality function. Product quality exerts a strong influence on their living conditions. Personal safety and health are today closely related to product quality, quality is also a prerequisite for competitiveness.

3. Analysis of the technological process of extraction and storage of coal lignite quarries

The ultimate goal of the work of a career lignite mining basin of Oltenia is to extract and exploit coal by shipping the beneficiaries. It continuously has to correlate production capacity by delivery capacity; deposits of coal in the pits are designed to ensure the space required for storing lignite, thus ensuring a movement of stocks that do not prevent production or supplies coal. Among the largest deposits of coal are: Lupoaia, Rosiuta, Cocoreni (have the ability to deposit more than 100 thousand tons).

All deposits of coal mining basin component of the careers of Oltenia, are of intermediate, where coal is the run time up to 30 days. In the activity at stores stock a great movement of coal or coal loading wagons previously filed and delivered forming cavities deposition filled with fresh coal extracted from the quarry. The coal extracted from quarries is transported circuits bands of excavators and deposited large capacity equipment in warehouse stacks deposition methodology in successive layers. Filing stacks coal deposit is made by car type or ASG or KSS (Fodor D., Predoiu I., 2015).

Answering coal deposits are made by car type KSS have double functions: the deposition and removal. The coal is taken from these facilities by circuits lanes at points of loading and unloaded railroad type FALS. An exception is coal deposit in Western Berbeşti career where coal loading is done with excavators' classic trucks.

The storage capacity of coal production capacity depends career grain and coal. The grain is higher, the storage capacity is smaller and vice versa. In general, if the circuits are not installed conveyors crushers to reduce grain, coal has a grain size of up to 150 mm.

Analyzing the achievements of careers lignite mining basin of Oltenia, it appears that production in 2013 was 16 185 thousand tons, while deliveries amounted to 16.815 thousand tons, so the stock of coal at year-end to 155 thousand tons. Under these conditions, the average stationary coal mining in deposits was 10 days, which has contributed to weighted average qualities on the total year of 1872 kcal/kg.

4. Research on storing coal

Coal deposits have some peculiarities, and after their analysis and research the following conclusions:

1) The coal to be protected against air disintegration and self-ignition. The breakdown is produced by the absorption of atmospheric oxygen by hydrocarbons contained in the coal.

2) Problems related to reduce quality coal storage mention the following: the main factors contributing to the degradation and self-ignition in the coal storage technique are: the excessive height of the stack and placing the non-compacted coal in the stack; homogenization process lignite extracted from the mining basin Oltenia, it is very difficult to achieve due to: Changes in quality of coal strata in operation; operating conditions; Technical characteristics of the machines.

3) Homogenization tape is made by superimposing layers derived from coal with calorific different, or portions of these layers that mix tape collectors in the discharge points from their driving stations. The process is applicable for the existent careers: Jilt South Jilt North Rosia Pinoasa, Lupoaia tomatoes.

4) If the Rosia de Jiu career, the weighted average production quality is scheduled for 2103 kcal/kg at year 2011.

The necessity of applying a technique of mixing the conveyor belt by adjusting the output level to ensure a quality career average in the range 1800-2000 kcal/kg, lies in the fact that if a single extraction layers V and IX, storage should make separate stacks and by default would lead to refusal beneficiaries to purchase coal with a high ash content.

5) Coal deposits of coal homogenization is settling destination stacks, namely: stacks that will preserve for a period of time, usually forms during warm and dry weather only when you cannot deliver coal to power plants, due to objective reasons; stacks of continuous work, for which the training methodology Chevron.
6) Self-ignition is the result of thermal balance in the amount of heat produced by a coal mass traversed by a current of air is greater than the amount of heat lost through the coal mass exchange with the environment.
7) The piles of coal deposits should be placed lengthwise to the direction of movement of the prevailing winds, oriented so that the north side of the stack to be as less exposed because humidity persists longer in the north and the danger of self-ignition is higher these places. It has been found that the nuclei of fire occurring in about 2/3 of the height of the stacks.
8) Compacting piles of coal by mechanical means (roller, bulldozer blade), coal density increases from 10% to 24% compared to the initial filing. In this way, the air is removed from the stack and there are no air circulation channels. It has been estimated in a number of careers, it was found that the bulk density of compacted coal increases from 0.845 t/ m^3 for coal freshly excavated and deposited in warehouses to 1,025 t/m^3 by mechanical compaction.

5. Requirements regarding the design of a new coal deposit for a career

Considering environmental policy on emissions of pollutants resulting from the process of storage of coal from the Rosia de Jiu career, a decision should be taken for implementing one of the solutions proposed as follows:
- Maintaining coal deposit in the current location;
- Waiver of the landfill and taking career Pinoasa coal deposit, located on Valley Timişeni;
- Waiver of the landfill and a new landfill in the northern coal quarry, east of the embankment triage point loading coal wagons;
- Waiver of the landfill and a new landfill in the northern coal quarry for delivery by rail and taking career Pinoasa coal deposit, located on Valley Timişeni, for delivery to Rovinari thermal power.

Since after arranging the deposit of coal burning in the vicinity of the power plant Rovinari career Pinoasa will make a circuit of transporting coal from this deposit was considered applicable version of the route outside the perimeter Pinoasa that could be jointly carried out by two careers. Thus, the cost of purchasing the land (approx. 6.9 ha) and route planning will be borne 50% by each of the two mining units.

Following the evaluation of the main charges and work necessary for the implementation of each of the alternatives analyzed, and environmental legislation in force for the deposit Rosia quarry, it chose which involves giving up the landfill and a new landfill for coal in the northern area of career east of the railway embankment triage. Loading wagon may be achieved by building a new warehouse but reduced to a capacity of 90,000 t. One advantage is the embankment of the railway has a height of 11 m, located between the future warehouse and city Rovinari, which will reduce the spread of emissions. For this deposit amount of expenditure amounts to approximately 45.1 mil. lei..

6. Case study on developing the simulation model of a coal deposit

6.1. Discrete event dynamic system in constructing models

It's called dynamic system discrete event dynamic system which possesses the following two properties:
• The state space is a discrete set;
• Transition mechanism is driven by states with appearance asynchronous events.

According to this definition, building a model for system discrete event requires the identification of two sets discrete (finite or countable): X - state space, E - the set of events and formulating a mathematical description of the regularities in the occurrence of events in the crowd It determines the transitioning state space X.

The events of the set E can be regarded as making a frame clock asynchronous (non-scheduled) that pilots conducting transitions in clock asynchronous X. This structure should be understood as a regular clock that pilots equivalent discrete-time dynamic systems (such descriptions entry - status - exit or entry - exit). However, as problematic behavior, are fundamental differences as asynchronous clock eliminates periodicity provided just needed time to study the dynamics of discrete systems.

6.2. The mechanism for updating state model for discrete event system

In the list of events, the events are arranged in ascending order of time points when they occur. Any event has the effect of status update. Updating the list of events is the introduction of the new events, the occurrence of which is possible or not, depending on system status. We draw attention to the fact that the events should not be understood only as external to the system, which is why updating the list depends on the current status. Thus the time evolution of a model for discrete event system can be studied following procedure steps:

Step 1. The first element of the list is removed (e_1, t_1).

Step 2. Updating the time he t_1 value.
Step 3. Updating the system state due to transition triggered by the event e_1.
Step 4. Updating the list of events.
Step 1 resumes.

6.3. Concepts used to describe a Petri net

Petri network consists of a directed graph and an initial state called the initial marking. Petri net graph is directed, weighted and bipartite, consisting of two types of nodes, called positions or locations (like) respectively representing states and atomic transitions; arcs go from one position to be a transition from either a transition to a place (Jucan T., Tiplea F. L., 1999).

As a graphic symbolization positions (locations) are represented by circles, and transitions by bars or rectangles. Also, all pre-conditions (inputs) a transition are related locations through targeted direct arcs, and a transition is in turn connected by arches targeted all its post-conditions (outputs).

Generally, the network Petri is just dynamic structure of the system. To check but fairness representation introduced the concept of network Petri marked: a location/state atomic and associates the truth of its operation, the value represented by the presence (meaning "condition satisfied" or truth value "1" state) or the absence of a black spot (mark or token) in the circle representing the location.

In modeling problems using the concepts of conditions and events, conditions and positions represent transitions represent events. A transition (event) has a number of input and output positions, which represent pre-conditions and post-conditions for that event. The presence of a token in a position to be understood as a logical "true" for the condition associated with the position (Valk R., 1998).

Petri is attached to a network, generally a matrix of inputs I and outputs a matrix A the following rule:

$I_{ik} = w(p_i, t_k)$ if the location p_i is set input pi (preconditions) transition ${}^{\bullet}t_k$, and 0 otherwise;

$O_{jk} = w(t_k, p_j)$ if the location p_j belongs to the outputs (post-conditions) of the transition $t_k^{\bullet}$, and 0 otherwise,where w is the evaluation function.

Petri locations in a network representing a production system can mean storage areas (buffers) or have the significance of state variables of the process. The chips flowing through the network can represent quantities of production in a production system.

Petri graph associated network system is constructed by introducing all known transitions and locations of pre-conditions and post-conditions their joined by arches.

6.4. Using Petri networks in modeling problem producer - consumer

This problem involves a common object that we have access, and this object is specified to be a buffer.

The process manufacturer (technological lines for coal mining) creates coal in tones which is available in the buffer, the consumer (customer supply) wait until the charcoal production is put in buffer, take her there and eat - supplied the beneficiary.

An alternative to this problem is the problem of multiple producers / consumers multiples, several production lines extracted and stored quantities of coal are placed in a buffer common to many consumers. In Petri network solutions to this problem we start with system chips s original location process and t chip manufacturer in the original location of the dispatch process to the consumer.

Alternatively problem producer/consumer for a finite buffer. In this version of the problem producer/consumer, it is known that buffer between producer and consumer is finite, that has only n locations for storing coal. Therefore the manufacturer cannot always produce as fast as he wishes, but must wait if the consumer is slow and full buffer. Figure 1 is a solution to this problem. Final buffer is represented by two sites: B is the amount of coal that has been extracted but not yet consumed and C is the number of free locations in the buffer, the original C is *n* chips and B none.

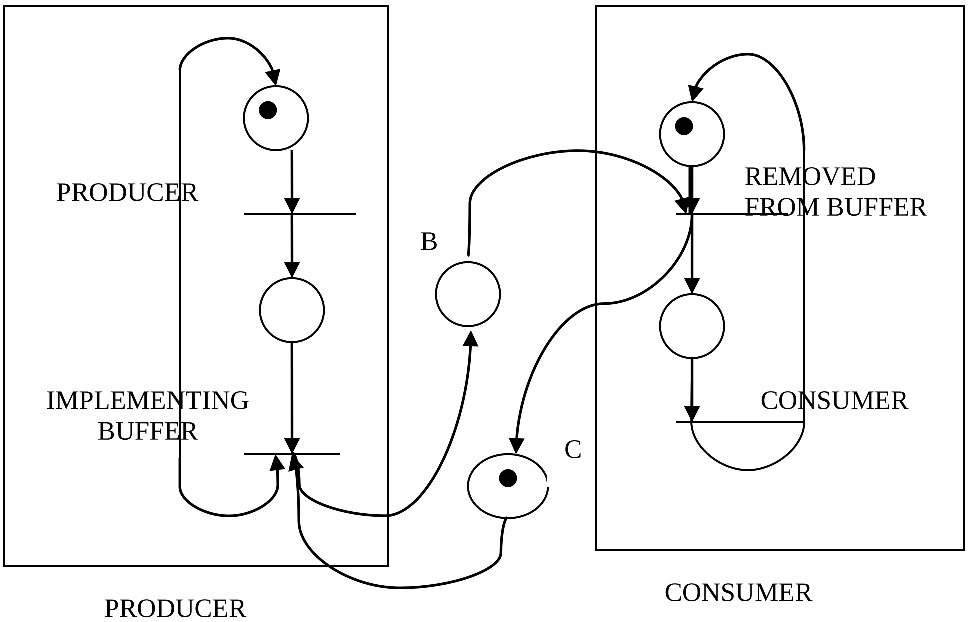

Fig. 1. The problem of multiple producers / consumers multiples with finite buffer

If the buffer is full, then C will have no tokens and B will *n* chips. At this point, if the manufacturer is trying to store the extracted output buffer will be stopped because there is no chip in C to validate this transition.

6.5. Simulation model describing the operation of a coal deposit

Walk correct modeling and simulation analyze locations and network transitions Petri correspondent meanings.

The construction model home starts by identifying the status and its principal activities, followed by a description of the pre-conditions explicit conduct each event and the consequences resulting (Boldea C. R., 2006).

Figure 3 shows the operation of one producer/consumer in terms of stock coal deposit.

The set of nodes in the network is used locations: $L=\{L1, L2, L3, L4, L5, L6\}$, where: *L1*: GProd – control coal production ("production ready"); *L2*: GD - storage of coal extracted command ("ready" for storage); *L3*: Stock - amount of coal in stock; *L4*: Stock'- available storage capacity meter of extracted coal; *L5*: GC - "ready" for shipping coal to the consumer; *L6*: GPrel - coal shipping demand ("ready for production").

The set of nodes used in network transitions is $T = \{T1, T2, T3, T4\}$, where: *T1*: Prod - coal production; *T2*: Dep - extracted coal storage in stock; *T3*: Prel - takeover by the consumer of coal; *T4*: Consumption - "consuming" the amount of coal shipped.

It further inputs I write matrix A and matrix outputs, which are presented in Tables 1 and 2, these tables represent the inputs and outputs of transitions to locations and vice versa. The tables are built on Figure 2.

To mark the start we have: $M_0 = (1, 0, 0, 3, 0, 1)$.

Network above us analyzed the viability, safety, repetitiveness and narrow-mindedness (behavioral and structural).

Behavioral properties network topology Petri dictated so and the initial mark of the network, and are defined as those that characterize the properties of a network model behavior over time, following a succession of transitions.

The structural properties of the non-timed Petri net are those properties which depend on the network topology and does not depend on the initial mark in one of the following meanings: whether the property is kept regardless of the original mark; whether the property is the fact that there are markings that provide some initial execution sequence of transitions.

Computer simulation and analysis in the Petri Net Toolbox allow the assessment indices (criteria) performance that characterizes the operation of coal storage process modeled by timed Petri net, expressing both customer service efficiency and use of resources (Păstrăvanu O., Matcovschi M.H., Mahulea C., 2002).

The conditions under which the experiment was conducted simulation include simulation time setting and selection of the final moment of the experiment by achieving a certain number of events, the execution of a specific transitions or chips reached a certain position. Following the simulation model with the input data set showed that storage capacity is designed at a proper technological process of lignite quarries of Rosia de Jiu.

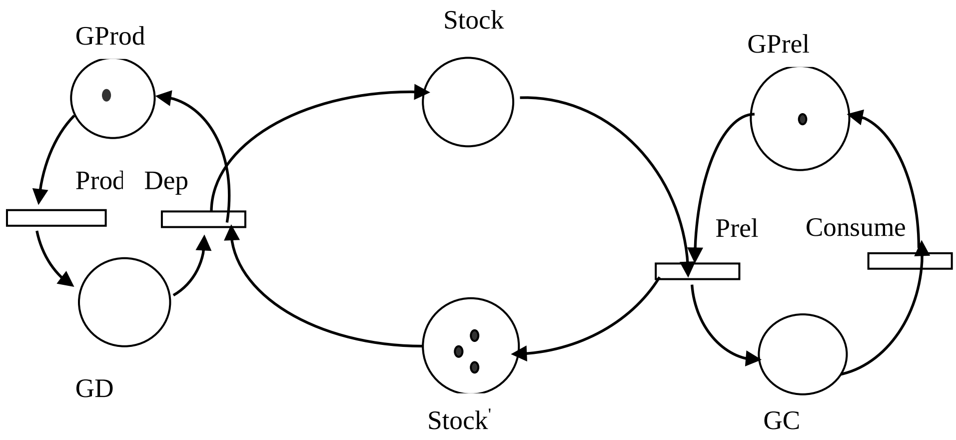

Fig. 2. The producer / consumer system with a deposit of coal stock

Table 1. Inputs Matrix I^T

INPUTS	T_1	T_2	T_3	T_4
L_1	1	0	0	0
L_2	0	1	0	0
L_3	0	0	1	0
L_4	0	1	0	0
L_5	0	0	0	1
L_6	0	0	1	0

Table 2. Outputs Matrix O^T

OUPUTS	T_1	T_2	T_3	T_4
L_1	0	1	0	0
L_2	1	0	0	0
L_3	0	1	0	0
L_4	0	0	1	0
L_5	0	0	1	0
L_6	0	0	0	1

7. Conclusions

In the activity at stores stock a great movement of coal or coal loading wagons previously filed and delivered deposition forming cavities are filled with fresh coal extracted from the quarry. The storage capacity of coal in storage, production capacity depend on quarry. Modeling and simulation can contribute to understanding and improving a real system. Although the system can be very complex, it is good to try to build a model as simple as possible. This is achieved both by defining the system boundaries analyzed so as to be considered only essential characteristics in terms of objective analysis and the definition of simplifying assumptions. By modeling and simulation system of extraction, storage and delivery of lignite coal in carriers wanted was to outline the modeling power of Petri networks. This is the concrete way in which real systems can be studied as complex structure and increasing managerial performance in production processes lignite quarries.

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Romanian mining industry, assumptions of last decade and future insights

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Abstract

Romanian economic strategy after '89 Revolution brings some changes including mining industry. These changes proved to be baneful for romanian society mostly in last decade. These assumptions and facts, motivates deepening some statistical data and studies. Based on these observations corroborated with geological data can be outlined future insight about romanian mining industry.

Keywords: mining industry, last decade, Romania, global production, assumptions, insights;

1. Introduction

As a consequence of an complex geological structure, Romanian basement contain rich and diverse deposits (ores) of useful minerals, like: mineral fuels, precious metals, ferrous metals (Iron and ferro alloys), non-ferrous metals, rare and disperse metals (rare earths), non metallic ores etc. Solid ore deposits of Romanian useful minerals are small or have medium size at most. Large or very large ore deposits can be considered only some salt deposits.

Thereby, Romania has exploitable geological reserves totalling: 3 billion tons of lignite and brown coal (coking coal); 1 billion tons of hard coal (steam coal); 40 million tons of precious metals (gold and silver ores); 90 million tons of poly-metalliferous ores; 900 million tons of copper ores; 4 billion tons of salt (Fodor and Baican, 2001).

Also, in the country basement are sufficient and rich deposits of radioactive metals, bauxite and inexhaustible amounts of useful and ornamental rocks (construction minerals).

2. The decline of Romanian mining industry – Assumptions

Since 1990, the national mining production dropped sharply for most minerals. From an average producer (or even larger for some minerals), Romania abandoned extraction for almost all metals that were exploited in the recent past and past.

The consequences were felt most intensely in mono-occupational areas, where mining industry was the main or single employer. Some reports show that in the entire mining sector worked before the '90s, overall one million people or more. Of those, 350,000 were hired directly in mining sector and other 700,000 indirectly worked in related activities.

The energetic industry has provided employment for 65,000 persons only, while the others worked in non-energetic mining. Of those employed directly, 175,000 were miners and the difference being involved directly in other related activities: administration, engineering, designing, transportation, chemistry etc.

There were 114 mining regions in Romania, spread in 16 counties. At the ceasing of mining activities, a total of 155 localities depended with 50% or more of their earnings by the mining activities carried on their geographical area (RMGC, 2013).

From one different perspective, the same situation is illustrated by the raw material dynamics. For a better comprehension of the national and global trends in mining industry it is necessary to compare those two databases.

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Thereby, based on "World Mining Data", they were selected the last ten years values (since 2004 to 2014) related to all the romanian mining products and compared with global data (Table 1).

According to "World Mining Data", the mineral raw materials included in the following database are arranged in five groups: Iron and Ferro-Alloy Metals, Non-Ferrous Metals, Precious Metals, Industrial Minerals, Mineral Fuels (without construction minerals).

Detailed knowledge of mineral production, market concentrations and the resulting trends are important for political decision-making in this field (Weber and Zsak, 2006; Reichl et al., 2016).

Table 1. Production of raw materials exploited in last decade in Romania, compared with their global dynamics. World Mining Data 2004 – 2014, (Weber and Zsak, 2006; Reichl et al., 2016)

Elements	**Romania**				**Global production**			
	2004		**2014**		**2004**		**2014**	
	Rank	**Production**	**Rank**	**Production**	**Producers**	**Production**	**Producers**	**Production**
Iron (Fe-Content) [t] **(Iron and Ferro-Alloy Metals)**	36/0.01%	99776	0	0	50	717211921	50	1554479681
Manganese [t]	15/0.12%	16617	26/0.03%	4880	22	14091120	29	19323994
Bauxite (crude ore) [t]	20/0.11%	150000	0	0	25	140324909	32	261896886
Aluminium [t]	22/0.80%	222300	25/0.49%	263098	39	27615063	43	53478696
Copper [t]	31/0.11%	15639	47/0.04%	7680	49	14728192	56	18435342
Lead [t]	22/0.37%	11863	43/0.01%	570	39	3201721	46	5431962
Zinc [t]	31/0.17%	16318	48/0.02%	3120	42	9716834	51	13763854
Gold [kg]	44/0.14%	1430	*80/0.02%*	*500*	86	2408260	93	3008396
Silver [kg]	*33/0.10%*	*19000*	*37/0.07%*	*18000*	58	19295026	64	27017590
Baryte [t]	42/0.00%	73	0	0	45	7564506	30	9491655
Bentonite [t]	25/0.17%	18161	33/0.10%	18583	45	10690398	50	17783816
Diatomite [t]	10/1.04	14192	0	0	26	1360145	22	2232722
Feldspar [t]	23/0.48%	60636	44/0.03%	7570	48	12596536	48	29111676
Graphite [t]	16/0.07%	395	0	0	19	568545	15	1095244
Gypsum (and Anhydrite) [t]	0	0	25/0.50%	815586	80	97791073	77	162589212
Kaolin [t]	35/0.08%	22337	40/0.09%	30638	57	26586656	56	35945406
Salt [t]	17/1.09%	2398607	23/0.71%	2058292	103	220754797	97	288041472
Sulfur [t]	40/0.04%	17836	0	0	51	42275267	50	70773036
Talc [t]	23/0.13%	9725	0	0	43	7767283	34	8247181
Steam Coal* [t]	-	3016335	-	1158448	-	-	-	-
Steam Coal** [t]	-	-	-	459860	-	-	-	-
Total Steam Coal*** [t]	-	3016335	-	1618308	-	-	-	-
Steam Coal (WMD) [t]	*27/0.06%*	*2675737*	*51*	*47000*	61	4148803648	54	5996545849
Lignite [t]	12/3.32%	30410351	12/2.87%	23556300	34	915789235	31	821130199
Natural Gas [Mio. m^3]	31/0.50%	13000	42/0.30%	10730	86	2599888	86	3570104
Petroleum [t]	440.15%	5500000	49/0.09%	3903000	92	3744144107	100	4156948624
Uranium (U_3O_8) [t]	15/0.23%	100	16/0.13%	91	21	44193	19	67944

* Productions reported by the Energy Complex Hunedoara (ECH); ** Productions reported by the National Society of Mining Decomissioning Jiu Valley (NSMDJV); *** Total productions reported by the ECH &NSMDJV; - no data; 500 estimated value by the WMD.

In fact, this image can be completed by the percentage report, for romanian mining industry being as follows (2004/2014): Iron and Ferro-Alloy Metals (full stop production from 99776 t in 2004 to 0 in 2014), Manganese (-70.6%), Bauxite (full stop production from 150000 t in 2004 to 0 in 2014), Copper (-50.9%), Lead (-95.2%), Zinc (-80.9%), Gold (-65.0%), Silver (-5.3%), Baryte (full stop production from 73 t in 2004 to 0 in 2014), Diatomite (full stop production from 14192 t in 2004 to 0 in 2014), Feldspar (-87.5%), Graphite (full stop production from 395 t in 2004 to 0 in 2014), Salt (-14.2%), Sulfur (full stop production from 17836 t in 2004 to 0 in 2014), Talc (full stop production from 9725 t in 2004 to 0 in 2014), Steam Coal (-46.3%), Lignite (-22.5%), Natural Gas (-17.5%), Petroleum (-29.0%) and Uranium (U_3O_8) (-9.0%). But the real image is completed by some exceptions for which the report 2004/2014 it is positive: Aluminium (+18.4%), Bentonite (+2.3%), and Kaolin (37.2%). A particular case is represented by gypsum, which start the production in 2009 and reach from 720713 t to 815586 t in 2014).

Previewing this dataset, the general impression for mostly of parameters is the continuous decreasing for national production and continuous increasing for the global ones. For these, the statistics have marked slight increases. Not the same thing can be said about the global production which continuously increases for each parameter according WMD (Figure 1, Figure 2). In fact, this increasing of world mining production is the general feature of the last century not only of the last decade, for all ore deposits, including construction minerals, even if these are not included in presented statistics.

Also, for some values, reported by the World Mining Data, relative to the national situation, there are some uncertainties. In this situation there are productions of gold and silver and also the productions of steam coal. For steam coal it was been possible comparison with real values provided by the producer itself. It is well known that steam coal (hard coal) are exploited lately only in Jiu Valley basin. Maybe, the repeated reorganization of the companies who exploited the romanian steam coal, have caused some malfunctions in international data reporting. Currently, the mining activities in the Jiu Valley are carried out under the coordination of “Societatea Naţională de Închideri Mine Valea Jiului” (the National Society of Mining Decomissioning Jiu Valley), within the perimeters of the mining sectors

Petrila, Paroşeni and Uricani and also under the coordination of the entity known as “Complexul Energetic Hunedoara S.A” (Energy Complex Hunedoara). “Complexul Energetic Hunedoara S.A” was created by the unification of several commercial entities, namely “Electrocentrala Deva S.A.”, “Electrocentrala Paroşeni S.A.” and “Societatea Naţională a Huilei S.A.”; its main role consists of electricity generation using hard coal sourced from the mining perimeters Lonea, Livezeni, Vulcan and Lupeni (CEH Portal, 2014).

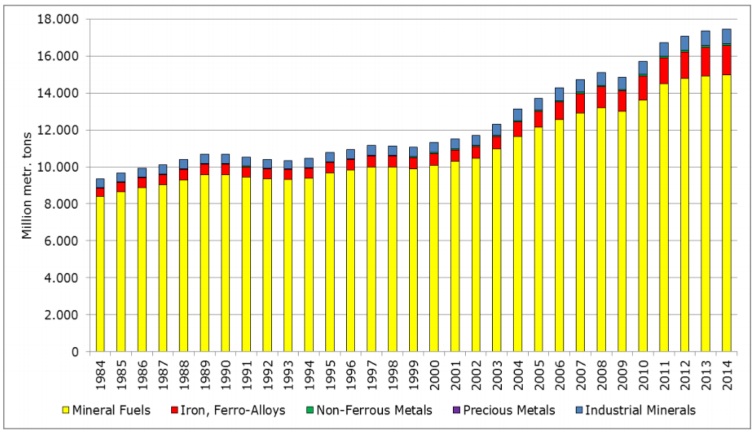

Fig. 1. World mining production 1984-2014 by groups of minerals (without construction minerals, in Million metr. t)

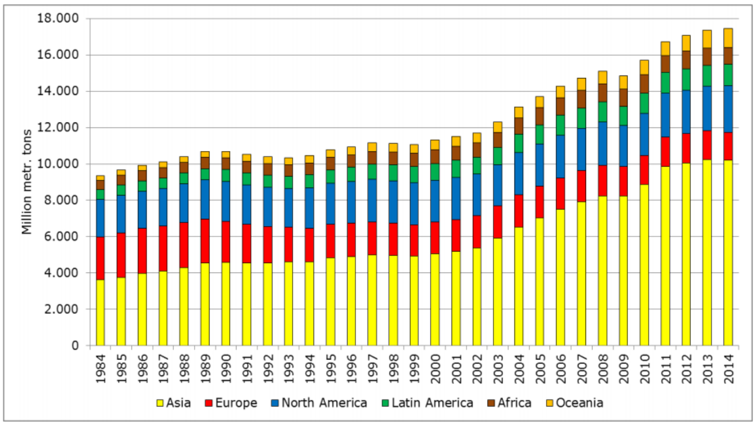

Fig. 2. World mining production 1984-2014 by continents (without construction minerals, in Million metr. t)

3. Future insights

For our country, regarding metalliferous raw minerals and ore deposits (including iron and ferro-alloy metals, non-ferrous metals and precious metals), we consider primarily interest of foreign investors, representatives of traditional nations in exploitation, concerning especially: precious metals like gold and silver ore deposits from South Apuseni Mountains; copper ore deposits from Moldova Noua, Rosia Poieni and The Crystalline-mesozoic Zone of Oriental Carpathians; rare earths, especially the tellurium associated to gold-silver ore deposits from Săcărâmb (Buia and Lorinţ, 2011a; Buia and Lorinţ, 2011b; Buia et al. 2011; Popescu et al, 2013a, Popescu et al, 2013b); manganese ore deposits from Bistrița Mountains (The Crystalline-Mesozoic Zone), whose production wasn't complete abandoned, although decreased by 70%.

Regarding industrial minerals (non metallic ores) demand proves to be increasing for bentonite, gypsum and kaolin. For these, also there are many areas which can satisfy this perspective. In the European context, the continuous development of transport infrastructure requires the increasing of production for gravel products and aggregates. About mineral fuels, in the context of energetic autonomy, one equable balance require maintaining the coal participation to present level at least (Buia and Lorinţ, 2010; Buia et al, 2014). Even if the past and actual government policy led to decommissioning of the uraniferous mining, in the context of spending cuts of radioactive fuels, would entail reopening of production capacities from Orientali Carpathians. Also, one of G20/2016 statements about resources, encouraged the production of mineral resources (raw materials) depending to each country possibilities, just for counteract the monopole developed by the China and huge companies.

4. Conclusions

Of late years, Romanian mining industry decline continues. All parts of the mining sector have been affected, but the worst situation was registered in metal mining, where the number of employed decreased dramatically. Romania has closed hundreds of mines, most still having exploitable potential.

The reopening of mines can mean tens of thousands of direct jobs and hundreds of thousands of jobs in related industries. Currently in exploitation are only rocks and building materials, ornamental rocks, salt, bentonite, feldspar, gypsum, lignites, steam coal (hard coal) and uranium ore deposits. From metalliferous minerals ore deposits under exploitation are only the copper one from Rosia Poieni and one for precious metals (Au, Ag) from Rovina-Bucureşci (Certej) in South Apuseni Mountains.

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The assimilation of a new metal building support for the execution of underground excavations

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Abstract

The concerns for a more efficient underground coal mining activity in the Jiu Valley continued on previous research results in domain of supporting for underground excavations and also in ensure stability for horizontal mine workings. Researches have been made for the introduction and assimilation of the competitive laminated profiles, for implementation of supporting and most appropriate models clamps for fastening elements. In this context, taking into account the situation encountered present in Romania with regard to the plight recorded in providing the necessary laminated profiles and clamps for implementation of metallic support for underground excavations, it is proposed and presented further in order to assimilation, a new metal building support, based on external acquisition and use of laminated profiles. similar in terms of static characteristics and resistance with the most common types designed and purchased from domestic. Besides, was studied the use of the right type of clamp for joining and tightening elements, having the shape and constructive characteristics closely related to obtaining a secure and permanent contact at the joint.

Keywords: underground excavation, the metal support, laminated profiles, clamps to joint, sliding elements, carrying capacity;

1. Introduction

The sliding metal support, applied to achieve underground excavations for opening and preparation of deposits of useful minerals, involves in conventional design, combining elements (beam and two columns) with openings between the shoulders of the laminated profiles. This connection, during loading leads to damaging the of construction by compressing the upper element (beam) and split the lower element (pillar), with all the inconveniences arising from seizure (block) at the level of engagement with the clamps for elements sliding and hardening of support.

The new structure of support proposed for assimilation entails modifying of constructive form of the classic laminate, so be assured pressing and constant contact between elements, through hollows at the base of the collar practiced profiles.

Corresponding of the new way to combine the laminated profiles, the new support structure provides the use of appropriate clamp. The appropriate clamp has collar to level of the inferior clamp to penetrate into crevices practiced at the base of the collar profiles. It provides a controlled and uniform tightening over entire length of of the slide elements.

By replacement of current support with the new proposed structure, it overcomes the constructive drawbacks and, It is expected to increase the competitiveness and ensuring the compatibility of current and future requirements of placing and execution of excavations, due to the increase bearing capacity of metal frames supportive by approx. 30%. Also it is ensure a uniform system of sliding and much more controlled of the elements in the joints and the system will reduce current costs allocated for exploitation and maintenance.

2. Laminated profiles for supporting realization

In terms of ensuring internal necessary current base of profiles, In answer to encounter unfavorable situation, their

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purchasing from external suppliers is done via existing local companies, specialized in procurement and marketing of such product type. Among laminated profiles thus acquired externally include laminate series THN respectively THN 21, manufactured by Bulgarian STOMANA INDUSTRY SA.

That purchased laminated profile is machined under German rule DIN 21544-85, which implies execution steel 31Mn4 brand, whose composition does not provide the use of vanadium as an alloying element, and the carbon content amounts to 0.28%.

In this case the substitution of vanadium in the chemical composition or of other alloying elements for improving the structure of iron-crystalline steel execution is performed by delivering the laminate normalized condition, that is relieved from hot, in order to improve the hardness profile (frangibly), as well as a high carbon content. The letter "N" of symbols confirms the improved condition of the steel profile by applying normalization process (Pleșea et al., 2015; Radu et al., 2016; Vereș et al.,2015)

The firm producing a such laminate profile delivers the product in three size classes, namely THN 16.5, THN 21, THN 29, whose resistance and static characteristics (Table 1) are roughly similar to those of indigenous manufacturing laminates SG (18, 23 and 29) and constructive shape is similar with laminates from the TH class, respectively SG 29 type produced in a prior period in our country (Figure 1).

Tabel 1. Static and resistance characteristics of the new laminated profiles manufactured abroad

Profile type	Weight, kg/m	Section, cm^2	Moments of inertia, cm^4		Resistance modules, cm^3	
			Ix	Iy	Wx	Wy
THN 16,5	16,5	21,02	186	223	40	42
THN 21	20,92	26,65	324	398	61	64
THN 29	29,0	37,0	616	775	94	103

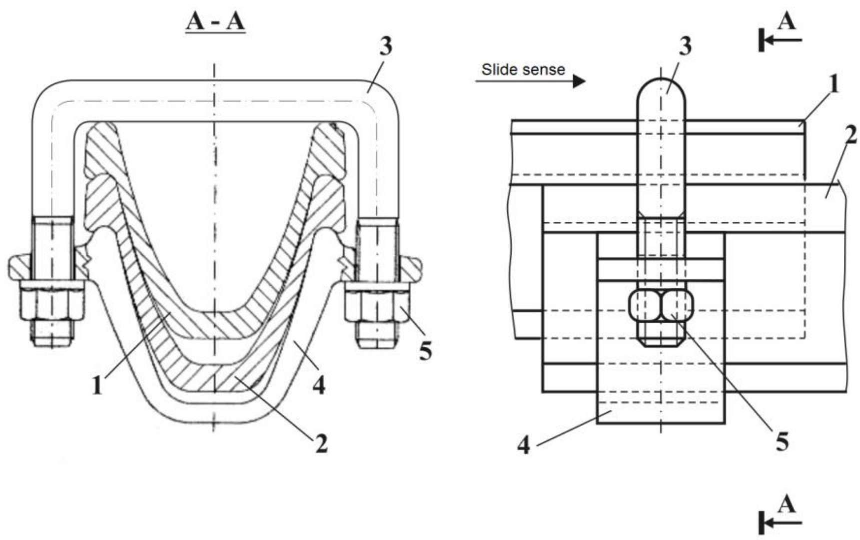

Fig.1 Metal construction supporting the new improved form: 1,2-laminated profiles, superior (beams) and lower (pillar); 3- round necklace of tightening and joining the clamp; 4- lower flat clamp; 5- the nut threaded necklace of clamp

Of the three variants of laminated possible for purchased and applied to conditions in our country, namely in underground mines in the Jiu Valley, the equivalent current domestic laminate SG 23 has proved to be the laminated profile THN 21 in point of view of its static and resistance characteristics. This is in fact the subject of the compatibility analysis performed in an earlier period for this product (Radu et al., 2016; Vereș et al.,2015).

Thus, based on analyzes of equivalence / compatibility performed on the two types of laminates the following assessments have been formulated:

- The shape of laminate profile THN 21 is like a trough, similar to profile SG 23, the difference being the presence of hollows practiced at the base of the laminate shoulders respectively at the collar of laminate. These grooves are designed to achieve contact at the junction profiles (joining beam supporting over the two poles) and remove the damaging of calibration which occurs when the laminate SG 23 interweaved the profiles one in another, because of higher laminate (beams) compression and splitting the lower (pillar). The shape of laminate profile THN 21 with grooves applied at the base of shoulders is similar with laminate profiles used worldwide, included in the TH series, manufactured by German DIN 21544-80 standard requirements;

- The mass of the new laminated profile THN 21 (20,92 kg/m) is reduced by about 10% compared to the mass of the laminate SG23 (23.25 kg /m) resulting in an equivalent reduction of the cross section, which is in this case 26 , 65 cm^2, compared to 30 cm^2 for the laminate SG 23. Due to the reduction of cross section and, respectively of the metal consumption by approximately 3 kg/m, the laminate THN 21 shall be reduced its size constructive too. This invokes from the beginning the use of the optimal type of clamp for joint;
- Even while reducing its dimensional characteristics, laminate THN 21 possesses strength characteristics similar in size to those of laminate SG 23, in this point of view it fits to delivery terms imposed by German standard DIN 21544-80.

Regarding the equivalence of laminate THN 21 with the other delivery requirements set by standard DIN 21544-80 (bars length, chemical composition, macroscopic state of the laminate, marking mode and baling etc.), those are required to be followed by concrete indications contained in the quality Certificate attendant from the sending of the product.

From studies of equivalence performed on the two types of laminates, the findings highlight the possibility of acquiring and using new kind of laminated profile for implementation of the metal support in underground excavations, by conditioning the ensuring of technical and quality regulations on its machining in accordance with German DIN 21544-80, restrictions which fall under the responsibility of factory.

Besides this rolled from the wide range of laminated profiles used in European countries, laminates "V" series were analyzed to see if them can be purchased and applied to underground conditions in the Jiu Valley. The characteristics of these laminated "V" series are presented in Table 2.

Table 2. Type and characteristics of rolled analyzed and proposed for implementation

No.	***The laminated profile / Country of origin***	***Sectional area, (cm^2)***	***The linear mass, (kg/m)***	***Static resistant characteristics***			
				I_x, (cm^4)	W_x, (cm^3)	I_y, (cm^4)	W_y, (cm^3)
1.	V 21 / Poland	21,0	27,0	341	61,3	398	64
2.	V 28 / Poland	28,0	35,6	626	97	687	95
3.	V 34 / Poland	34	43,3	850	126	870,7	113,8

3. Joining elements of new types of laminates

The support has ties whose lower lugs back has shoulders obtained directly from molding in order to achieve contact with the support. Compared with conventional types of Ties used in the past, the new proposed model provides the same simple construction (Figure 1), differentiation constitutes a flat clamp fitted with shoulders. Therefore, clamping element is consisting of the round collar (3), flat clamp with shoulders (4) and screw nuts (5) (Figure 1). The round necklace has φ 28mm diameter, as in the current classic type and it is provided at the ends with thread M 27 for tightening with screw nuts. The flat clamp with shoulders has the width of 70 mm and 16 mm thick.

As with the current type of support to the overlay 400 mm of the laminated profiles, it is provided the location of two such clamps spaced 200 mm one from another and respectively at distances, of 100 mm each from the ends of the joint (Radu et al., 2016; Vereș et al.,2015).

. The clamp can be executed with proper resources in a stamping process from OL 37 - 2k as in the current classic type and round collar can be the same as that of the composition of the current "SG 23". Assuming that the new simple type of clamp can be purchased from own sources, the it is proposed acquisition from import, with provided laminate.

Also, to reduce the cost price for ties ,it may be purchased only flat bottom clamps from imports and the round collars may be provided from own facilities existing with specific constructive adaptations.

4. Domain of use and impacts expected

New support assembly can be applied to the execution of underground excavations having in a first phase a provisionally role, like mine galleries of various sizes located in various reservoir conditions.

In terms of execution and suitable operation, the new support structure can contribute to the following advantages (Radu et al., 2016; Vereș et al.,2015; Vereș et al.,2014):

- providing an elastic sliding operating mode for similar loads, but smaller in size of capacity of the support;
- increasing stability and safety in underground exploitation excavations;
- considerable reduction of consumptions of work and of additional expenses for carrying out excavations maintenance (reprofiling, hearths smoothing);
- reducing the time for panels exploitation by reducing the time allocated for maintenance, which has the consequence ensuring production rhythmicity for the main beneficiaries
- rhythmicity ensuring in implementation / purchase of rolled and clamps and continuity in exploiting of various useful minerals underground

In addition to these advantages, this type of support ensures optimal exploitation of underground excavations on much longer periods of time in terms of recovery and reuse of the supporting components, approximately in their entirety, without further intervention for any subsequent reconditioning.

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Mining design based on a digital terrain and deposit body model at Tismana Open Pit

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Abstract

This paper presents the advantages of mining planning and design based on digital model open pit (land and deposit body) using software. Generally, this specialized software for mining are intended for use by specialized technical staff (mining staff, land surveyors and geological staff), each has a dedicated module of the software. Through the land surveyor module the digital terrain model will be created, through the use of the module dedicated to geology will get the body deposit and not last, is presented the mining module through which the planning and pit design can be done. The paper concludes with an example of mine planning design in Tismana open pit.

Keywords: body deposit,open pit, mining, digital terrain model;

1. Introduction

Mining for mineral resources was done since ancient times in open pit mines and underground mining. In the last hundred years, because of the advancement in technological development and advancement of operation methods, open pit mining has gained a high efficiency and productivity. Surface mines are more advantageous than those underground, economical resources requiring is smaller and the production capacities is comparable, producing over 75% of world production of useful minerals.

With the advancement of computer technology and emergence of the electronic computer, it started the development of applications (software programs for mining domain either surface or underground). Next, we talk about the development of application software for surface mining.

These specialized software should is addressed to a specialized staff composed of a mining engineer, surveyor and geologist. Each of them have a separate module dedicated. The surveyor was able to create digital terrain model, geologist create digital model of the deposit and mining engineer is able to use both in such a way as to be able to schedule and estimate production of useful minerals, and not least to be able to see the evolution over time of the mine surface. Next will be presented on short the way of working by using the Surpac.

Surpac is one of the most common programming software for geology and mining works in open pits, this application provides effective use three-dimensional graphics and workflow automation for data processing. Surpac addresses all the requirements of geologists, engineers, surveyors and mining engineers in the field and is flexible enough for different methods of operation and types of deposit. Surpac contains tools that can make data management of drilling, geological modeling of the deposit modeling for earth blocks, geostatistics, mining planning, resource estimation, etc. Surpac is a modular application easily adapted to our needs. Surpac reduces the likelihood of data duplication and can export files while specific areas of GIS and CAD.

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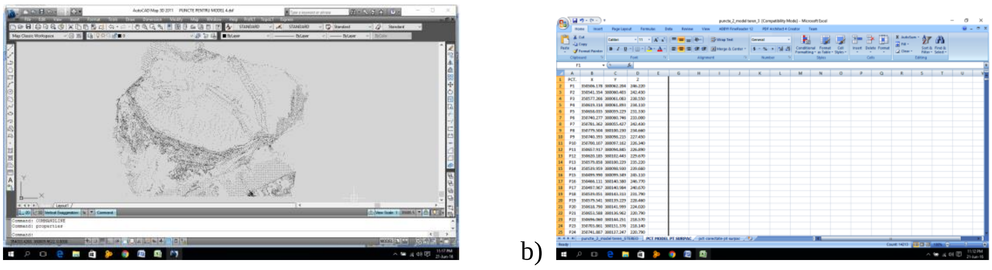
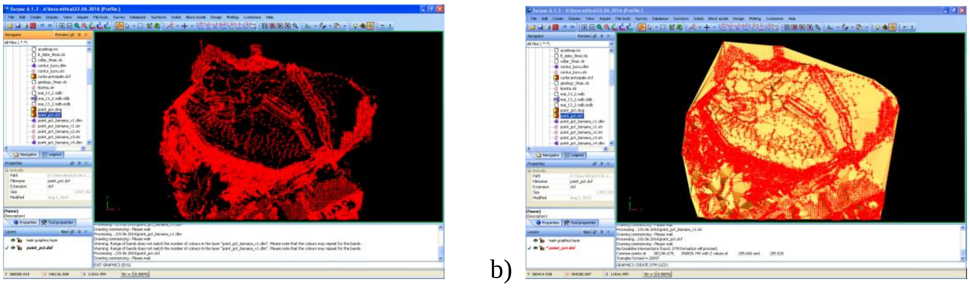
2. Creation of a digital terrain model

Before we start to create the digital terrain model we must collect data (perform surveying, photogrammetric measurements, collecting data stored in analog format, etc.) with which we can extrapolate a model exactly as the land area of interest is presented. Creating digital terrain model in general is the task of the professionals in topography; they are the ones who will update the database in time, with the advance of slopes in surface mining. Surveying software module for specialized staff can upload information from several types of digital files. An example would be taking files from CAD (Computer Aided Design) (fig. 1 a) and another example would be the file type Microsoft Office Excel where they are stored in a table format in which each point has an identifier and spatial coordinates (X, Y, Z) and as the case may be, a description (fig. 1b).



a) b)

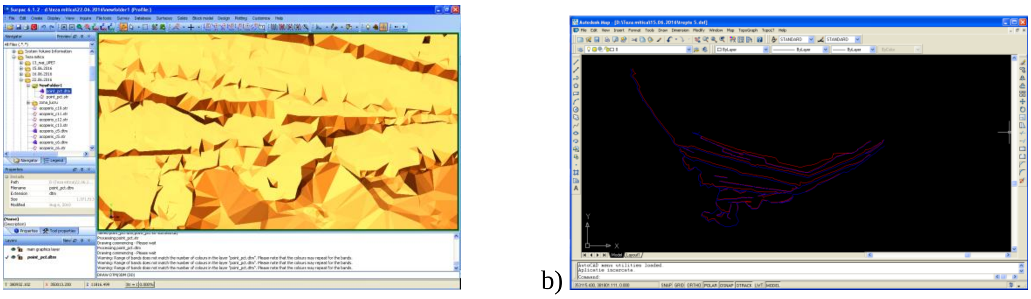
Fig. 1. (a) Example of converted data in tabular form in the CAD drawing;(b) Example of table with coordinates converted to digital format MS Excel



a) b)

Fig. 2. (a) DXF file import in Surpac application.; (b) Digital Terrain Model

To create a digital terrain model a DXF file is imported into Surpac describing the points of interest (can be seen in Figure 2 a) and the digital terrain model (as seen in Figure 2 b) can be generated. However, as can be seen the generated model doesn’t represent the reality on the ground in some areas and to correct this situation it is necessary to introduce break lines.



a) b)

Fig. 3. (a) Detail Area of the digital model; (b) Viewing forced slope change lines in CAD applications

After entering in the computer program of new constraints, we could generate a digital terrain model representing more accurately the reality on the ground (according to the data collected in advance).

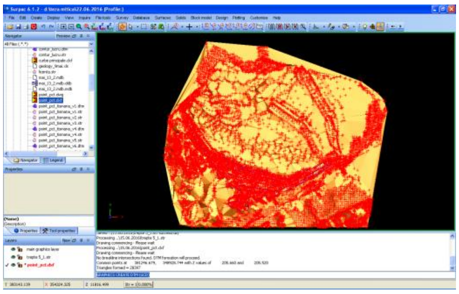
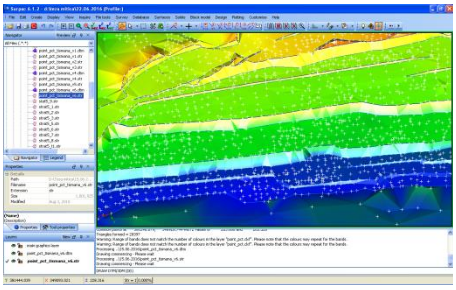
a)  b) 

Fig. 4. (a) Digital terrain model with break lines; (b) Digital terrain model with break lines (viewing excavation steps)

In Figure 4 a) and b) can be seen a digital terrain model that accurately represents the excavation area. We will also save the resulting data in a file type and in the same time .dtm will be created and file of the same name .str containing textual data with which we can recreate digital model ever.

3. Creating digital model of the deposit

To create the digital model of the deposit (the ore body deposit) is necessary to collect geological data in the field. Geologist or any legal source for such technical operations does up to date geological data collection. It takes data from direct mapping of slopes already open in open pit mines, and if there are no open pit mines in the area of interest, the date necessary is collected by performing exploration drilling (Fig. 5a and 5b), with which the stratigraphic column describe the ore body in our area of interest.

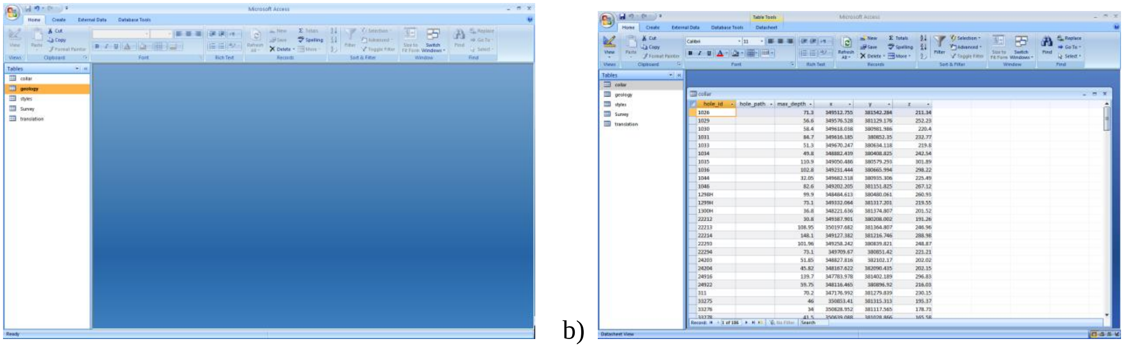
a)  b) 

Fig. 5. (a) Drilling plant; (b) Stratigraphic column - obtained from core drilling

Geologist will do the description of these lithological and stratigraphical samples (cores) that were recovered from the drilling. The description of drill holes will be stored can be tabular or graphic (drawn pad) be it analogical or digital describing the structure and composition of the subsoil respectively. The number of geological drilling holes required to describe in detail and accurately the structure and composition of the subsoil in area of interest is determined depending on the arising situations in which there are differences compared to existing data.

Before converting analogue geological data in digital format, we must choose the form and structure under which we will convert this data. For this, we must choose specialized software for our industry because each application has accepted the form and structure of data that can be processed. This application can retrieve information from various databases, for this project we will use the Microsoft Access database type.

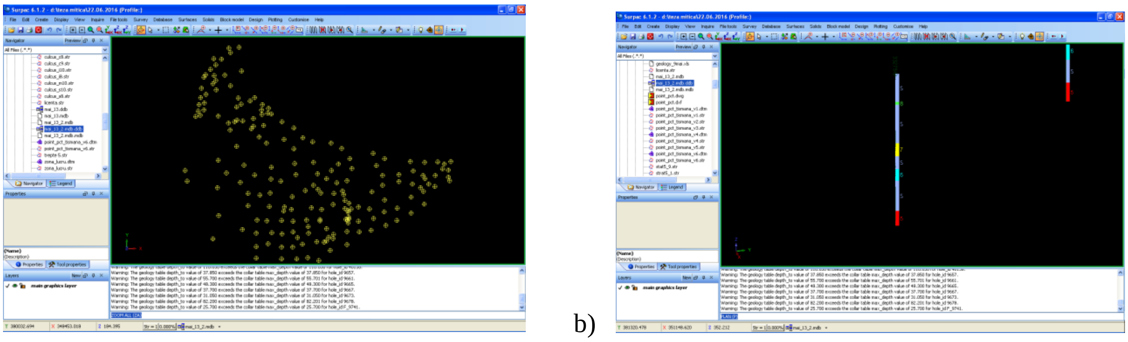
Geological structure databases (MS Access) for application Surpac contains several tables (Fig. 6) including the following: collar, geology, survey, etc. These tables refer to information obtained from drillings in our area of interest (in Figure 6b can see an example of information contained in the table collar).



a) b)

Fig. 6. (a) Geological database that contains tables collar, geology, styles, survey, translation; (b) Example with information in the table Collar geological database

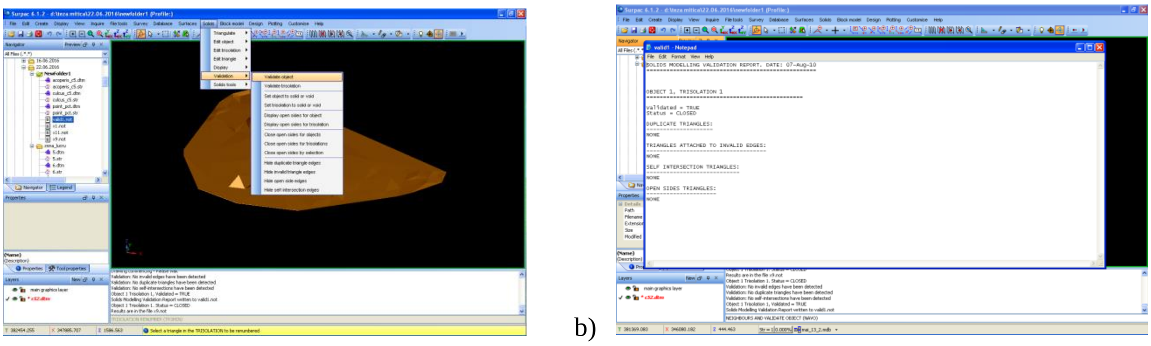
To create the digital model of the ore body deposit is required to access the geological database with Surpac, after which we can display and extract different information (Figure 7 a and b) with which we can create digital model of the ore body deposit (if we talk about our deposit is lignite coal). In general, coal deposits are in the form of layers of various sizes (thickness).



a) b)

Fig. 7. (a) Drilling holes from the database; (b) Lithological column and labels represented according to data set in the database

To create the digital model of the deposit (in our case we speak of multilayered coal deposit) we need to extract from the database top (upper part of the deposit) and bottom (lower part deposit) for each coal seam of the deposit that lies in our area of interest. Based on this data representing the top or the bottom of coal seams we can create a surface that will represent the top and another to represent the bottom, through the union of the two surfaces will result in a solid object that defines each coal seam. We will validate in Surpac these solid objects and will result the volume of our coal deposit in our area of interest.



a) b)

Fig. 8. (a) The solid object representing the coal seam of our ore deposit; (b) Object validation and obtaining the volume of the coal seam from our deposit

The process it will be applied for all seams in the area of interest, ultimately resulting the digital model of the coal deposit.

4. Planning and design for bucket wheel excavator e1400-07 in tismana quarry

For this goal, we chose an area in which it will be illustrate the working procedure in which we plan and design the area to be excavated.

The bucket wheel excavator E1400-07 (Figure 9 a and b) working in the area of elevation 180-150 (high bench) and 150-140 (under the bench, below the transport conveyor belt) (Figure 9 c).

Fig. 9. (a) and (b) E1400-07 bucket wheel excavator; (c) below the transport conveyor elevation 150-140

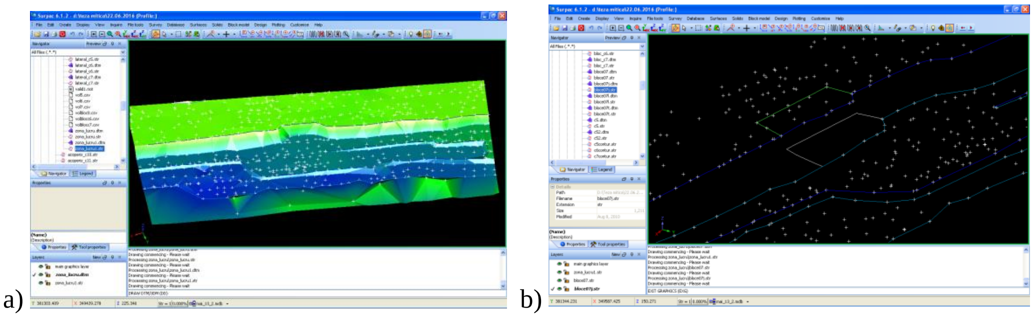


Fig. 10. (a) Work area cut from the digital terrain model; (b) Draw the top and bottom of the block excavation

To facilitate processing of the data will crop an area of digital terrain model as you can see in Figure 10 a); using our digital terrain model will draw the top and bottom of the solid object (Figure 10 b) that will represent the volume of the rock mass that can be excavated in a certain time. In Figure 11 a and b can be seen the block excavation and volume reported for it.

Following the report result we see that the block volume is 104 338 cubic meters, we know that the excavator E1400-07 has a capacity of 1100 cubic meters per hour and works 16 hours a day, so this block can be excavated in about 6 days.

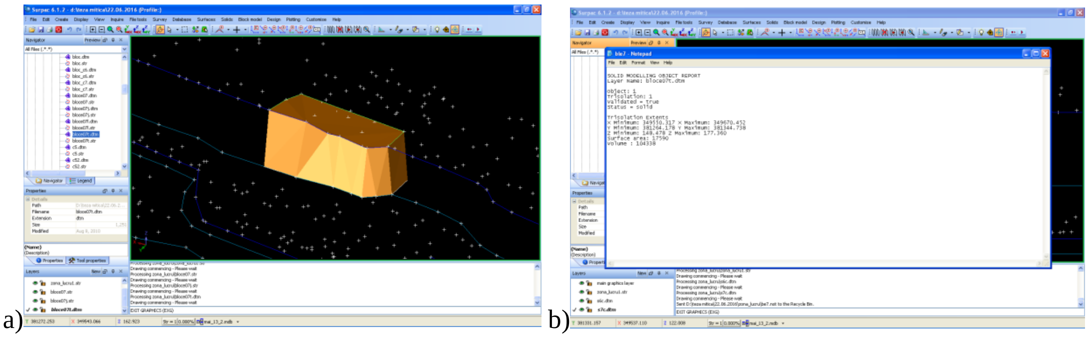


Fig. 11. (a) Block excavation object; (b) Report with the volume calculated for the block excavation

To find the volume of useful minerals that can be extracted from the block excavation, we will intersect the block with digital model of the ore body deposit. Following this procedure will notice that block is intersecting two coal layers (layer 6 and layer 7 of the coal deposit) as can be seen in Figure 12 a).

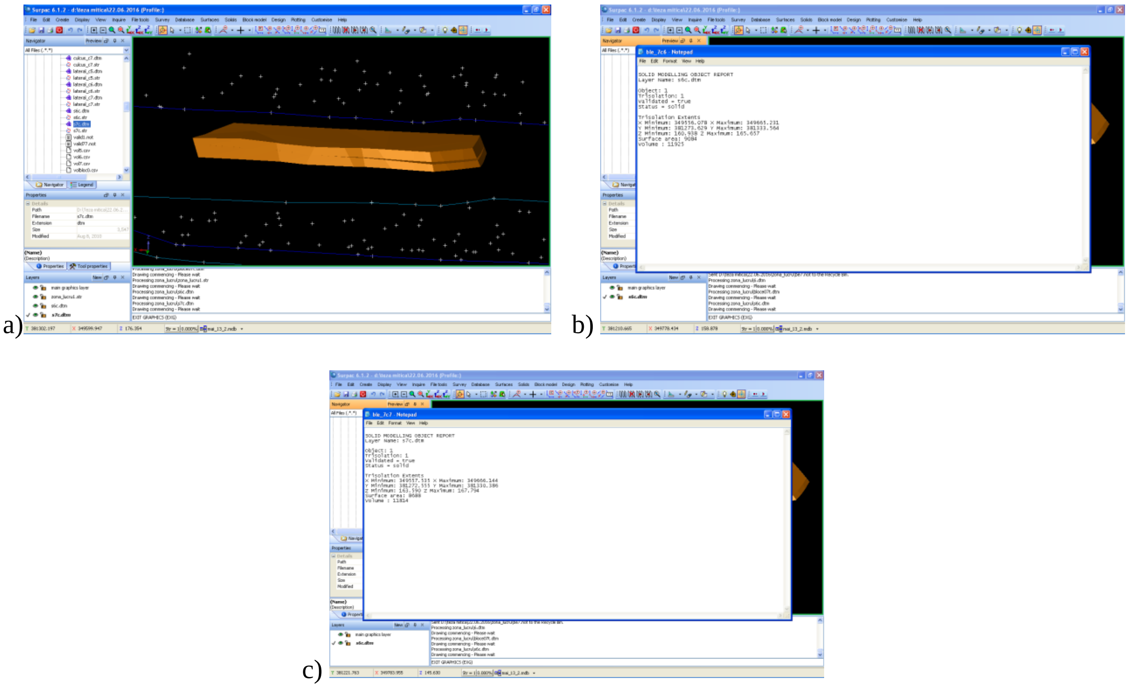


Fig. 12. (a) The shape and position in the bench of the two coal layers (layer 6 and layer 7 coal) after intersection.(b),(c)

The resulting volume report for the ore in the excavation block for layer 6 and layer 7 in the coal deposit. After generation of the report with the volume of coal, we will see the resulting volume of 11925 cubic meters for layer 6 and 11814 cubic meters for layer 7, resulting a total volume of 23739 cubic meters, for the six days we have an average of 3956.5 cubic meters of extracted coal per day of operation.

5. Conclusions

Following the operations performed above we can draw the following conclusion:

- Accurate estimation of volumes that are to be excavated is easier and closer to reality.
- We can visualize the three-dimensional format for the mining operation, and we can draw conclusions easier on the shape, size.
- We can see the evolution over time of the mine in the future and in the past (if we have information from the beginning of opening the mine until present times).
- We can create multiple scenarios of the evolution in time of operation and can choose the most suitable one.

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The analysis of three-dimensional behavior of objectives in mining industry using the Global Test of Congruence with two stages of measurement. Locating deformations using statistical tests.

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Abstract

Monitoring three-dimensional behavior of industrial objectives can be achieved through rigorous mathematical processing using the Global Test of Congruence, which determines whether or not deformations appear among several stages of measurements. Locating deformations in the geodetic network is achieved by using statistical tests, Student's t-test or F Multiple statistical test.

Keywords: Geodesy, the least squares method, the theory of errors, the Global Test of Congruence, Student's t-test, F test.

1. Introduction

Except the obvious cases where macro-deformations occur, there are special circumstances where it is desirable to highlight whether deformations exist or not for strategic industrial objectives, sometimes in the range of millimeters, and also locating those deformations in the measured geodetic network. In order to achieve this and in interests of accuracy, 3D position of points is studied separately in terms of planimetry and altimetry due to different surveying instruments that are currently used. For planimetric positioning using geodetic equipment such as total stations, planimetric coordinates are indirectly determined in the local system or Stereographic 1970. This equipment often does not meet the accuracy requirements for elevation set by the beneficiary, moreover the trigonometric levelling method used in determining position in the vertical plane and elevation is not sufficiently qualitative, therefore geometric levelling is used as a working method with optical levels or electronic equipment, for determining level differences and distances and then indirectly elevation.

2. Determining deformations using the Global Test of Congruence

For determining planimetric and altimetric deformations, the Global test of Congruence is being used. After conducting measurements, the result consists in complex geometric figures. By studying these figures among several stages of measurements and their congruence, we may be able to rigorously determine whether or not there is a displacement of the measured points. The difference between the parameters among at least two stages of measurements must be in a safety limit. The safety limit shall be determined according to the standard empirical error of the measurements. In each stage of the observations, the functional-stochastic model for processing is determined, in most cases in current practice as for the indirect measurements. The functional model with the default hypothesis:

$$L_i + v_i = A_i + x_i; i = \overline{1,n}$$

(1)

matrix $$\begin{pmatrix} L_1 \\ \ldots \\ L_n \end{pmatrix} + \begin{pmatrix} v_1 \\ \ldots \\ v_n \end{pmatrix} = \begin{pmatrix} A_1 & 0 & 0 \\ 0 & \ldots & 0 \\ 0 & 0 & A_n \end{pmatrix} * \begin{pmatrix} x_1 \\ \ldots \\ x_n \end{pmatrix} \qquad (2)$$

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Where: L_i - vector of measurements; v_i - vector of error corrections; A_i - matrix of unknown parameters coefficients; x_i - vector of unknown parameters. Stochastic model:

$$\sum L_i = \sigma_0^2 * Q_i \quad \text{where: } \sum L_i \text{ variance-covariance matrix} \tag{3}$$

Q_i - cofactor matrix, diagonal matrix with "0" displayed on the secondary diagonal, which indicates that the measurements are independent, uncorrelated. We impose $\sigma_0 = \rho''$, therefore we impose the measurement accuracy by choosing the working method and the corresponding equipment. In this case, Stonex R2+ total station has the accuracy in determining horizontal angular directions $\rho'' = 2''$, so $\sigma_0 = 2''$. For altimetry Bosch GOL32 Professional level has the accuracy of 1mm/ km in geometric levelling, so $\sigma_0 = 1mm$. The processing is carried out under the minimum imposed condition:

$$v^T * P * v \rightarrow \min \tag{4}$$

$$P_i = Q_i^{-1} \tag{5}$$

Where: P_i - weight matrix and Q_i^{-1} - inverse of cofactor matrix

We impose a null hypothesis: $\{H_0\} : E\{s_{0i}{}^2\} = E\{s_{0n}{}^2\} = \sigma_0{}^2$ *(6)*

Where $s_{0i}{}^2$ - standard theoretical deviation corresponding to the stage i.

The alternative hypothesis is: $\{H_1\} : E\{s_{0i}{}^2\} \neq E\{s_{0n}{}^2\} \neq \sigma_0{}^2$ *(7)*

$$F_{practic} = \frac{s_{0i}{}^2}{s_{0_n}{}^2} \tag{8}$$

$$F_{theoretic} = F_{f_1, f_2, \alpha} \tag{9}$$

Where: f_1, f_2 - degrees of freedom; α - risk coefficient, $\alpha = 5\%$

The decision as a result of applying the statistical test will be 1- α, so 100% - 5% = 95 % mathematical probability .nThe decision of the test: $F_{practic} > F_{theoretic}$ *(10)*

So: The hypothesis $\{H_0\}$ is false→ the hypothesis $\{H_1\}$ is the true

$$F_{practic} \leq F_{theoretic} \tag{11}$$

So: The hypothesis $\{H_0\}$ is true→ the hypothesis $\{H_1\}$ is false , we can apply the Global test of Congruence. Processing will be carried out considering a free network, the most common case in current practice:

$$X = (A^T * P * A) * (A^T * P * l) \tag{12}$$

$$A^T * P * A = N \tag{13}$$

Using a special inverse

$$A^T * P * A = n \tag{14}$$

Considering stage i measurements:

$$x_i = \mathrm{N_i}^+ * n_i \tag{15}$$

$$\Sigma_X = \sigma_0{}^2 * Q_X \tag{16}$$

Σ_X - covariance matrix

$$Q_X = N_i^+ = P_i^{-1} \tag{17}$$

$$s_{0_i}{}^2 = \frac{v^T * P * v}{n_i - u_i + d} = \frac{\Omega_i}{f_i} \tag{18}$$

Where: n_i - the number of equations for stage i; u_i - the number of unknowns in stage i; d - datum defect

f_i - degrees of freedom, redundancy

$$s_0^{\ 2}=\frac{\sum \Omega_i}{\sum f_i}=\frac{\Omega}{f} \quad (19)$$

$s_{0_i}^{\ 2}$ is the standard empirical deviation of the deformation model. For applying any statistical test, we must establish work hypotheses:

$$B*X=W \quad (20)$$

The null hypothesis for Global test of Congruence:

$$\{H_0\}:E\{X_i\}=E\{X_n\}\Leftrightarrow E\{X_n\}-E\{X_i\}=0 \quad (21)$$

$$\begin{pmatrix}-I & I\end{pmatrix}*\begin{pmatrix}x_i\\ x_n\end{pmatrix}=B*X=W=0 \quad (22)$$

$B=\begin{pmatrix}-I & I\end{pmatrix}$ - configuration matrix (23)

$$\Omega_H=\Omega+R \quad (24)$$

Ω_H - the sum of square errors influenced by statistical hypothesis; Ω - the sum of initial statistical square errors, not influenced by linear hypothesis; R - the sum of additional statistical square errors, which we have already introduced, the influence of the linear hypothesis. We want to assess the size of R, as the error of a function of indirectly determined quantities (the theory of error):

$$R=(B_X-W)^T*\left[B*\left(A^T*P*A\right)^+*B^T\right]^+*(B_X-W) \quad (25)$$

$$R=(X_n-X_i)^T*\left(N_i^{\ +}+N_n^{\ +}\right)*(N_n-N_i) \quad (26)$$

$(N_n-N_i)=d$ - vector of discrepancies (27)

$$\left(A_i^{\ T}*P_i*A_i\right)^{-1}+\left(A_n^{\ T}*P_n*A_n\right)^{-1}=N_i^{\ +}+N_n^{\ +}=Q_{dd}^{\ +} \quad (28)$$

$Q_{dd}^{\ +}$ -cofactor matrix corresponding to the vector of discrepancies, d

$$R=d^t*Q_{dd}^{\ +}*d \quad (29)$$

$$d=X_2-X_1 \quad (30)$$

h = n - d (31)

h - the rank of the matrix Q - the same in all stages; d - defect of reference data

The size of the test procedures for a two-step measurements:

$$F=\frac{R}{s_0^{\ 2}*h}=\frac{d^T*Q_{dd}^{\ +}*d}{\frac{v^T*P*v}{n_i-u_i+d}*h}=\frac{d^T*Q_{dd}^{\ +}*d}{\frac{v^T*P*v}{f_i}*h}=\frac{d^T*Q_{dd}^{\ +}*d}{v^T*P*v}*\frac{f_i}{h} \quad (32)$$

Where: $\dfrac{d^T*Q_{dd}^{\ +}*d}{v^T*P*v}$ is a fraction of squares.

The size of the test has Fisher distribution with f degrees of freedom as numerator and h degrees of freedom in the denominator. The probability is the following: $P\{F\le F_{h,f,1-\alpha}|H_0\}=\alpha$ (33)

Where:

F - the practical value; $F_{h,f,1-\alpha}$ - the theoretical value**;** H_0 - the null hypothesis; α - the probability.

The decision of the statistical test is the following:

- $F\le F_{h,f,1-\alpha}\rightarrow(H_0)$ is true $(H_0):E\{X_i\}=E\{X_n\}\Leftrightarrow E\{X_n\}-E\{X_i\}=0$ (34)

so there is no deformation in the network.

- F > $F_{h,f,1-\alpha}\rightarrow(H_0)$ False, it is necessary to a alternative hypothesis H_1

$$(H_1):E\{X_i\}\ne E\{X_n\}\Leftrightarrow E\{X_n\}-E\{X_i\}\ne 0 \quad (35)$$

so there is deformation in the network. In order for the Global test of Congruence to determine whether there are deformations in the network, the following conditions have to be met:

- For both stages of measurements, the same geodetic datum must be used in processing;
- For all the stages of measurements the reference defect must be the same, or the datum defect; considering the geometric leveling d=1, trilateration d = 3, triangulation d = 4, photogrammetry d = 7;
- The configuration of the networks should be the same on both stages, the ideal case; if this condition cannot be met, then the configuration matrix minimizes as a whole or partially;

- The standard theoretical deviation should be the same in all the stages.

3. Locating deformations

For locating deformations, mostly for the displaced points of the network, statistical tests are used, such as the Student's Statistical t- Test or F-test.

3.1.Student's Statistical t- test

$$s_j = s_0 * \sqrt{Q_{jj}} \quad (36)$$

The previous equation determines the standard empirical deviation of the elements contained in the vector of discrepancies d, as determined by 30) Q_{jj} - the components of the main diagonal of cofactor matrix vector d, Q_{dd}

$$Q_{dd}^{+} = \begin{pmatrix} Q_{11} & & & \\ & Q_{22} & & \\ & & \ldots & \\ & & & Q_{nn} \end{pmatrix} \quad (37)$$

$$t_j = \frac{d_j}{s_j};\ j = \overline{1,n} \quad (38)$$

Considering a planimetric network, the number of points in the network is $\frac{n}{2}$, for a network in space the number of points in the network is $\frac{n}{3}$. The null hypothesis $\{H_0\} : E\{d_j\} = 0$ *(39)*

The probability that the null hypothesis is satisfied:

$$P\{t_1 \le t_{\lim}/t_1 \le t_{\lim}/.../t_n \le t_{\lim} | H_0\} = 1 - \alpha \quad (40)$$

Since all the n sizes are not statistical independent, from the statistical point of view, the safety threshold α must be replaced with $\overline{\alpha}$; $(1-\overline{\alpha})^n = 1-\alpha$, so $\overline{\alpha} = \frac{\alpha}{n}$ *(41)*

The null hypothesis (H_0):

$$(H_0): t_j - t_{f,1-\overline{\alpha}} = 0 \quad (42)$$

$t_{f,1-\overline{\alpha}}$ Shall be calculated in accordance with the statistical equations or can be extracted from the Student distribution tables. The decision of the test is the following:

- $t_j \le \mathrm{t}_{\lim} = t_{f,1-\overline{\alpha}} \rightarrow (H_0): t_j - t_{f,1-\overline{\alpha}} = 0$ is true, so the *j point is not moved (43)*
- $t_j > \mathrm{t}_{\lim} = t_{f,1-\overline{\alpha}} \rightarrow (H_0): t_j - t_{f,1-\overline{\alpha}} = 0$ is false, an alternative hypothesis is introduced:

  $(H_0): t_j - t_{f,1-\overline{\alpha}} \ne 0$ Therefore the *j point is moved* *(44)*

3.2. The F test

The vector of the discrepancies, determined with 30), as shown below:

$$d = \begin{pmatrix} d_{X_1} \\ d_{Y_1} \\ d_{X_2} \\ d_{Y_2} \\ \ldots \\ d_{X_n} \\ d_{Y_n} \end{pmatrix} \qquad Q_{dd}^{+} = \begin{pmatrix} d_{X_1X_1} & d_{X_1Y_1} & & & & & & O \\ d_{Y_1X_1} & d_{Y_1Y_1} & & & & & & \\ & & d_{X_2X_2} & d_{X_2Y_2} & & & & \\ & & d_{Y_2X_2} & d_{Y_2Y_2} & & & & \\ & & & & \ldots & & & \\ & & & & & & d_{X_nX_n} & d_{X_nY_n} \\ O & & & & & & d_{Y_nX_n} & d_{Y_nY_n} \end{pmatrix} \quad (45)$$

We partition a vector: $d_k = \begin{pmatrix} d_{xk} \\ d_{yk} \end{pmatrix} \qquad k = \overline{1,n}$ *(46)*

$$Q_{dd_K} = \begin{pmatrix} Q_{X_KX_K} & Q_{X_KY_K} \\ Q_{Y_KX_K} & Q_{Y_KY_K} \end{pmatrix} \quad (47)$$

For each point, we calculate as shown below, analogous to the Global test of Congruence:

$$F_k = \frac{d_k^{\,T} \cdot Q_{ddk} \cdot d_k}{s_0^{\,2} \cdot h}; k = \overline{1,n} \tag{48}$$

The null hypothesis of the statistical test :

$$(H_0): E\{d_k\} = 0 \tag{49}$$

The value of d_k must be 0. The probability as it follows: $P\{F_1 \le F_{\lim} / F_1 \le F_{\lim} / \ldots / F_n \le F_{\lim} | H_0\} = 1 - \alpha$ *(50)*

Due to correlating the quantities that were statistical tested, instead of the risk coefficient α , shall be considered

$$\bar{\alpha} = \frac{2 * \alpha}{u} \text{; where: u - the number of unknowns} \tag{51}$$

$$F_{\lim} = F_{2,f,1-\bar{\alpha}} \tag{52}$$

The decision of the test:

$$F_k \le F_{\lim} = F_{2,f,1-\bar{\alpha}} \rightarrow (H_0): E\{d_k\} = 0$$ *(53)*o

r $$F_k > F_{\lim} = F_{2,f,1-\bar{\alpha}} \rightarrow (H_0): E\{d_k\} \ne 0$$ *The point k in the network is not moved* *(54)*

4. Case Study

Monitoring the stability of the hill's versant at the mining quarry Stoenesti-Plaiul Cheii, located in Stoenești village, in the N-E of Arges county, Romania, using geodetic equipment, Stonex R2+ total station with the accuracy in the determination horizontal angular directions 2", which results in determining distances on the simple prism up to 5000m, 1.5mm+2ppm accuracy; the telescope magnification up to 30X . For monitoring in the vertical plane, Bosch GOL32G Professional optical level was used, with an average standard deviation of 1mm double km in geometric leveling, also with high accuracy for an individual survey by 1mm/30m, with the working range of up to 120m, the minimum focus distance 0.3m and telescope magnification 32X.

Fig. 1 (a) Stonex R2+Total Station; (b) Bosch GOL32 Professional Optical Level

Fig. 2 (a) and (b) 3D tracking points; (c) and (d)Deformations/ effects on Plaiul Cheii hill

After statistical processing the information, resulting in the following data: the planimetric coordinates in Sterographic 1970 coordinates system and elevations in Black Sea 1975 reference system.

Table 1. Summary of coordinates for seven points that were monitored during 2014 and 2015, in 8 stages of measurements

Point no.	N[m]	E[m]	H[m]	Point no.	N[m]	E[m]	H[m]	Point no.	N[m]	E[m]	H[m]	Point no.	N[m]	E[m]	H[m]
1I2014	417346,620	512351,006	690,480	1II2014	417346,705	512350,921	690,600	1III2014	417346,712	512351,080	690,510	1IV2014	417346,762	512351,120	690,560
2I2014	417324,335	512291,325	666,220	2II2014	417324,420	512291,240	666,350	2III2014	417324,367	512291,279	666,080	2IV2014	417324,407	512291,329	666,110
3I2014	417304,933	512331,192	680,160	3II2014	417304,935	512331,190	680,160	3III2014	417304,996	512331,054	680,110	3IV2014	417305,016	512331,074	680,130
4I2014	417279,823	512323,138	680,900	4II2014	417279,805	512323,132	680,920	4III2014	417279,983	512323,025	680,770	4IV2014	417280,003	512323,055	680,790
5I2014	417278,544	512364,319	688,660	5II2014	417278,549	512364,318	688,680	5III2014	417278,696	512364,099	688,610	5IV2014	417278,716	512364,109	688,660
6I2014	417265,312	512381,429	693,330	6II2014	417265,581	512381,061	693,470	6III2014	417265,587	512381,053	693,390	6IV2014	417265,597	512381,083	693,440
7I2014	417245,347	512406,275	702,050	7II2014	417245,319	512406,393	702,130	7III2014	417245,366	512406,430	701,990	7IV2014	417245,366	512406,460	702,030

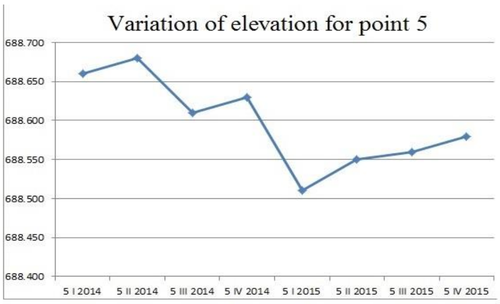
Point no.	N[m]	E[m]	H[m]	Point no.	N[m]	E[m]	H[m]	Point no.	N[m]	E[m]	H[m]	Point no.	N[m]	E[m]	H[m]
1I2015	417346,662	512350,964	690,670	1II2015	417346,743	512350,906	690,680	1III2015	417346,687	512350,956	690,490	1IV2015	417346,727	512350,996	690,540
2I2015	417324,543	512291,330	666,520	2II2015	417324,527	512291,385	666,300	2III2015	417324,430	512291,249	666,730	2IV2015	417324,470	512291,279	666,760
3I2015	417304,946	512331,010	680,150	3II2015	417305,124	512330,915	680,170	3III2015	4173005,034	512330,933	680,180	3IV2015	417305,044	512330,983	680,220

4I2015	417279,972	512322,925	680,860	4II2015	417280,131	512322,912	680,790	4III2015	417280,098	512322,928	680,790	4IV2015	417280,118	512322,938	680,820
5I2015	417278,818	512364,127	688,510	5II2015	417278,863	512364,001	688,550	5III2015	417278,869	512363,991	688,560	5IV2015	417278,879	512364,041	688,580
6I2015	417265,604	512381,043	693,490	6II2015	417265,542	512381,028	693,460	6III2015	417265,589	512380,983	693,420	6IV2015	417265,599	512381,003	693,440
7I2015	417245,481	512406,349	702,120	7II2015	417245,429	512406,342	702,060	7III2015	417245,375	512406,362	702,090	7IV2015	417245,395	512406,412	702,130

Table 2. Coordinates' variation for seven points that were monitored during the years 2014 and 2015 (right) variation of elevation for point 5 (left)

Point	Quarter I – Quarter II			Quarter II – Quarter III			Quarter III- Quarter IV		
	ΔN	ΔE	ΔH	ΔN	ΔE	ΔH	ΔN	ΔE	ΔH
1	-0,085	0,085	-0,120	-0,007	-0,159	0,090	-0,020	-0,040	-0,030
2	-0,085	0,085	-0,130	0,053	-0,039	0,270	-0,030	-0,050	-0,030
3	-0,002	0,002	0,000	-0,061	0,136	0,050	-0,030	-0,050	-0,050
4	0,018	0,006	-0,020	-0,178	0,107	0,150	-0,010	-0,010	-0,030
5	-0,005	0,001	-0,020	-0,147	0,219	0,070	-0,020	-0,030	-0,020
6	-0,269	0,368	-0,140	-0,006	0,008	0,080	-0,040	-0,040	-0,020
7	0,028	-0,118	-0,080	-0,047	-0,037	0,140	-0,020	-0,010	-0,050

Point	Quarter I – Quarter II			Quarter II – Quarter III			Quarter III- Quarter IV		
	ΔN	ΔE	ΔH	ΔN	ΔE	ΔH	ΔN	ΔE	ΔH
1	-0,081	0,058	-0,010	0,056	-0,050	0,190	-0,040	-0,010	-0,020
2	-0,016	-0,055	0,220	0,097	0,136	-0,430	-0,010	-0,030	-0,050
3	-0,178	0,095	-0,020	0,090	-0,018	-0,010	-0,040	-0,050	-0,010
4	0,159	0,013	0,070	0,033	-0,016	0,000	-0,030	-0,030	-0,020
5	-0,045	0,126	-0,040	-0,006	0,010	-0,010	-0,050	-0,040	-0,020
6	-0,062	0,015	0,030	-0,047	0,045	0,040	-0,020	-0,050	-0,020
7	0,052	0,007	0,060	0,054	-0,020	-0,030	-0,010	-0,030	-0,040



For the last two stages of the measurements, using the Global Test of Congruence, we determined the size F for planimetry, the practical value of this statistical test, 14.44, which was compared to the theoretical value of the test, $F_{theoretic}$=3.44. The same statistical test was used for leveling, where we determined F=106.20 and $F_{theoretic}$=2.85. For locating deformations we used Student's t-test and the F test, we determined t_{lim}=2.03 and F_{lim}=3.26 for planimetry which we compared with the values we obtained for each point that was monitored, t_j and F_k. For geometric leveling we obtained values t_{lim}=2.63 and F_{lim}=6.94 which were compared to the individual values obtained for each point t_j and F_k.

5. Conclusions

Using the Global Test of Congruence we highlighted the fact that among the two stages of measurements t_i and t_{i+1} the points are displaced. Using Student's t-test and F-test we conclude that all the analyzed points are displaced, given the fact that the calculated functions are higher than the limit functions for all seven points, $t_j > t_{\mathrm{lim}}$ and, both from planimetric and altitude point of view, this also applies for the last two monitored quarters , III and IV of the year 2015. In Stoenesti mining area we have dealt with macro deformations in the range of centimeter or even decimeter, due to clay extraction activities, however this deformation does not endanger life or people's households, as the mining area is outside Stoenesti village, in an uninhabited area with restricted access. The decision of the Global test of Congruence is true with a statistical probability of 1- α, 1-0,05=0.95=95 %. A decision with statistical probability of 100 % is not possible, this also applies in the case of any statistical test. The Global test of Congruence reveals that the resulting networks in two stages of measurements are not congruent, so there is deformation in the network, but it does not indicate which points are displaced. This statistical test can be used for more than two stages of measurements, in this case, the test function will have a statistical distribution x^2. Student's t-test is not sufficiently stable, but it is considered stable if the displaced points in the network are not numerous, this conclusion is also valid for the F-test. The test takes into account the coordinates of a point, but it does not take into account the correlations that may arise among points in the network. It is necessary to calculate $\bar{\alpha}$. This size is not to be found in the Student's distribution tables. Using the F test, we can test every point in the network and also certain groups of points.

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The weighted distribution and evaluation of the accuracy routes and networks topographic mining support

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Abstract

Lifting and plotting topographical works executed to achieve the objectives mining from surface and underground support are based on a lot of points and trails stable forming polygonal networks. Mining objectives that must be designed, built and pursued their stability over time are very important from the technical, economic and social. As a result, topographic bases must meet quality requirements and correlated with the dynamic nature of mining activities.

Keywords: Mining surveying, topographic underground networks, errors, topographic measurements;

1. The purpose theme

1.Mine workings at surface and underground methods are driven by special topographical surveying relative to a base of support consists of routes or networks topographic materialized on the mining works. Therefore, it requires a proper correlation between the topographic base of support, topographic works spespeciale (stakeout) and the mining works.

2.The importance of work mine workings is characterized in that a dynamic nature, that are made in different periods. It follows that the topographic base and support must be done in stages, but results in solving corresponding network block. On the other hand methods that are required to be assessed results. Such goals will be achieved for leveling routes and networks.

3.Route geometric leveling consider points A and B between which were executed geometric precision leveling measurements (Fig. 1). If quotas are known absolute HA, HB of points A and B, leveling differences measured h1, h2, h3 are used to determine quotas H1 and H2 absolute two points P1 and P2 situated on the leveling AB.

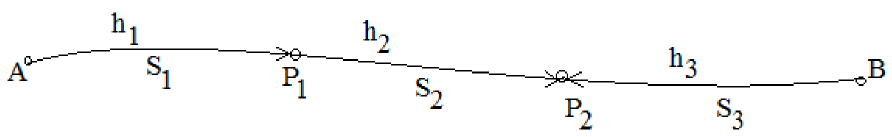

Fig. 1. Route geometric leveling

Are known:

- H_A, H_B data size
- h_1, h_2, h_3 measured size
- S_1, S_2, S_3 the lengths leveling of lines between points A, P_1, P_2, B measured size

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Must be determined quotas H_1 and H_2 of points P_1 and P_2 and assessed their accuracies. We denote with H_1^0, H_2^0 provisional quotas points P_1 and P_2. These are obtained as:

$$\begin{aligned} H_1^0 &= H_A + h_1 \\ H_2^0 &= H_B + h_3 \end{aligned} \tag{1}$$

We denote with x_1 and x_2 Likely corrections and provisional quota shares they obtained probable H_1 and H_2 of points P_1 and P_2 with equality:

$$\begin{aligned} H_1 &= H_1^0 + x_1 \\ H_2 &= H_2^0 + x_2 \end{aligned} \tag{2}$$

With the above notations can form equations:

$$\begin{aligned} (H_1^0 + x_1) - (H_A + h_1) &= v_1 \\ (H_2^0 + x_2) - (H_1^0 + x_1 + h_2) &= v_2 \\ (H_2^0 + x_2) - (H_B + h_3) &= v_3 \end{aligned} \tag{3}$$

Or:

$$\begin{aligned} x_1 \qquad + l_1^0 = v_1; &\quad l_1^0 = H_1^0 - H_A - h_1 \\ -x_1 + x_2 + l_2^0 = v_2; &\quad l_2^0 = H_2^0 - H_1^0 - h_2 \\ x_2 + l_3^0 = v_3; &\quad l_3^0 = H_2^0 - H_B - h_3 \end{aligned} \tag{4}$$

The system of equations obtained is solved if the condition is attached:

$$[pvv] = min \tag{5}$$

p are measured variable weights, those weights equations errors.

Is obtained the system:

$$\begin{aligned} (p_1 + p_2)x_1 - p_2 x_2 + p_1 l_1^0 - p_2 l_2^0 = 0 \\ -p_2 \quad + (p_2 + p_3)x_3 + p_2 l_2^0 + p_3 l_3^0 = 0 \end{aligned} \tag{6}$$

$$\begin{aligned} (p_1 + p_2)x_1 - p_2 x_2 + l_1 = 0; &\quad l_1 = p_1 l_1^0 - p_2 l_2^0 \\ -p_2 x_1 + (p_2 + p_3)x_2 + l_2 = 0; &\quad l_2 = p_2 l_2^0 - p_3 l_3^0 \end{aligned} \tag{7}$$

The system eliminate unknown x_1 and it obtain:

$$x_1 = \frac{p_2 x_2}{p_1 + p_2} - \frac{l_1}{p_1 + p_2} \tag{8}$$

$$\left(-\frac{p_2^2}{p_1 + p_2} + p_2 + p_3\right) x_2 + \frac{p_2 l_1}{p_1 + p_2} = 0$$

$$\frac{p_1 p_2 + p_3(p_1 + p_2)}{p_1 + p_2} x_2 + L_2 = 0 \tag{9}$$

$$\left(p_3 + \frac{1}{\frac{1}{p_1} + \frac{1}{p_2}}\right) x_2 + L_2 = 0$$

$$\left(p_3 + \frac{1}{\frac{1}{p_2}}\right) x_2 + L_2 = 0 \tag{10}$$

p_2 share in the point P_2

It results the conclusion:

Leveling lines; disposed in series with weights p_1 and p_2 determine a share p_2 the relationship that exists between:

$$\frac{1}{P_2} = \frac{1}{p_1} + \frac{1}{p_2} \quad (11)$$

With these specifications we can write:

$$(P_2 + p_3)x_2 + L_2 = 0$$
$$L_2 = l_2 + \frac{p_2 l_1}{p_1 + p_2} \quad (12)$$

To note that shares generally are obtained using the lengths, so $p_i = \frac{1}{S_i}$.

Observe that the resulting correction equation x_2 is written directly by bike route leveling, as well as the initial system of equations. Will be calculated simply in the right order x_2 nd hereinafter right x_1.

For evaluation of precision must be determined: mean square error m_0 the level difference per unit length and mean square errors m_1 and m_2 they obtained probable values quota points P_1 and P_2.

Using matrix calculation we can write:

$$m_0 = \sqrt{\frac{v\prime pv}{n-k}} \quad (13)$$

n – number of equations
k – the number of unknowns

so:

$$n - k = 3 - 2 = 1$$

$$v'pv = l'(p - pAQ_{xx}A'p)l \quad (14)$$

In which:

$$Q_{xx} = (A'pA)^{-1} \quad (15)$$

And:

$$A = \begin{pmatrix} 1 & 0 \\ -1 & 1 \\ 0 & 1 \end{pmatrix}; \qquad l = \begin{pmatrix} l_1 \\ l_2 \\ l_3 \end{pmatrix}; \qquad p = \begin{pmatrix} p_1 & 0 & 0 \\ 0 & p_1 & 0 \\ 0 & 0 & p_1 \end{pmatrix} \quad (16)$$

It is easy to deduce that:

$$Q_{xx} = \frac{1}{D}\begin{pmatrix} p_2 + p_3 & p_2 \\ p_2 & p_1 + p_2 \end{pmatrix} \quad (17)$$

In witch:

$$D = p_1(p_2 + p_3) + p_2 p_3 = p_3(p_1 + p_2) + p_1 p_2 \quad (18)$$

With these:

$$Q_{xx} = \begin{pmatrix} Q_{11} & Q_{12} \\ Q_{21} & Q_{22} \end{pmatrix} \quad (19)$$

In witch:

$$Q_{11} = \frac{p_2 + p_3}{D} = \frac{1}{p_1 + P_2}; \quad \frac{1}{P_2} = \frac{1}{p_2} + \frac{1}{p_3}$$

$$Q_{22} = \frac{p_1 + p_2}{D} = \frac{1}{p_3 + P_1}; \quad \frac{1}{P_1} = \frac{1}{p_1} + \frac{1}{p_2} \quad (20)$$

And

$$Q_{12} = Q_{21} = \frac{p_2}{D} = \frac{1}{p_1 + p_3 + \frac{p_1 p_3}{P_2}} \tag{21}$$

Finally we can write:

$$\begin{aligned} m_1 &= m_0\sqrt{Q_{11}} \\ m_2 &= m_0\sqrt{Q_{22}} \end{aligned} \tag{22}$$

Weighting coefficients Q_{11} and Q_{22} are obtained simply by leveling route scheme. In this way is obtained Q_{xx}.

2. Conclusions

Underground routes and geometric leveling networks are made appropriate steps to achieve mining works, from simple to complex question. By using how they are distributed weights, leveling routes and networks can be partially solved by solving obtaining the same results as a whole. Also, for every situation can be evaluated by calculating the weighting coefficient accuracies of measurements determined.

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The analysis of precision in angular intersections and resections

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Abstract

Angular intersections are known for a long time ago but their use is often avoided because the large errors may occur in determining new points. However the use of intersections is very practical in engineering activity. Even accurate measuring instruments and experienced operators are used, the accuracy of such method especially depends of the geometry of placing new points compared to the old known points. This paper shows how to calculated the accuracy of determining a new point in the case of intersections or resections. Besides the analytical trait, the paper presents graphical representations showing that areas with accurate determinations and that areas with vague determinations. The paper is useful for practitioners who must decide depending on field conditions if they can use or not the intersections and resections method.

Keywords: the method of determining, accuracy, intersection, resection ;

1. Introduction

The methods used for control surveys are: Traversing; Least squares estimation of survey networks; Satellite position fixingș; Intersection and Resection. If the inaccessible point is to be coordinated from known points then the process is one of intersection. If the inaccessible point has known coordinates and the instrument station is to be coordinated then the process is one of resection.

Using these techniques, one can establish the coordinates of a point *P*, by observations to or from known points. These techniques are useful for obtaining the position of single points, to provide control for setting out or detail survey.

Intersections also applies in the mining area to determine the stability of extraction towers for measuring the slope edge in pits measuring stokpiles in waste dumps and warehouses.

2. Intersection

2.1. Equations used in the method

If it is considered known points A and B, of these point 1 will be determined by measuring angles α and β (fig.1).

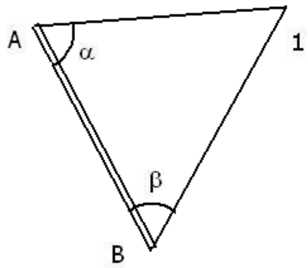

Fig. 1. Intersection

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Problem solving can be done either analytically or trigonometric. In analytical solving are calculated

$$x_1 = \frac{y_B - y_A + x_A tg(\theta_{AB} - \alpha) - x_B tg(\theta_{BA} + \beta)}{tg(\theta_{AB} - \alpha) - tg(\theta_{BA} + \beta)} \tag{1}$$

$$y_1 = \frac{x_B - x_A + y_A ctg(\theta_{AB} - \alpha) - y_B ctg(\theta_{BA} + \beta)}{ctg(\theta_{AB} - \alpha) - ctg(\theta_{BA} + \beta)}$$

The trigonometric solving uses sinus law and lead to the result

$$x_1 = x_A + AB\frac{\sin\beta}{\sin(\alpha+\beta)}\cos(\theta_{AB} - \alpha) \tag{2}$$

$$y_1 = y_A + AB\frac{\sin\beta}{\sin(\alpha+\beta)}\sin(\theta_{AB} - \alpha)$$

2.2. Evaluating the accuracy of determination

New point determination depends on the position of supporting points and also depends on angles measured.

$$x = f(x_A, y_A, x_B, y_B, \alpha, \beta) \tag{3}$$

$$y = g(x_A, y_A, x_B, y_B, \alpha, \beta)$$

If errors of support points are considered negligible, the error of point 1 determination can be expressed as:

$$m_{X1} = \pm\frac{m_\alpha}{\rho''}\sqrt{\left(\frac{\partial x}{\partial\alpha}\right)^2 + \left(\frac{\partial x}{\partial\beta}\right)^2} \tag{4}$$

$$m_{Y1} = \pm\frac{m_\alpha}{\rho''}\sqrt{\left(\frac{\partial y}{\partial\alpha}\right)^2 + \left(\frac{\partial y}{\partial\beta}\right)^2}$$

It was considered that every angle is measured just as accurately, $m_\alpha = m_\beta$. Partial derivatives are:

$$\frac{\partial x_1}{\partial\alpha} = \frac{D_{A1}}{\cos\theta_{A1}(tg\theta_{A1} - tg\theta_{B1})} \qquad \frac{\partial x_1}{\partial\beta} = \frac{D_{B1}}{\cos\theta_{B1}(tg\theta_{A1} - tg\theta_{B1})} \tag{5}$$

$$\frac{\partial y_1}{\partial\alpha} = \frac{D_{A1}}{\sin\theta_{A1}(ctg\theta_{A1} - ctg\theta_{B1})} \qquad \frac{\partial y_1}{\partial\beta} = \frac{D_{B1}}{\sin\theta_{B1}(ctg\theta_{A1} - ctg\theta_{B1})}$$

The expressions of errors on the two main directions X and Y are:

$$m_{X1} = \pm\frac{m_\alpha}{(tg\theta_{A1} - tg\theta_{B1})\rho''}\sqrt{\frac{D_{A1}^2}{\cos^2\theta_{A1}} + \frac{D_{B1}^2}{\cos^2\theta_{B1}}} \tag{6}$$

$$m_{Y1} = \pm \frac{m_\alpha}{(ctg\theta_{A1} - ctg\theta_{B1})\rho''} \sqrt{\frac{D_{A1}^2}{\sin^2\theta_{A1}} + \frac{D_{B1}^2}{\sin^2\theta_{B1}}}$$

For the case of intersections resolved through trigonometric method, the relations expressing errors on the direction X, Y are:

$$m_{X1} = \pm \frac{m_\alpha}{\rho''} \frac{D_{AB}}{\sin^2(\alpha+\beta)} \sqrt{\sin^2\beta\cos^2(\theta_{AB}+\beta) + \sin^2\alpha\cos^2(\theta_{AB}-\alpha)}$$
$$m_{Y1} = \pm \frac{m_\alpha}{\rho''} \frac{D_{AB}}{\sin^2(\alpha+\beta)} \sqrt{\sin^2\beta\sin^2(\theta_{AB}+\beta) + \sin^2\alpha\sin^2(\theta_{AB}-\alpha)} \quad (7)$$

Even though the obtained relations have different forms, them lead to the same results which show that it is not matter if the resolving of intersection is performed by analytical or trigonometric method.

In figures (2), (3), (4) are presented distributions of new point determination errors depending on the position of the new point compared to the old known point A and B.

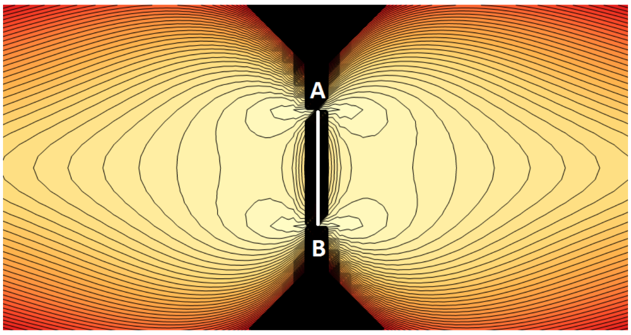


Fig. 2. The distribution of errors in determining a new point on directions parallel to AB

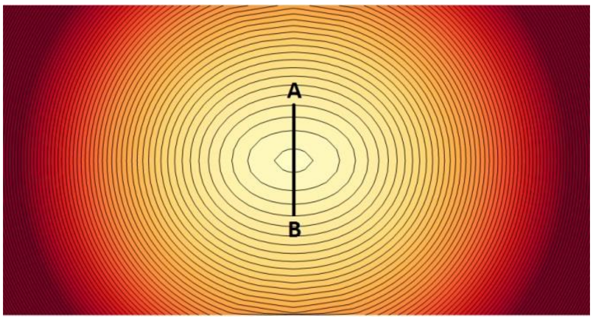


Fig. 3. The distribution of errors in determining a new point on directions perpendicular to AB

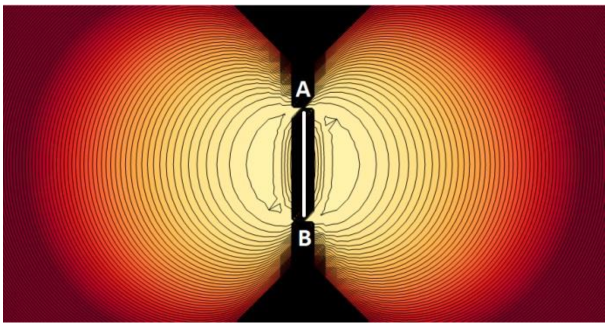


Fig. 4. The distribution of mean square errors of determining a new point

Analyzing the figures you can see that there are areas in which determinations are more accurate in one direction or another direction are very imprecise. For example, if A and B are known pilasters on both sides of a dam, then through the angular intersection, displacements cross the dam can be measured very accurately (fig.3) while longitudinal movements are almost impossible to determine (fig.2).

3. Resections

3.1. Equations used in the method

Resection involves the angular measurement from *P* out to the known points *A*, *B*, *C* (*Fig.5*). It is an extremely useful technique for quickly fixing position. A variety of analytical methods is available for the solution of *P*: Snellius Pothenot, Delambre, Cassini, Colins etc. In the following it will approach the method of barycentre coordinates which is also known as *`Tienstra's method'*

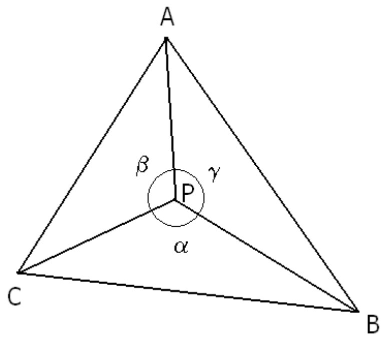


Fig. 5. Resection

The resection can be solved by next relations:

$$X_P = \frac{P_A \cdot X_A + P_B \cdot X_B + P_C \cdot X_C}{P_A + P_B + P_C}$$

(8)

$$Y_P = \frac{P_A \cdot Y_A + P_B \cdot Y_B + P_C \cdot Y_C}{P_A + P_B + P_C}$$

where

$$P_A = \frac{1}{\operatorname{ctg} A - \operatorname{ctg} \alpha} \qquad P_B = \frac{1}{\operatorname{ctg} B - \operatorname{ctg} \beta} \qquad P_C = \frac{1}{\operatorname{ctg} C - \operatorname{ctg} \gamma} \tag{9}$$

3.2. Evaluating the accuracy of determination

The determination of the new poin P occurs with errors on X and Y directions and errors can be estimated with relations:

$$m_{XP} = \pm \sqrt{\left(\frac{\partial f}{\partial \alpha}\right)^2 \cdot m_\alpha^2 + \left(\frac{\partial f}{\partial \beta}\right)^2 \cdot m_\beta^2 + \left(\frac{\partial f}{\partial \gamma}\right)^2 \cdot m_\gamma^2} \tag{10}$$

$$m_{YP} = \pm \sqrt{\left(\frac{\partial g}{\partial \alpha}\right)^2 \cdot m_\alpha^2 + \left(\frac{\partial g}{\partial \beta}\right)^2 \cdot m_\beta^2 + \left(\frac{\partial g}{\partial \gamma}\right)^2 \cdot m_\gamma^2}$$

Where:

$$\frac{\partial f}{\partial \propto} = \frac{(X_P - X_A) \cdot P_A^2}{(P_A + P_B + P_C) \cdot \sin^2 \alpha} \cdot \frac{1}{\rho''} \tag{11}$$

$$\frac{\partial f}{\partial \beta} = \frac{(X_P - X_B) \cdot P_B^2}{(P_A + P_B + P_C) \cdot sin^2\beta} \cdot \frac{1}{\rho''}$$

$$\frac{\partial f}{\partial \gamma} = \frac{(X_P - X_C) \cdot P_C^2}{(P_A + P_B + P_C) \cdot sin^2\gamma} \cdot \frac{1}{\rho''}$$

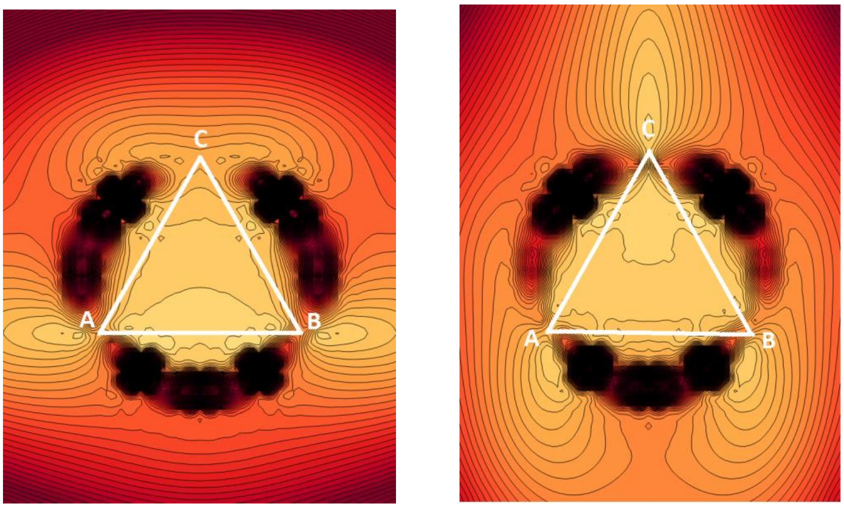
$$\frac{\partial g}{\partial \propto} = \frac{(Y_P - Y_A) \cdot P_A^2}{(P_A + P_B + P_C) \cdot sin^2\alpha} \cdot \frac{1}{\rho''}$$

$$\frac{\partial g}{\partial \beta} = \frac{(Y_P - Y_B) \cdot P_B^2}{(P_A + P_B + P_C) \cdot sin^2\beta} \cdot \frac{1}{\rho''}$$

$$\frac{\partial g}{\partial \gamma} = \frac{(Y_P - Y_C) \cdot P_C^2}{(P_A + P_B + P_C) \cdot sin^2\gamma} \cdot \frac{1}{\rho''}$$

It has made graphical representation of the size errors of new point depending on its position relative to oldest known points. Representations were made in the following assumptions :

- It was considered that every angle is measured under the same conditions of precision
- It was considered that known points A, B, C form an aproxmativ equilateral triangle.



a) b)

Fig. 6. Curves of equal error in determining a new point using resection -Tienstra's method; (a)The errors in the direction perpendicular to AB; (b) The errors in the direction paralel to AB

It can be seen as the geometric area in which determined points have big errors is even the circle passing through the known points A, B, C and vicinity of that circle.

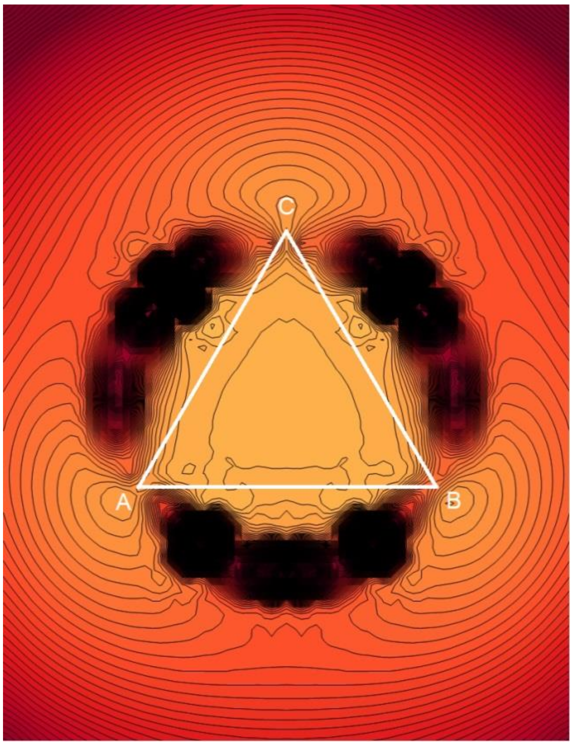


Fig. 7. The distribution of mean square errors of determining a new point using resection

4. Conclusions

Knowing how the position of new point in relation with the position of oldest known point influences the accuracy of the outcome is beneficial to decide if the intersection /resection method is suitable or not for that case. Also possible errors can be calculated based on the angles measured in the field. Practitioners have to decide depending on field conditions if they can use or not the intersections and resections method.

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Aspects of introducing the cadaster information system of cultural heritage sites within the historical Maramures

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Abstract

The cadaster of cultural heritage sites, as a subsystem of general cadaster in Romania, aims to record and realize a systematic inventory of the historical cultural sites. The Laws and specific regulations concerning the cultural heritage and cadaster provide the framework for the management of real estates listed as historical monuments. The paper proposes an overview of steps on realization of the cadaster information system of cultural heritage sites with representative aspects within the Maramures Depression, in northern part of Romania, as one of the richest in such cultural and historical sites. In conclusion, it is necessary to develop and implement a new software product for the integrated management of historical cultural sites to contribute to the sustainable development of the referred area.

Keywords: cadaster of cultural heritage sites, information system;

The cadastre reflects the relationship between the human being and space, being a product with multiple technical, legal, economic and also cultural valences. It has its origins in the political, social and economic history of the territories where it is applied. By its historicity, the cadastre becomes the witness of the spatio-temporal organization of the communities to whom it is addressed. The documents created by the cadastre works done in different historical times are sources of knowledge and documentation of the built space and of that space with various other destinations within the perimeters administered by the local communities whose space was being inventoried. In this respect, the cadastre of historical cultural heritage directly reflects the cultural valences of the cadastre. The importance of this subsystem of the general cadastre becomes evident during the devising of any sustainable development strategy at different levels: local, regional or national. In any such strategy, the protection and revaluation component becomes essential; assuming the development of specific strategies with projects and measures related to the protection, conservation and sustainable use of the built heritage in order to achieve sustainable territorial development.

Such a strategy of local development has been conceptualized starting from the needs and trends of local development by The Association of Intercommunity Development ”The Maramures Land” (AID), which represents an associative entity of the town halls from the historical Maramures, with the role of attracting grants and of achieving cross-border and international cooperation structures for fundraising and investment in the associated communities. This is the largest territorial association in the county, proposing opportunities for revitalizing Sighet as the center of the historic region of Maramures, organizing a platform that will become the driving force to initiate, implement and coordinate investment projects in the town halls which are members. One of the strategic priorities of the sustainable development strategy proposed by AID ”The Maramures Land” is the preservation and revitalization of local cultural heritage, especially those inscribed on the List of Historical Monuments 2010. It was took into account mainly the exploitation of the built heritage through urban revitalization projects, the exploitation of the archaeological heritage by providing access to archaeological sites and organizing outdoors exhibitions. To achieve this highly complex objective which requires multidisciplinary skills, it was necessary to outline an interdisciplinary research project with multiple objectives that constitute basic documentation for preparing the themes for designing the specifications, for purchasing the feasibility studies, for investment objectives relating to development works and documentation for approval of

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intervention works.

In this project it was proposed to be built an informational system of cadastre for the historical monuments in the mentioned area whose implementation was drawn up following the following plan:
- consultation of a specialized bibliography and the pre-establishments of a set of specific conceptual delimitations;
- documentation regarding the laws concerning the legal status of the historical monuments and also concerning the introduction of the specialized cadastre;
- evaluating the current state of the documentation of monuments, ensembles and historical sites in terms of management of these categories of objectives;
- documenting the progress in achieving the cadastre of historical monuments;
- developing a working methodology to achieve topo-cadastral work in accordance with the regulations in force;
- developing a methodology for obtaining and editing final results;
- the need for making a software for the management of historical monuments.

1.The consultation of specialized bibliography and the pre-establishments of a set of specific conceptual delimitations.

The premises of the research started from the first conceptual delimitations provided in Romanian legislation, namely the definitions of art. 3 of Law no. 422/2001 on the protection of historical monuments.

a)monument – a building or part of a building, together with the equipment, artistic components, interior or exterior furnishing elements that are part of these, as well as commemorative and funerary artwork, for public forum, together with the topographically delimited adjoining land, which is of cultural historical testimonies from an architectural, archaeological, historical, artistic, ethnographic, religious, social, scientific or technical point of view;

b)ensemble – a coherent group in terms of cultural, historical, architectural, urban, rural or museum construction, which together with the adjoining land forms a topographically defined unit which constitutes a cultural-historical witness significant from an architectural, town planning, archaeological, historical, artistic, ethnographic, religious, social, scientific or technical point of view;

c)site – a piece of land topographically delimited including those natural human creations that are cultural historical testimonies in terms of architecture, urban planning, archaeological, historical, artistic, ethnographic, religious, social, scientific, technical or cultural landscape.

According to the meanings of legal definitions, the reference works consulted and the proposed for consultation report to the urban and rural architecture in Maramures, the museology and ethnographic museotechnique, history and memoirs of the mentioned area, the archaeological research and specialized archaeological repertoires drawn on localities, bibliography on the preparation of planning documents, as well as works related to the making of the historical monuments cadastre. Wherever possible, there was retained reference works of renowned authors for each of the areas listed. References and sources proposed for consultation give a horizon on the current state of knowledge of the issues referred to members of the mentioned association.

2.The documentation regarding the laws concerning the legal status of the historical monuments, and the introduction of the specialized cadastre. In this respect, we took into consideration the following categories of legislation:
- the European law and European conventions to which Romania joined, as well as the charters, resolutions, declarations and recommendations of specialized international bodies agreed by UN,-UNESCO and CE are also treated as international law although not normative;
- legislation on the legal regime of the monuments, ensembles and archaeological and historical sites available online on the website www.cimec.ro;
- laws concerning the functioning of legal entities responsible for the management of historic monuments available online on the website mentioned; laws on urban and spatial planning available on the website www. mdrap.ro;
- legislation regulating the introduction of the cadastre in Romania, available on the site ANCPI;

3.Evaluating the current state of the documentation of monuments, ensembles and historical sites in terms of management of these categories of objectives. In achieving the proposed objective we consulted the existing documents at Maramures County Directorate for Culture, Cults and Heritage which holds a small part of records files for monuments, ensembles and historical sites listed on LMI 2010. The ranking, representing the legal procedure by which a building access regime for the protection of historical monuments, attested by its inclusion in the List of Historical Monuments, was done on the basis of documents that were submitted to the National Commission for Historical Monuments of the Ministry of Culture and they were not available for documentation at this stage of research.

According to article of the Law no. 422/2001 on the protection of historical monuments, the filing folder includes mainly:
- the technical documentation containing the analytical data sheet inventory, situation plans, a survey of the current building, a photo documentary with interior and the exterior of the building, the surroundings of the site and, where appropriate, data on the use of property and the technical expertise;
- the historical documentation, namely the historical-architectural study drawn up by a specialist certified by the Ministry of Culture in the field of historical monuments;
- the documentation regarding the legal situation containing copies of documents confirming ownership or other real rights over the property or documents issued by local government authorities, together with copies of the cadastral plan of the land register. As a result, a significant amount of the required documentation to make the informational system of the monuments, ensembles and historical sites of mentioned area are founded in these files. Therefore, some of these documents, for reasons of efficiency, can be updated by project promoters with the agreement of the specialized

structures of the Ministry of Culture. By consulting the List of Historical Monuments, LMI 2010, the result is that the historical Maramures area comprises a relatively large number (over 200) of monuments, buildings and historic sites and Sighetu Marmatiei is by far on the first place with more than 100 such targets.

4. Documenting the progress in achieving the cadastre of historical monuments. To achieve this objective of the research, given the large volume of information that is supposed to be managed, we can at this stage propose a methodology of documentation that can be applied in specific cases. Thus, for the sporadic cadastral works relating the notation of buildings qualified as historical monuments, it is necessary to consult the Eterra geoportal of the National Agency for Cadastre and Land Registration (ANCPI), with the last version, Eterra 3, in which the authorized people to perform cadastral works have direct access to the cadastral plan and the information in the land books (within certain limits), both collections of data being updated and available in real time. Thus the authorized person can proceed with the demarcation and communication of an affected area of interest of a historical monument, drawing a polygon within the cadastral plan from the system representing the focused area, communicating the request to the staff of the territorial Cadastre and Land Registration Office BCPI to process the application. The areas of interest can be identified using the eGISpat application. The EGISpat program, conducted through the Ministry of Culture in 2005 to achieve a geographic information system (GIS) for real protection of national cultural heritage (archeology and historical monuments), was the result of a partnership between the Ministry of Culture and ESRI Romania. eGISpat is, as is described by ANCPI, a comprehensive database of registration of the immovable property which stores, analyzes and correlates multiple data types, spatial, non-spatial, cartographic, photographic, etc., in order to obtain the necessary information for decision making in management activities, restoration, conservation and heritage building. For the purposes of information on the list of historical monuments and their location on the map, it can be viewed and used by the general public as an interactive online applications with capabilities of searching a historical monument by the following criteria: LMI 2010 code, city, address, timing, selection by the criterion county and navigation and identification directly on the map using specific instruments. The monuments, ensembles and historical sites are represented as a vector polygon perimeters placed on geographic coordinates. The legend allows loading and unloading the map by checking the thematic layers that compose it: LMI (warning that there are objectives registered in LMI in that locality), ensembles, monuments, sites, inventory, roads, rivers, communes, counties, and towns, each with its distinctive representation. The data provided by Eterra 3 refers to the related works for the registration of a building in the integrated system based on the sporadic works of cadastre and land registry, at the request of some interested people or upon notification by the competent authorities. In case the concerned area is not contained in such records, there is a need of consulting the existing cadastral documents in the current territorial archives BCPI or the National Archives, respectively maps, cadastral plans, land registers and books for the areas around the historical monuments. This procedure can be completed by georeferencing the scanned maps by using a minimum of four checkpoints on the ground and used to determine the location of the boundaries of historical monument buildings. The document also includes other specialized cadastres, an urban cadastre being, for example, developed for part of the historic center of Sighetu Marmației, and for forest areas that include landscaped areas within the surfaces there are required silvic plans and possibly parceled description for the studied area.

5. Developing a working methodology to achieve topo-cadastral work in accordance with the regulations in force. The proposed methodology aims to establish working procedures to be followed in scoring in the land the buildings that are listed as historical monuments. Registering is according to the article 18 from the Annex of Order 700 from 2015 of the ANCPI Director, an entry through which acts, legal facts or legal relations regarding personal rights, status or capacity of persons, in relation to buildings recorded in the land register become opposable to third parties or they are included with informative effect. In the same law is assigned that the registration of the historic or archaeological site quality of a real estate property is nonrestrictive achieved at the request of any interested person (the land owner registered within the land book, bearers of other real rights, the Romanian Government, Ministry of Culture and the county offices for culture and cultural heritage, respectively Bucharest similar offices, the National Commission for Historical Monuments, National Archaeology Commission, the National Commission Museums and Collections, as well as associations and foundations that have as object of activity protecting the historical monuments according to the law or the articles of association, based on the classifying order issued by the Minister of Culture and Religious Affairs and published in the Official Monitor of Romania. The historic monument attribute of a real estate property, in accordance with Law no. 422/2001 on the protection of historical monuments, had to be registered by the owner in the Land Registry, without charge, within 30 days from the date of registration of the Order of Ranking in the Official Monitor of Romania, Part I. In general, the cadastral documentation prepared for the registration in the land registry in the case of historical monuments and archaeological sites are similar of those first the first registration in the integrated system of cadastre and land registry.

Making the cadastral documentation involves the following steps:

- Identification of the location of the real estate on its natural or conventional limits prior to work execution followed by technical documentation which comprises sampling the current situation, according to the records held by the owner, in relation to the existing site elements and also requesting updated information from the database of Territorial Office / District Office.
- Implementation of field and office works involve choosing the method of work followed by the surveying woks to determine the configuration, location and size of the real estate, achieving connection the surveying networks for thickening and lifting, lifting the planimetric cadaster details located on the boundary and inside the real estate,

collecting attributes, verifications and validating existing data. The parcels components of the real estate that have different categories of use will be determined through expeditious methods. The permanent buildings located within the real estate will be represented by their ground level footprint. The kind of fences will also be written down.
- Drawing the analogue and digital documentation –. The digital part will include the site plan and boundaries and also the cpxml file. The analogue file will include a number of standard forms, copy of the classification order, copy of the land book information excerpt real, the coordination inventory of stationing points, the analytical calculation of the land, the technical memorials, topographical description, the area plan and delimitation on an appropriate scale of real estate, surveys of buildings, where appropriate, the framing plan of the real estate, so the property can be located and a property statement regarding the identification of the limits of the measured real estate. From the field practice there can be seen the precarious state or even the lack of geodetic or topographic points from the thickening geodetic network across a real estate classified as a heritage site or near it. These shortcomings can be filled using GPS technology to determine new points using the static method with increased residence time. On these new stationing points determined points, a total station could be set to determine new thickening points through the radiation method. The property regime of the real estates included in the List of historical and archaeological sites is diverse and it creates difficulties in achieving the subsystem of historical sites cadastre. A large part of them are private real estate with various land use categories but formally classified as built historical monuments, architectural ensembles or archaeological sites. The state also owns part of such real estate included in the public or private domain of the territorial administrative units, in some cases the operative management right being entrusted to local councils or museums within the area. Others are owned by institutions of education, culture or religious ones and a small number of such sites are located within the management units of forestry areas. To be noted that Romsilva has introduced a new concept in the forest management in the FSC forest certification system namely high conservation value forests (HCVF) based on six criteria established by the FSC standard. According to the sixth criteria of the mentioned standard, the management of forest areas with essential value for preserving the cultural identity of a community or area, so those areas comprising their perimeter historical monuments or archaeological sites too, is aimed at improving conservation attributes considered at the time of determining these HCVF sites, prohibiting or limiting any forest works.
6. Developing a methodology for obtaining and editing final results. The registering procedure in the Land Book of the historical monument is an approach that has its final aim its inclusion in the integrated system of cadastre and land registry. The drawn up documentation for each real estate classified as a historical monument or archaeological site is subject to approval procedure and reception of specialized cadastral works with the award of a cadastral number. The elaborated result with legal value in this case is the land book information excerpt issued following the opening of a new entry in the land registry. For the mentioned research project there was proposed the drawing of new final works to help the potential applicants for funding applications.
- A code of built heritage for the city of Sighetu Marmatiei which will contain precise regulations establishing the buffer zone for historical monuments, the approval of intervention works as well as responsibilities and recommendations for local urban planning regulations. 3D models drawn in CAD environment for the improvement of the quality of documenting handouts. This requires the introduction of new technologies in the process of documenting the historical monuments such as using digital photogrammetry as well as some specialized software products in digital imaging and processing into formats that can be used in the CAD environment. One such software that does not require large budgetary effort is Photomodeler. The result will be getting the 3D model of the building heritage.
7. The need for making a software for the management of historical monuments. This finding derived from the addressed issues and from the questions of the research is also the main conclusion of the research. At the national level there is no software for the integrated management of historical monuments and the created documents only serve to certain punctual objectives. The EGISpat program mentioned above partially covers the management needs of historical monuments although it is made on GIS platform with the ability to integrate and correlate spatial data and attribute data. It was created as a pilot project of digital mapping of historical monuments and it only covers limited user needs, serving as a medium for public information on the location and configuration of the buildings included in the List of Historical Monuments. From the perspective of the management of monuments, ensembles and historical sites, the realization of a computerized land records on buildings classified as historical monuments is a tool for their effective management. The validation of the research results will be considered as accomplished with the development of the proposed integrated strategy developed by AID ”The Maramures Land”

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Analysis Possibilities of Rocks Breakage by Means of Proportional Hazard Regression

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Abstract

The rock massif is a natural environment difficult to know; the predictions regarding its behaviour are only approximate, even uncertain. The four fundamental features, namely, rock massifs, are natural, discontinuous, heterogeneous and anisotropic environments have multiple consequences and raise really difficult issues in the mining field and generally, in the constructions field. In order to provide quantitative and qualitative the mode of development of the cracks and occurrence of the rocks breakage, respectively the time at which the break occurs, we have proposed a statistical analysis method of the results obtained by laboratory tests using the Cox regression. The importance of this method consists in the fact that there is the possibility to establish the relation between a certain factor through which the breakage can be expected and rock capacity to resist; this method can be applied also in the analysis of the underground works' stability. By means of Cox regression we can determine the relative influences of different factors upon rocks breakage. In this paper it is presented a probabilistic analysis of instantaneous breakage hazard on a number of 18 samples of salt rock from Salt Mine Praid.

Keywords: hazard, breakage, probabilistic analysis, Cox regression, rock, event, time;

1. Introduction

The rock as a whole is a material characterized by a complex and nonlinear behaviour, and often with the manifestation of dilatancy phenomenon under the loads' action. The assessment of behaviour under load of rocks until fracturing involves the determination of the mechanical and deformation characteristics and establishes the characteristic points of the stress - strain curve, and the four stress specific levels (Toderas, 2014). Rock breaking stress is a function of the conditions under which the test is carried out and as a result, it is an inherent property of the rock (Toderaş, 2014). Only the stress levels σ_{if} and σ_{fs} are the independent parameters of test conditions and also the volume of samples; the σ_{fs} stress can be considered as the real rock's strength for uniaxial compressive load, because one l load above this level stress leads to the destruction of the rock which the rock cannot tolerate as a permanent load and σ_{if}, as a stress that defines in fact the dilatancy threshold (or dilatancy limit stress).

2. Cox proportional hazards regression in the analysis of rocks breakage

Cox regression or of the *proportional hazard* was developed for the first time in the medicine and biosciences, but it seems that it began to be applied in a fairly large scale in engineering domain, mainly in the study of the time of rocks breakage. This regression is also called of "proportional hazard" since it is based on the assumption that if the hazard may vary over time, then the hazard functions' ratio remains constant, namely the two hazard functions are proportional to each other (Cox, 1975). Through such regression we can achieve a multivariate analysis, which involves determining the relative influences or effects of different causes (or factors) on a single event, namely the breaking rocks time. The importance of the effect that a parameter or a characteristic of rock has on hold time until the failure can be highlighted by hazard rate (or risk rate) (HR), determined on the basis of risk (hazard) (Barlow, 1994-1999).

As compared to the definition of risk factor given for the first time by Barlow (1963), we also define this notion from the viewpoint of rock mechanics. We consider a range of time whose lower limit is different from zero (time

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sufficiently low where breakage can appear and big enough in which a rock sample can resist until breakage); than the coefficient of risk is defined as the probability per unit time of a considered interval in which a rock sample did not break under the action of load which it has undergone, but will break at the time t belonging to this range. In other words, the risk coefficient can be determined as the ratio of the number of defects per unit time from considered interval and the average specimens of the same type of rock from which no breakage was recorded at the time value corresponding to the middle of pre-established time range. The hazard (the risk) and the probability that material system resists and does not register breakage are two interrelated concepts, the correlation of these being complex; through this there is the possibility to establish one parameter using the other. If the risk is constant for the whole period of study, it seems that this one is independent of the length of time where the material system (the rock) had enough internal cohesion to withstand, namely to oppose of the applied effort.

For example, in case of uniaxial compressive loads of rock samples, after the effort applied exceeded the threshold of dilatancy or the fracturing - fragmentation stress, a rock with lower strength would have the same risk of breakage' manifestation as a higher strength rock. In case of creep tests, a rock sample mentioned under load, on stress degree of (0.7 – 0.85) σ_{rc}, for a period of 10 days would present the same risk of breakage in the next immediately moment (in a very short time) like a rock sample that was mentioned under load at the same stress degree for a period of 30 days.

An approach as close to reality regarding the constancy of hazard is to eliminate any possible assumption and determine this characteristic based on the results of the laboratory tests (or measurements in situ, if we analyze the situation of stability of rock contours around underground works); an assumption regarding this parameter would not be fair and would involve significant errors. Therefore, for a given type of rock it would be necessary that relative hazard to be considered as a particular combination of the values of variables with significant weight at a certain moment of time. The relative hazard is defined as the ratio of hazard for combining those variables at a given time and the hazard for the same time of a hypothetical sample (ideal model) whose values are all equal to 0 for predictive variables (Lin, 1994, Spiekerman et al., 1998). Such a phenomenon is known as "basic hazard" and it is a virtual notion, namely in case of rocks we could assume that such a sample would exist, but "ideal" term in this situation will eliminate a number of parameters or factors (as variables) that have significant influence in the development and manifestation of breakage.

For the reason that miscalculation of breakage probability and respectively of breakage risk to be as small as it should, it would be necessary that each time at least 30 samples of the same rock type to be analyzed. The breakage of rocks could be analyzed by means of two models: Cox's proportional hazards model and the Cox proportional hazards model with time-dependent covariate. From the point of view of mechanics rocks, we define the function of hazard as the risk that a rock to break away in a very short time *dt*, after a certain period of time T (assuming that until that moment the rock resisted).

Through regression or the Cox model we can estimate the effect of using a method of strengthening or improve the strength characteristics of rocks on their contour in case of underground works chosen in accordance with other independent variables (or factors) and we have the opportunity to estimate the breakage hazard (or risk) or other event (or phenomenon) that would be interest, given their prognostic variables. In the case when the analyzed rock samples (samples which have been submitted to an improvement in the mechanical properties and the sample witness) are similar in terms of known variables that influence the ability of their resistance, the Cox model used for these variables will produce a more precise estimation of the effect of increasing rock strength (Gorunescu, 2013 & Gorunescu et.al., Schoenfeld, 1982, Hinkle, Wiersma & Jurs, 1994).

3. Results and discussions

In the Laboratory of Geomechanics of the University of Petrosani it has been studied a number of 37 salt cylindrical samples, having the fineness ratio $\lambda \cong 1.5$; the tests were conducted at monoaxial compression, following also time at which the breakage of salt samples was manifested.

Taking into account the number of samples submitted to the tests, we have chose a number of 18 salt samples for which we have realized the statistical analysis of the influence way of the rock strength on the breakage time. Analysis can be done either by t-test or using the ANOVA (Armitage P., Berry G., 1994; Kleinbaum et.al., 1998) techniques or by dispersion analysis, respectively analysis of variance.

t-test is somehow limited because of realising only a comparison of the differences between two groups. On the other hand, if we have a larger number of independent variable levels, then is necessary to apply other techniques such that the effect of independent variable on the dependent once being expressed by a higher degree of fineness (Hinkle, Wiersma & Jurs, 1994), for example the ANOVA technique.

To apply this technique, the first stage was to identify the possible method to be applied; available data are quantitative, thus the problem is reduce the comparison of the averages of two populations (the time when the breakage occurs and the monoaxial compressive breaking strength of salt samples). The fact that the analysis of these data proves that the two averages are different, means that we can apply the analysis of variance with one factor.

Table 1 presents the results obtained by statistical processing of experimental data, applying the ANOVA analysis of variance, simple or unifactorial (single factor).

Table 1. Summary output and ANOVA analysis Single Factor

			SUMMARY			
Groups	Count	Sum	Average	Variance		
Time until breakage	18	2870	159.4444	21162.56		
Compressive breaking strength	18	1142.286	63.46035	2935.414		
			ANOVA			
Source of Variation	SS	Df	MS	F	P-value	F crit
Between Groups	82916.5129	1	82916.51	6.880762	0.012949	4.130018
Within Groups	409716.4878	34	12050.48			
Total	492633.0007	35				

In table 1, in the area SUMMARY are mentioned the data related to the two populations: number of units from each population, namely 18; the amount for each population; variance of population. It is observed that the smallest average and the highest dispersion were registered in terms of compressive breaking strength. In the area ANOVA from table 1 is computed the statistics F for the unifactorial variance analysis, its value being 6.880762.

Because $F_{calculated} = 6.880762 > F_{crit} = 4.130018$, it follows that we reject the null hypothesis H_0 and accept the alternative hypothesis H_1 as a true one. Therefore, it can be said with a probability of 95 % that the compressive strength of salt samples influence significantly time variation until their breaking occurs.

For a confidence associated range, equal to 0.05 %, the hazard rate depends of the compressive breaking strength value of salt. Applying Cox regression method, considering as interest variable the value of compressive strength and the other variables constant, for the Cox regression the hazard rate shows that the variation of this characteristic value leads to the change of hazard rate. The calculus showed a hazard rate HR = 3.01 > 1, which means that decreasing compressive breaking strength leads to increased risk of occurrence of breakage and reduce the time of manifestation of this phenomenon (p-value = 0.1234). In figure 2 is show the Cox curve obtained from processing of experimental results.

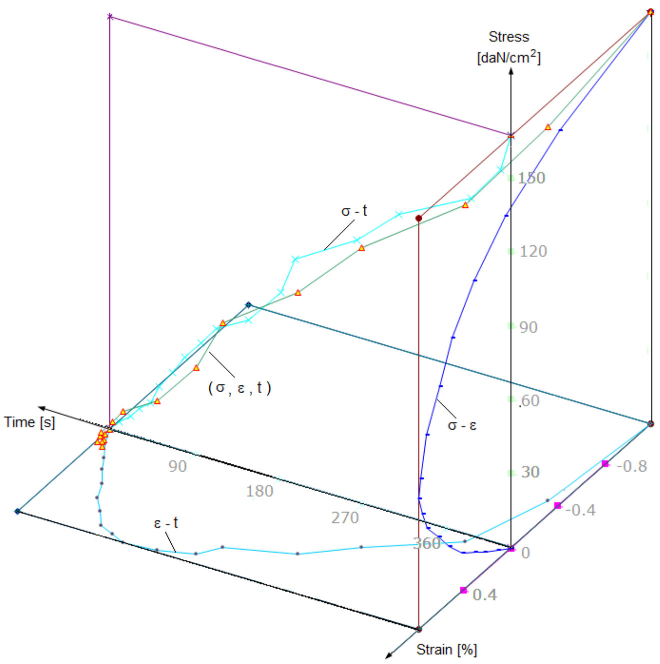

Fig. 2. The curve of Cox proportional hazard model

In horizontal plan, the Cox curve projection express the strains variation corresponding to the breaking time of salt samples; the Cox curve projection in lateral plan express the strains variation corresponding to appearance of breakage related to compressive strength. The results obtained by means of Cox proportional hazard model are in accordance with the nomogram for evaluation of behavior at deformation under load of rocks until the occurrence of breakage (Toderas, 1999).

4. Conclusions

Salt presents a specific behavior under the effect of cracking phenomenon. Preexisting cracks or the ones caused by stresses could be developed and microscopically determine a change in volume, namely the dilatancy; the fissuration phenomena is irreversible. Dilatancy is a phenomenon that constitutes the effective indicator of the occurrence of cracking, leading to a significant increase of permeability of salt and consequently to diminish its initial tightness; therefore it can't be neglected in stability analysis of underground works executed in salt massive (Toderaş, 2003, 2016).

Through regression or Cox model we can estimate the effect that in case of underground works, the applicability of consolidation method or improvement of rocks resistance characteristics on their contour, chosen in accordance with other independent variables (or factors) and so, we have the possibility to estimate the hazard (or the risk) of breakage or other event (or phenomenon) that would present interest, given their prognostic variables. As higher the hazard is, the risk of breakage is higher. Other factors could also interfere here, and that could determine another event that could be produced (for example a growth of temperature or humidity, in case the analyzed sample is a salt one).

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Increasing the quality of protections for high-voltage power lines

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Abstract

Continuous increase in power of energy systems, development in high-voltage networks, and increased complication of phenomena occurring in electrical systems during short-circuits, required studies and raised important issues for electrical engineers worldwide. These include the study on fault phenomena, development of calculation methods, of new protection and construction principles for relays, which to ensure the location and immediate liquidation of short-circuits.

Special attention has been granted to the quality of relays schemes, in terms of clarity and correctness, because there are widely known the adverse consequences which these type of faults may have upon the protection by relays. The main aim of automation and protection by relays used in electro-energetics consists in limiting the effect of faults occurred and in ensuring the continuous power supply of consumers, without interruption.

This paper deals with the replacement of protections from aerial high-voltage power lines, made of contact relays with exceeded life-cycle, with modern numerical relays which comprise protections required for the system's full safety operation.

Keywords: electric protection; power line; quality; numerical relay; high-voltage;

1. Introduction

For ensuring the continuous control of operation regimes for electrical installations and for automatic liquidation of faults and hazardous regimes, protection through relays has to include several elements within its structure, described in the following.

A first group of elements is represented by input elements which receive from current and voltage transformers information on the operation regime of the protected installation, these information are values and phase shifts of currents and voltages measured by current and voltage transformers. Input elements fulfil filtering, amplification or additional values determination functions, obtained using currents and voltages received from measurement transformers. Therefore, for example, input elements may contain symmetrical components filters or superior harmonics filters, required for proper operation of several types of protection (Florea and Loga, 2013; Petrilean et al., 2015).

A second group of elements is represented by processing and decision elements which receive certain values from the input block and process them, performing logical and calculation operations for establishing if a fault exists or not within the protected installation. If a fault is detected, processing and decision elements (representing the processing and decision block) transmit to the elements from the next block the decision for starting the switches of the protected installation.

The third group is represented by output elements, representing the output block. Elements of this block aim to ensure enough power for commanding the start of the switches from the protected installation and for transmitting the required signals.

Protection by relays mainly aims to detect the fault and disconnect the damaged element, in order to avoid the extending of the fault and for returning as soon as possible to the normal operation regime for the rest of elements of the system which are still in operation (Cioca and Moraru, 2012; Moraru et al., 2013). For fulfilling the aimed purpose, protection by relays has to fulfill the following qualities:

- Rapidity – the protection has to disconnect the damaged element as shortly as possible.

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- Selectivity – the protection has to disconnect only the damaged equipment by starting its switches, every other part remaining in operation.
- Sensitivity – the protection has to start for deviations as low as possible compared to the normal value of the physical parameter controlled. Therefore, a protection by current relays will be more sensitive as it will start for current values deviations as low as possible compared to the normal value through the circuit.
- Reliability – the protection's property to notice the fault for which it was designed and not to have starting rejections (operation safety at the occurrence of operation conditions) or false drives (safety to unexpected operations).
- Electromagnetic compatibility – the property of protection installations not to interfere with electromagnetic fields and not to generate electromagnetic perturbations in the surrounding environment.
- Communication – the property of the protection equipment to exchange information with the human operator for balancing driving parameters, obtaining values of controlled parameters and data on the fault values.
- Self-surveillance – the property of the equipment to permanently test its state and to signal any fault which may lead to improper operation.

Self-testing, communication and reliability increase by periodical auto-testing and permanent self-surveillance may be achieved only for protection installations designed with numerical technology (Pasculescu and Niculescu, 2015; Pasculescu et al., 2011).

Issues presented and solved within the current paper have been designed in order to capture the main aspects on the possibilities to implement modern protection installations in high-voltage networks from the national power system, based on the analysis of old or modern equipment from the system's stations or the ones which can be found internationally (Pasculescu et al., 2015; Suvar et al., 2015; Vlasin et al., 2013).

Although several types of maximal current protection exist, depending on the starting element's type, on the manner for choosing the start current or on the fact that the protection is operated delayed or not at the occurrence of a short-circuit, several facts will be detailed in the following.

2. Undelayed maximal current protection

The start current of the protection is chosen so that the protection starts when the short-circuit current for a short-circuit occurring in the protected area reaches the lowest possible value ($I_{sc.min}$).

$$I_{pp} = I_{sc.\min} \qquad (1)$$

In this case, at the occurrence of a short-circuit, regardless its place within the protected area, the protection commands the start of the switch and the fault is liquidated. The fault liquidation time is given by the own time of the current relay plus the switches starting time – Figure 1.

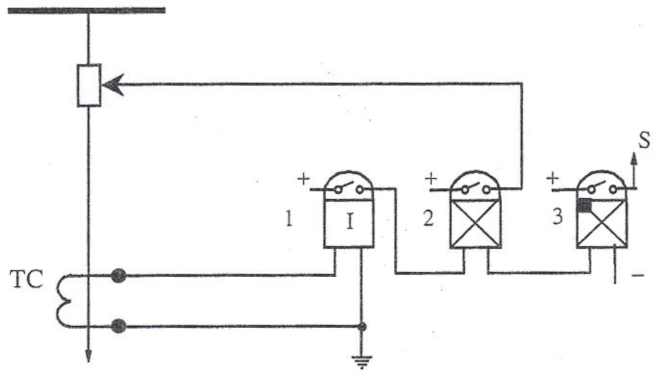

Fig. 1. Schematic diagram of the undelayed maximal current protection

3. Delayed maximal current protection

The schematic diagram is presented in Figure 2 and comprises besides the current relay one time relay which artificially achieves the required delay for starting the switch only if the current from the primary circuit is maintained higher than I_{pp} for more time than the established delay. The delays is constant and does not depend on the short-circuit value.

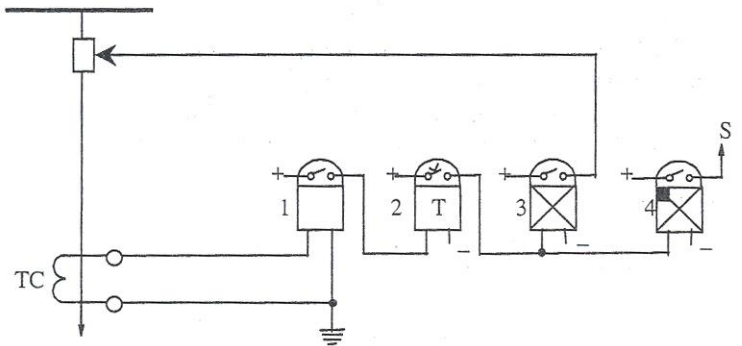

Fig. 2. Schematic diagram of the delayed maximal current protection

4. Delayed maximal current protection with minimum voltage blocking

Compared to the delayed maximal current protection, this protection also comprises a minimum voltage relay which allows transmitting the impulse from the starting element to the delaying element only if the voltage in the area of the protected element is lower than a certain value established – Figure 3.

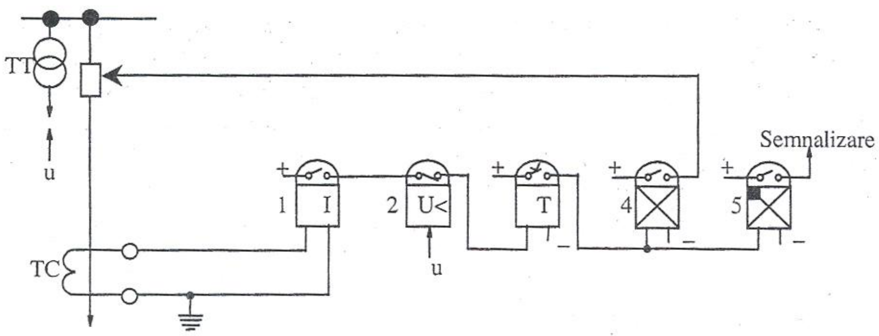

Fig. 3. Schematic diagram of the delayed maximal current protection with minimum voltage blocking

5. Undirected maximal current protection

Significant increase of current intensities over the phases provides a simple and relatively easy criterion to be implemented within numerical protection terminals.

The logical diagram equivalent with a software implementation is presented in figure 4.

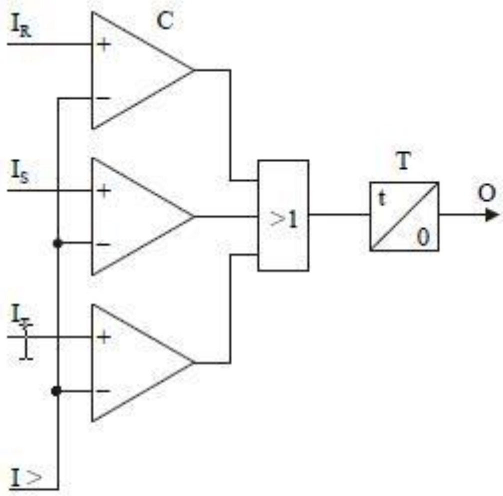

Fig. 4. Undirected maximal current protection

in which: IR, IS, IT values of current intensities over the phases,

I > established starting current,

C comparators,
T timing element with starting delay.
Output O of the maximal current protection is assigned to the triggering logic.
In case of an instant maximal current protection, the logical diagram equivalent to a software implementation is modified according to Figure 5.

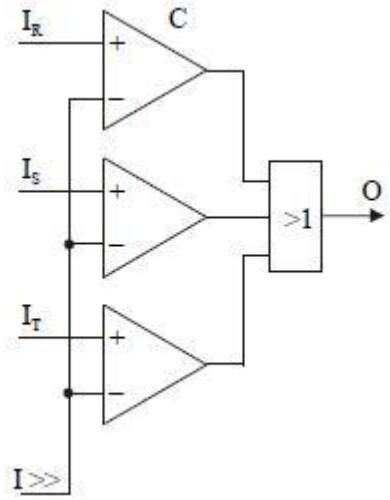

Fig. 5. Instant maximal current protection

The significance of the symbols is similar to the ones presented in Figure 4, and I >> represents the established starting current for this type of protection.

6. Directed maximal current protection

High voltage networks usually operate in loops. Therefore it is required to add a directional element to a maximal current protection, which to allow the start of the protection only for a fault current's circulation from the bars to the lines. The logical diagram equivalent to a software implementation is presented in Figure 6.

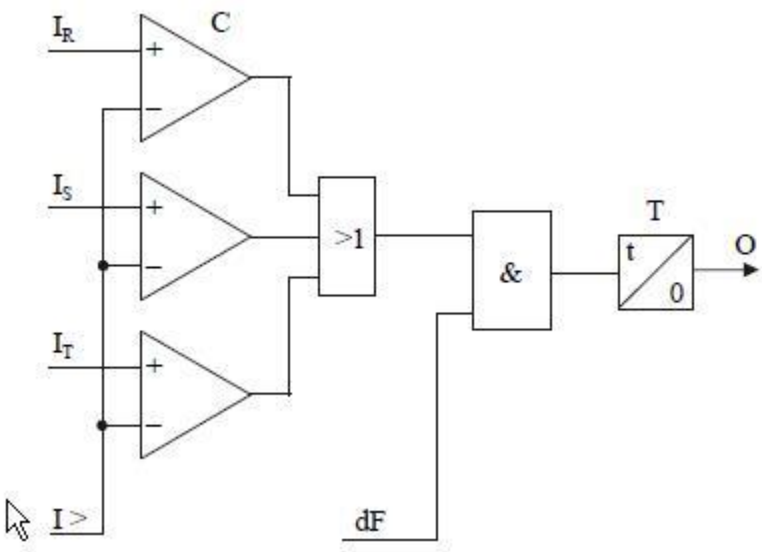

Fig. 6. Directed and delayed maximal current protection

7. Conclusions

Numerical protection systems with modern IT techniques ensure the efficient operation of the entire protection management and control system, which is an essential contribution to safe power supply (Buica et al., 2016; Magyari et al., 2014; Magyari et al., 2015)

Due to the many qualities of the numerical protection systems, it has the following advantages compared to the classical protection with contact relays:

- it removes starting delays of the protections due to the mobile elements of classic protection relays;
- it removes operation deficiencies caused by imperfect contacts of classic relays;
- high sensitivity, rapidity and reliability compared to classic relays used so far for protection schemes;
- feature for detecting faults occurring in electrical installations;
- time for which minor faults persist are shortened and therefore the faults of protected elements are almost insignificant;
- periods in which the faults are rectified are shortened due to the fact that the numerical protection system provides the user with the diagnose of the occurred fault by recording every event from the initiation of the protection functions to the decoupling of the faulty element from the electrical installation.
- the numerical protection system requires a smaller location space compared to the contact relays protection system. Classic relays required for contact relays protection being usually in large number require more cabinets than the numerical system which can be mounted in one, two or three cabinets, depending on the protected electrical installation.
- it removes non-functionalities caused by periodical prophylactic verifications of classic relays protections (classic relays are dismounted, checked, there are established their setting values for which the contacts have to be shut required for signalling and starting within the laboratory, and afterwards are mounted within the cabinet of the protection after developing the verification reports) and these verifications are replaces with simple periodical tests of the numerical equipment for viewing the initial settings;
- it provides a larger range of protection functions, some of them which cannot be applied using conventional relays (i.e. the function for balancing two voltages or the over-temperature function by developing the thermal table etc.)

Qualities of numerical protection systems, of complex automation and computers for tracking events have important influence on the decrease of staff from a power station. Its structure is modified by decreasing the number of exploitation staff and increasing the number of staff for maintenance with a number of specialists who shall maintain in operation the electronic and automation operation.

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Implementation of new tools to calculate dispersed volume of combustible gases to achievement classification of hazardous areas

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Abstract

Area classification is a method of analysing and classifying the environment where explosive gas atmospheres may occur so as to facilitate the proper selection and installation of apparatus to be used safely in that environment, taking into account gas groups and temperature classes.
Implementation of new tools to calculate dispersed volume of combustible gases account a upgrading research methods concerning the classification of hazardous areas. Efficient and quick execution calculation of the dispersed volume for gases or vapours which can form explosive mixtures in the process of determining the classification of hazardous areas, can be achieved by using a software application.
Using software tools as alternatives to old methods of calculation, we'll save time and we’ll reduce operating costs to calculate dispersed volume of combustible gases from various sources of release. In addition we could do various analyzes or studies regarding dispersed volume of gases for different types of plants.

Keywords: explosive gas atmosphere, hazardous area, source of release

1. Introduction

In areas where dangerous quantities and concentrations of flammable gas or vapour may arise, protective measures are to be applied in order to reduce the risk of explosions.

Installations in which flammable materials are handled or stored should be designed, operated and maintained so that any releases of flammable material, and consequently the extent of hazardous areas, are kept to a minimum, whether in normal operation or otherwise, with regard to frequency, duration and quantity. It is important to examine those parts of process equipment and systems from which release of flammable material may arise and to consider modifying the design to minimize the likelihood and frequency of such releases and the quantity and rate of release of material.

These fundamental considerations should be examined at an early stage of the design development of any process plant and should also receive prime attention in carrying out the area classification study. In the case of maintenance activities other than those of normal operation, the extent of the zone may be affected but it is expected that this would be dealt with by a permit-to-work system.

In a situation in which there may be an explosive gas atmosphere, the following steps should be taken:

- eliminate the likelihood of an explosive gas atmosphere occurring around the source of ignition, or
- eliminate the source of ignition.

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The amount of explosive atmosphere that can be considered dangerous outdoor may be evaluated from case to case. (Dobrescu I, 1987)

2. Area classification objectives

In most practical situations where flammable materials are used, it is difficult to ensure that an explosive gas atmosphere will never occur. It may also be difficult to ensure that apparatus will never give rise to a source of ignition.

Area classification is a method of analysing and classifying the environment where explosive gas atmospheres may occur so as to facilitate the proper selection and installation of apparatus to be used safely in that environment, taking into account gas groups and temperature classes (60079-0, 2010). It is rarely possible by a simple examination of a plant or plant design to decide which parts of the plant can be equated to the three zonal definitions (zones 0, 1 and 2). A more detailed approach is therefore necessary and this involves the analysis of the basic possibility of an explosive gas atmosphere occurring.

The first step is to assess the likelihood of this, in accordance with the definitions of zone 0, zone 1 and zone 2. Once the likely frequency and duration of release (and hence the grade of release), the release rate, concentration, velocity, ventilation and other factors which affect the type and/or extent of the zone have been determined, there is then a firm basis on which to determine the likely presence of an explosive gas atmosphere in the surrounding areas (60079-10-1, 2004).

This approach therefore requires detailed consideration to be given to each item of process equipment which contains a flammable material, and which could therefore be a source of release.

In particular, zone 0 or zone 1 areas should be minimized in number and extent by design or suitable operating procedures. In other words, plants and installations should be mainly zone 2 or non-hazardous. Where release of flammable material is unavoidable, process equipment items should be limited to those which give secondary grade releases or, failing this (that is where primary or continuous grade releases are unavoidable), the releases should be of very limited quantity and rate. In carrying out area classification, these principles should receive prime consideration. Where necessary, the design, operation and location of process equipment should ensure that, even when it is operating abnormally, the amount of flammable material released into the atmosphere is minimized, so as to reduce the extent of the hazardous area.

Once a plant has been classified and all necessary records made, it is important that no modification to equipment or operating procedures is made without discussion with those responsible for the area classification. Unauthorized action may invalidate the area classification. It is necessary to ensure that all equipment affecting the area classification which has been subjected to maintenance is carefully checked during and after re-assembly to ensure that the integrity of the original design, as it affects safety, has been maintained before it is returned to service.

The basic elements for establishing the hazardous zone types are the identification of the source of release and the determination of the grade of release.

Since an explosive gas atmosphere can exist only if a flammable gas or vapour is present with air, it is necessary to decide if any of these flammable materials can exist in the area concerned. Generally speaking, such gases and vapours (and flammable liquids and solids which may give rise to them) are contained within process equipment which may or may not be totally enclosed. It is necessary to identify where a flammable atmosphere can exist inside a process plant, or where a release of flammable materials can create a flammable atmosphere outside a process plant.

Each item of process equipment (for example, tank, pump, pipeline, vessel, etc.) should be considered as a potential source of release of flammable material. If the item cannot contain flammable material, it will clearly not give rise to a hazardous area around it. The same will apply if the item contains a flammable material but cannot release it into the atmosphere (for example, an all-welded pipeline is not considered to be a source of release).

If it is established that the item may release flammable material into the atmosphere, it is necessary, first of all, to determine the grade of release in accordance with the definitions, by establishing the likely frequency and duration of the release. It should be recognized that the opening-up of parts of enclosed process systems (for example, during filter changing or batch filling) should also be considered as sources of release when developing the area classification. By means of this procedure, each release will be graded either "continuous", "primary" or "secondary".

3. New tools to calculate dispersed volume of combustible gases

The hypothetical volume V_Z gives a guide as to the volume of flammable envelope from a source of release but that envelope will not normally equate to the volume of the hazardous area. Firstly, the shape of the hypothetical volume is not defined and will be influenced by ventilation conditions. The degree and availability of ventilation and possible variations in these parameters will influence the shape of the hypothetical volume. Secondly, the position of the hypothetical volume with respect to the source of release will need to be established. This will primarily depend on the direction of ventilation with the hypothetical volume biased in the down-wind direction. Thirdly, in many situations, (for example, outdoor conditions), account must be taken of the possibility of varying directions of ventilation.

Thus the volume of hazardous area from a given source of release will generally be several or even many times larger than the hypothetical volume V_Z (60079-10-1, 2004).

To ascertain the hypothetical volume, it is necessary to first establish the theoretical minimum ventilation flow rate of fresh air to dilute a given release of flammable material to the required concentration below the lower explosive limit. This can be calculated by means of the equation:

$$(dV/dt)_{min} = \frac{(dG/dt)_{max}}{k \times LEL_m} \times \frac{T}{293} \qquad (1)$$

where

$(dV/dt)_{min}$ is the minimum volumetric flow rate of fresh air (volume per time, m^3/s);

$(dG/dt)_{max}$ is the maximum rate of release at source (mass per time, kg/s);

LEL_m is the lower explosive limit (mass per volume, kg/m^3);

k is a safety factor applied to the LEL_m; typically:

$k = 0,25$ (continuous and primary grades of release)

$k = 0,5$ (secondary grades of release);

T is the ambient temperature (in Kelvin, K).

In order to calculate dispersed volume of combustible gases, we use a software application. This application is a mathematical model of a flammable gas jet that can be used as part of a hazardous area classification exercise under the Dangerous Substances and Explosives Atmospheres Regulations (DSEAR). It can model a wide range of flammable gases either in a ventilated enclosure or outdoors.

The model was originally developed for calculating the flammable gas cloud volume (Vz) as a scientifically based alternative to the method described in the international standard on area classification (IEC60079:10-1).

Software aplicattion (fig. 1) is easy to use, quick to run and allows the user to obtain realistic estimates of Vz for a given gas, pressure and hole size. The model can take into account the effects of ventilation by specifying the room volume and ventilation rate. It also provides estimates of the ventilation rate of naturally ventilated enclosures through a relatively simple model based on the effects of buoyancy and wind driven ventilation (Quadvent brochure, 2011).

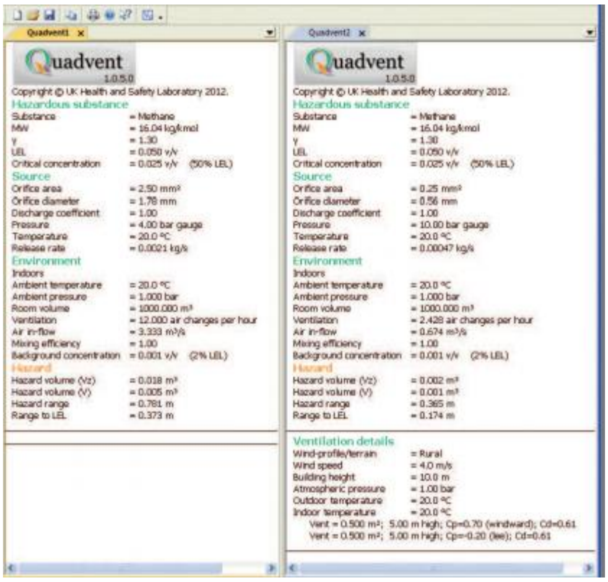

Fig. 1 Software aplication to calculate dispersed volume of combustible gases

The model has been published in a peer-reviewed journal and validated against a detailed data set for gas releases in a ventilated enclosure. The software has undergone a rigorous testing programme (http://www.hsl.gov.uk/products/quadvent), to ensure that it is a robust and valid instrument for hazardous area classification.

The software contains:

- a model of a gas jet released within a ventilated building or outdoors,
- a model for estimating the natural ventilation rate of a building
- a list of basic substance properties, as well as a comprehensive help system to assist with using the program.

4. Conclusions

When performing hazardous areas classification the first step to do is identify the sources of release and analyzing them to know the type or level of release, (continuous, primary or secondary grade release).

An important factor that has influence on dispersed volume of combustible gases is release flow which depends on other parameters such as geometry release source, velocity of release, concentration of flammable vapors.

Dispersed volume of combustible gases Vz described in the international standard on area classification, IEC60079:10-1 is at present approached by mathematical calculation. Documentation on technical analysis regarding the implementation a new tools of dispersed volume of combustible gases in the classification of hazardous areas, highlighted usefulness and need for new calculation tools, software tools, that will save time and operating costs.

Software application is a mathematical model that uses a database for gas releases in a ventilated enclosure. It also contains a model of a gas jet released within a ventilated building or outdoors, a model for estimating the natural ventilation rate of a building, a list of basic substance properties, as well as a comprehensive help system to assist with using the program.

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Renewable energy as a chance to get out of energy poverty on the example of Poland and Romania

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Abstract

This article aims to present renewable energy as a chance to reduce household spending on heating or solid fuels, and thus reduce energy poverty. This issue is important not only in Poland but also in other EU countries. The paper will present statistical data on deriving energy from renewable sources and the progress in their implementation in Poland and Romania against the EU guidelines.

Keywords: renewable energy, energy poverty

The aim of the article is to present renewable energy as a chance to reduce household spending on heating or solid fuels, and thus reduce energy poverty. The issue is important not only in Poland but also in other EU countries. The article will present statistical data concerning on deriving energy from renewable sources and the progress in their implementation in Poland and Romania against the European Union guidelines.

Energy poverty is an important problem of the governments of numerous countries, including Poland or other EU countries. Most frequently the phenomenon affects smaller places and people from so-called socially sensitive groups. In accordance with Article 3 sections 13c and 13d of the Energy Law Act (Journal of Laws, 1997), the notion of a sensitive user of electricity and gas fuels is introduced.

For the first time, the problem of energy poverty was noticed and defined in Great Britain where it was assumed that a household is in the situation of energy poverty when it has to allocate more than 10% of its income to maintain the sufficient level of heating (Figaszewska, 2016). The definition also included the expenditure on energy used for those purposes, namely, heating water, lighting, cooking, the use of appliances (Szczerbowski, 2016).

According to the statistical data, in 2012 the population of Poland made up 7.7% of the total population of the EU-27 countries, which meant the 6th position, and for Romania the 7th position among the EU countries. The number of households in Poland accounted for 6.4% of the households in total in the EU-27 countries, which also gave it the 6th position, and Romania occupied the 8th position among the European Union states. The average number of people in the household in Poland was 2.8 and 2.9 in Romania, and was higher than the average in the European Union which was 2.3 persons (Energy Consumption in Households in 2012).

An increase in the prices of energy, gas or heat is becoming a social problem faced by the users on the energy, gas, heat market, including socially sensitive users. It may lead to the revelation of the phenomenon and growth of the scale of energy poverty (Figaszewska, 2016).

In 2007 the European Union introduced a separate project co-financed by the European Commission, *European Fuel Poverty and Energy Efficiency Project - EPEE*. It was noticed that energy poverty is becoming a more and more serious problem in the EU states. It is estimated that from 50 to 125 million of citizens in Europe are affected by energy poverty, and it is forecasted that the number may grow with the increasing energy prices.

In the structure of household spending on energy in Poland, relatively a lot is spent on heating and solid fuels (coal). According to the statistical data, spending on energy carriers in Poland account for about 11.5 % of the total costs of the maintenance of households in 2014. We can also indicate socio-economic groups where this share reaches more than 15%, namely retirees and pensioners. In the European scale, this level is one of higher - we are just behind Slovakia, Hungary, Romania and the Czech Republic (Kurowski, 2012).

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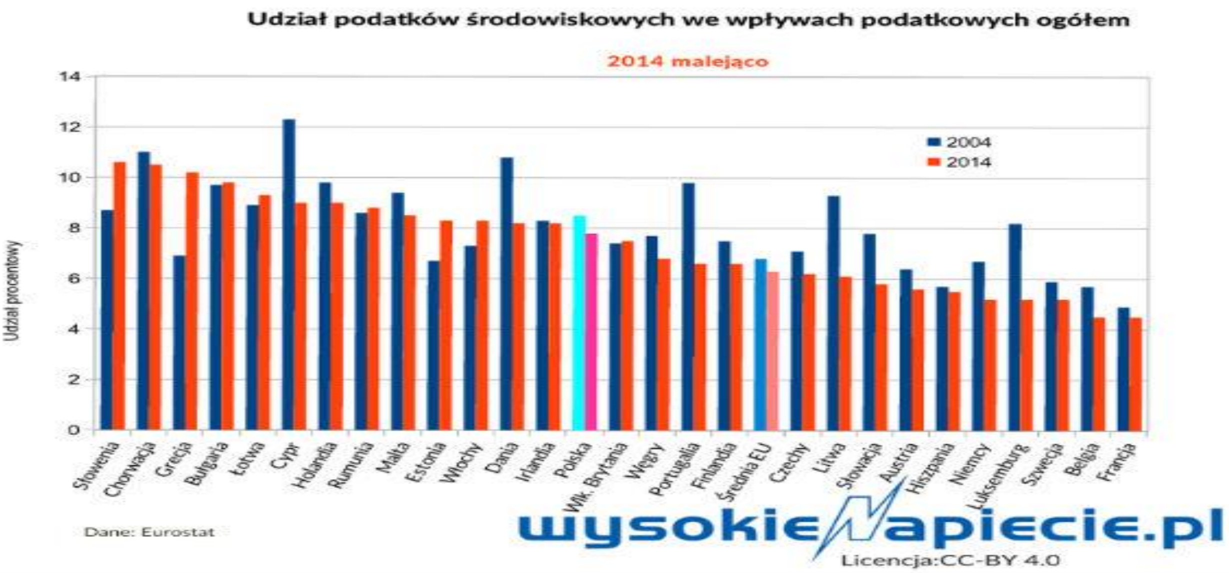
The electricity, gas price for households includes, in addition to the basic price, VAT and other taxes, also environmental ones (Energy, 2016). For statistical purposes, four types of environmental taxes are distinguished - energy tax (including CO2 emission taxation), transport, pollution emission and resource exploitation tax. In 2014 energy taxes made up 76.5% of the totality, transport taxes - 19.9%, and the two remaining categories gave jointly 3.6% of the revenues (WysokieNapiecie.pl). The share of environmental taxes in total tax revenues is presented in Fig. 1.



Udział podatków środowiskowych we wpływach podatkowych ogółem - The share of environmental taxes in total tax revenues
Udział procentowy - Percentage share
2014 malejąco - 2014 descendingly
Słowenia - Slovenia Dania - Denmark Hiszpania - Spain
Chorwacja - Croatia Irlandia - Ireland Niemcy - Germany
Grecja - Greece Polska - Poland Luksemburg - Luxembourg
Bułgaria - Bulgaria Wlk. Brytania - Great Britain Szwecja- Sweden
Łotwa - Latvia Węgry - Hungary Belgia - Belgium
Cypr - Cyprus Portugalia - Portugal Francja - France
Holandia - The Netherlands Finlandia - Finland
Rumunia - Romania Średnia EU - EU average
Malta - Malta Czechy - Czech Republic
Estonia - Estonia Litwa - Lithuania
Włochy - Italy Słowacja - Slovakia
Dane: Data Austria - Austria

Fig. 1 The share of environmental taxes in total tax revenues
Source: www.wysokienapiecie.pl

The new EU policy on energy and the environment, which was agreed by the European Council in March 2007, establishes the perspective programme of political actions aiming at the accomplishment of three main objectives of the community energy policy, namely the sustainable production of energy, as well as competitiveness and the security of supplies. In order to implement those objectives, the EU committed itself to fulfilling by 2020 the "20-0-20" targets, that is to reducing emissions of greenhouse gases by 20%, increasing the share of renewable energy in the total energy consumption to 20% (currently the share is 8.5%), and to raising energy efficiency by 20%. Owing to the adoption of the "20-20-20" package, the EU and its members undertake actions towards more sustainable, secure and more new-technology based energy policy (Kurzak, 2010). Additionally, reaching at least 10% share of biofuels in the sales of transport fuels (Directive 2009/28/EC). For the subsequent years, the following are stipulated:

- 2020-2025 – the commencement of the production of electricity with the use of photovoltaic cells for a large scale, and the production of the second-generation bioethanol, second-generation biodiesel and biohydrogen (according to Energy Policy of Poland until 2030),
- 2030 - in accordance with the EU document ("Action plan for emission economy by 2050") the CO2 reduction is to amount to 40%,
- 2040 - according to this document, the reduction is to be 60%,
- 2050 - the EU roadmap provides for the carbon dioxide emissions at the level of 80-95%.

Energy from renewable sources stands for energy coming from natural, repetitious natural processes, derived from renewable non-fossil sources of energy (water, wind, solar energy, geothermal energy, energy from wave, ocean currents and tidal energy, as well as energy produced from solid biofuels, biogas and liquid biofuels, and energy of the surroundings (natural environment) used by heat pumps. Renewable energy sources are an alternative to traditional primary non-renewable energy carriers (fossil fuels). Their resources replenish in natural processes, which in practice allows to treat them as inexhaustible. Moreover, deriving energy from these sources, in comparison with traditional (fossil) sources, is more environmentally friendly. To a great extent, using renewable energy sources decreases the harmful impact of power industry on the natural environment, mainly through the reduction of the emissions of harmful substances, particularly greenhouse gases. In the domestic conditions, energy from renewable sources includes energy coming from sunlight, water, wind, geothermal resources, as well as energy produced from solid biofuels, biogas and liquid biofuels, and energy of the surroundings generated through heat pumps. The scope of the use of energy from renewable sources in the European Union member states is regulated by adequate EU documents and normative acts establishing general and detailed targets concerning the obligation to achieve the set indicators of the share of energy from renewable sources in gross final consumption of energy (Energy from renewable sources, 2015).

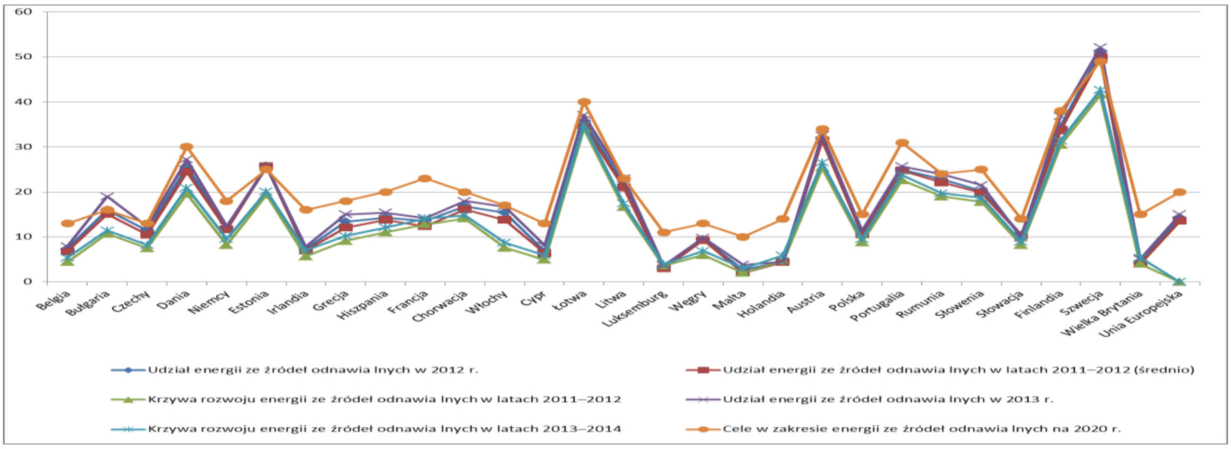
According to the renewable energy progress report published in June 2015 (Progress towards the EU's 2020), the progress of the member states towards achieving renewable energy targets for 2020 is successive. Table 1 presents Poland's and Romania's progress towards achieving 2020 renewable energy targets.

Table 1 Poland's and Romania's progress towards achieving 2020 renewable energy targets.

Country	Share of energy from renewable sources	Share of energy from renewable sources in the years 2011–2012 (on average)	The curve of development of energy from renewable sources in the years 2011–2012	Share of energy from renewable sources in 2013	The curve of development of energy from renewable sources in the years 2013–2014	Renewable energy targets for 2020
Poland	10.9	10.6	8.8	11.3	9.5	15.0
Romania	22.8	22.1	19.0	23.9	19.7	24.0
European Union	14.3	13.6	not applicable	15.0	not applicable	20.0

Source: *Eurostat for 2013, 2012*

Figure 2 presents the progress of all EU member states in achieving renewable energy targets for 2020.

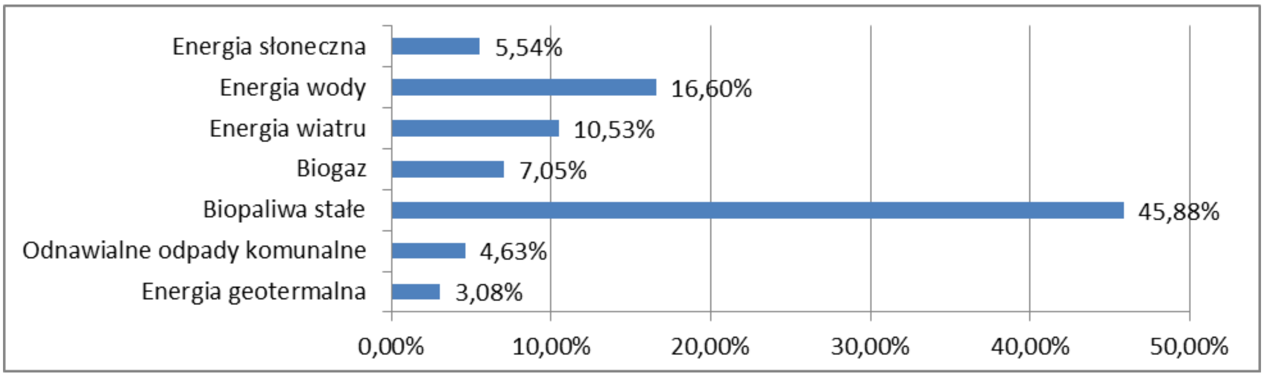


Belgia -Belgium Chorwacja - Kroatia Polska - Poland
Bułgaria - Bulgaria Włochy - Italy Portugalia - Portugal
Czechy - The Czech Republic Cypr - Cyprus Rumunia - Romania
Dania - Denmark Łotwa - Latvia Słowenia - Slovenia
Niemcy - Germany Litwa - Lithuania Słowacja - Slovakia
Estonia - Estonia Luksemburg - Luxembourg Finlandia - Finland
Irlandia - Ireland Węgry - Hungary Szwecja - Sweden
Grecja - Greece Malta - Malta Wielka Brytania - Great Britain
Hiszpania - Spain Holandia - The Netherlands Unia Europejska - European Union
Francja - France Austria - Austria
Udział energii ze źródeł odnawialnych - Share of energy from renewable sources
Krzywa rozwoju energii ze źródeł odnawialnych w latach 2011 - 2012 - The curve of development of energy from renewable sources in the years 2011 - 2012
Krzywa rozwoju energii ze źródeł odnawialnych w latach 2013 - 2014 - The curve of development of energy from renewable sources in the years 2013 - 2014
Udział energii ze źródeł odnawialnych w latach 2011 - 2012 - Share of energy from renewable sources in the years 2011 - 2012
Udział energii ze źródeł odnawialnych w 2013 -Share of energy from renewable sources in 2013
Cele w zakresie energii ze źródeł odnawialnych na 2020 - Renewable energy targets for 2020

Fig. 2 The progress of all member states in achieving renewable energy targets for 2020
Source: *Eurostat for 2013, 2012*

The economic potential of renewable energy sources is 1,160 PJ, and the practical capabilities of using it for 2020 (the real market potential) reach 697 PJ. The conducted analyses proved that in the base variant it is possible to achieve

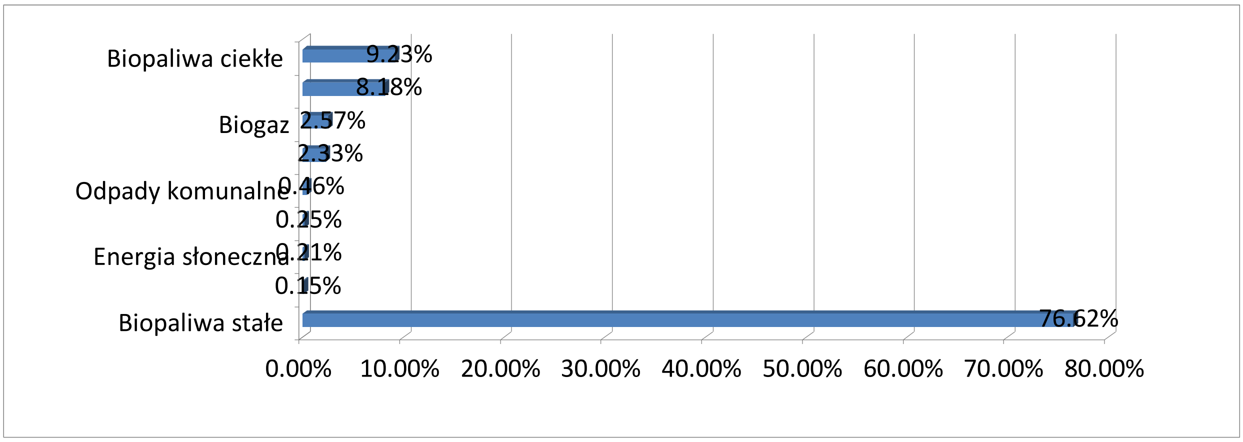
21.6% of the share of renewable energy in the balance of final energy consumption in Poland in 2020. The above market potential enables to achieve the partial target in the form of 10% share of biofuels in the use of transport fuels (petrol and diesel fuel) and makes it possible to reach 20-30% shares of renewable energy in the consumption of electricity and heat in 2020 (Institute for Renewable Energy, 2007). The structure of the generation of energy from renewable sources for Poland differs substantially from the structure of the generation of energy from renewable sources for the European Union. It primarily results from the geographical conditions characteristic for our country and the resources which can be utilized. The energy generated from renewable sources in Poland mostly comes from solid biofuels (76.62%), liquid biofuels, from wind power, hydropower and biogas (Renewable Energy in 2014). Generation of energy from renewable sources by carriers in EU-28 in 2013 is presented in Figure 3.



Energia słoneczna - Solar Energy, Energia wody – Hydropower, Energia wiatru - Wind power, Biogaz – Biogas, Biopaliwa stałe - Solid biofuels, Odnawialne odpady komunalne - Renewable municipal waste, Energia geotermalna - Geothermal energy

Figure 3 Deriving energy from renewable sources by carriers in EU-28 in 2013.
Source: Energia ze źródeł odnawialnych w 2014r. (Renewable energy in 2014), GUS (Central Statistical Office), Warszawa 2015,

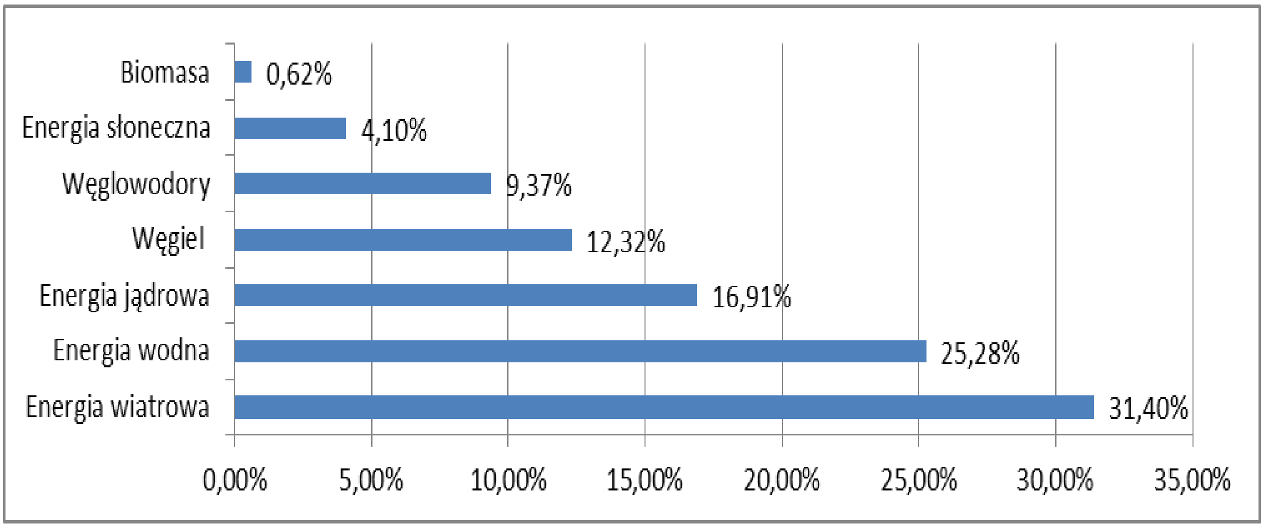
As it results from Figure 3, the biggest share in the generation of energy from renewable sources in the EU is made up by solid biofuels, and then hydropower. In Poland, the largest share in deriving energy from renewable sources is made up by solid biofuels and then liquid biofuels. Figure 4 presents the generation of renewable energy in Poland in 2014.



Biopaliwa ciekłe - Liquid biofuels, Biogaz – Biogas, Odpady komunalne - Municipal waste, Energia słoneczna - Solar Energy, Biopaliwa stałe - Solid biofuels

Figure 4 Generation of energy from renewable sources by carriers in Poland in 2014
Source: Energy from renewable resources in 2014, Central Statistical Office, Warszawa 2015,

The Romanian electricity market at the turn of the last decade has changed radically. The main and the most important factor of changes was the search for solutions which would aim at the reduction of electricity production costs. Renewable energy (wind and solar power) substantially influenced the biggest transformations on the market. In 2015, the share of renewable energy (wind, solar and biomass power) accounted for as much as 12.5% of the total production of electricity in Romania (Romanian Energy Regulatory Authority, 2016). The structure of electricity production with the division into the sources of its generation in Romania is presented in Figure 5.



Biomasa – Biomass, Energia słoneczna - Solar Energy, Weglowodory – Hydrocarbons, Węgiel – Coal, Energia jądrowa - Nuclear power, Energia wodna – Hydropower, Energia wiatrowa - Wind power

Figure 5 The structure of electricity production with the division into the sources of its production in Romania in 2015.
Source: The analysis of energy market in Romania with the division into individual sources, The statistical data come from ANRE – Autoritatea Nationala de Reglamentare in Domeniul Energiei (Romanian Energy Regulatory Authority), WPHI Bucharest- June 2016, p. 4

As it arises from Figure 5, the biggest share in the electricity production in Romania comes from wind power and hydropower.

When analysing the above data, we can assume that the European Union guidelines as for the 20-20-20 guidelines by 2020 will have been achieved, both in Poland and Romania. Renewable energy will constitute a considerable potential of generating energy demanded by households and the cost will be limited.

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Considerations regarding the resistance to chemical agents for Group I electrical equipment designed for use in explosive atmospheres

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Abstract

The requirements for equipment designed for use in explosive atmospheres are established by the new ATEX Directive 2014/34/EU (transposed into Romanian legislation by GD 245/2016) which entered into force starting from 20th of May 2016.
The explosion protection characteristics of equipments have to be assessed. For the assessment, these equipments are also subjected to type tests. In case of Group I electrical equipment (designed for use in underground firedamp mines), in the type tests category are also included the tests to verify the resistance to chemical agents for Group I electrical equipment.
The purpose of this paper is to present the importance of providing resistance to chemical agents for Group I electrical equipment, and also, to underline the testing methodology developed based on the requirements imposed by the applicable standards.

Keywords: type test, resistance to chemical agents, Group I electrical equipment.

1. Introduction

Assessment and testing of equipment designed to operate in potentially explosive atmospheres, in purpose of certification, represents an important aspect considering the existing explosion risk which has to be minimized in order to ensure people's health and safety, as well as to prevent goods damage and protection of the environment (Moldovan et al., 2012; Cioca and Moraru, 2012).

The equipment operating in hazardous explosive atmospheres has to be subjected to certification procedures, according ATEX Directive 2014/34/EU 0(transposed in Romanian legislation by Government Decision no. 245/2016) (Directive 2014/34/EU, 2014).

Electrical equipment designed for use in the underground of mines susceptible to firedamp are included in Group I (classification made according ATEX Directive 2014/34/EU and the European harmonized standard SR EN 60079-0).

For the assessment of explosion-proof characteristics of electrical equipment, the provisions of harmonized standards from the SR EN 60079 series are used. The standards SR EN 60079-0 (Explosive atmospheres. Part 0: Equipment. General requirements) and one or more of the standards containing the specific requirements for the type(s) of protection applied to equipment (ex. SR EN 60079-1 for the type of protection flameproof enclosure "d", SR EN 60079-7 for the type of protection increased safety "e", SR EN 60079-11 for the type of protection intrinsic safety "i") are used for performing the assessment. For evaluation of explosion-proof electrical equipment, these shall be subjected to type tests (Moldovan et al., 2014).

In the standard SR EN 60079-0 are indicated the type tests to which all the explosion-proof electrical equipment shall be subjected and the order in which these tests shall be performed (Moldovan et al., 2014; Moldovan et al., 2012).

In case of Group I equipment, in the type tests category are also included the tests to verify the resistance to chemical agents for Group I electrical equipment.

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2. Verification of resistance to chemical agents for Group I electrical equipment

2.1. Requirements for the tests of resistance to chemical agents for Group I electrical equipment

To maintain safety in operation, the explosion-proof electrical equipment for use in underground mines endangered by firedamp, whose enclosures or parts of enclosures are made of nonmetallic materials that can be exposed to the action of the chemical agents like oils and fats and / or hydraulic fluids for mining applications must maintain the explosion protection characteristics even in these unfavorable operating conditions (Moldovan et al., 2016). The chemical agents like oils and fats and / or hydraulic fluids are common to the underground mines and are used in different kind of applications and the parts of equipment made of non-metallic materials (plastic, rubber etc.) must be tested to verify the resistance to chemical agents. These non-metallic materials can be found on equipment designed for use in firedamp underground mines like luminaires, mining starters etc.

According to SR EN 60079-0, the resistance to chemical agents like oils and fats and / or hydraulic liquids for mining applications of enclosures or parts of enclosures made of nonmetallic materials shall be acceptable. It is generally accepted that resistance to chemical agents like oils and fats and / or hydraulic liquids for mining applications of glass and ceramic materials is not adversely affected when exposed to them, and therefore the application of the test is not required (SR EN 60079-0:2013, 2013).

If there are no other means of protection against exposure to oils and fats and / or hydraulic fluids for mining applications, tests must be carried out in order to verify the resistance of the material to these chemical agents, if the enclosure or parts of enclosure, on which the type of protection depends, are made of nonmetallic materials (SR EN 60079-0:2013, 2013).

The non-metallic enclosures and non-metallic parts of enclosures shall be submitted to tests of resistance to the following chemical agents:

- oils and greases;
- hydraulic liquids for mining applications.

According SR EN 60079-0 standard, the relevant tests shall be made on four samples of enclosure sealed against the intrusion of test liquids into the interior of the enclosure (SR EN 60079-0:2013, 2013):

- two samples shall remain for (24 ± 2) h in oil No. 2 according to the annex "Reference liquids" of ISO 1817, at a temperature of (50 ± 2) °C;
- the other two samples shall remain for (24 ± 2) h in fire-resistant hydraulic fluid intended for operating at temperatures between –20 °C and +60 °C, comprising an aqueous solution of polymer in 35 % water at a temperature of (50 ± 2) °C.

At the end of the test, the enclosure samples concerned shall be removed from the liquid bath, carefully wiped and then stored for (24 ± 2) h in the laboratory atmosphere (SR EN 60079-0:2013, 2013).

Because the explosion protection characteristics shall be maintained in the most adverse conditions, subsequently, each of the enclosure samples shall pass also a prescribed sequence of tests, as follows:

- The two samples tested for resistance to oils and greases shall be submitted then to the tests for resistance to impact, then to the drop test (if applicable), then to the tests for degrees of protection (IP) if applicable, and finally to the tests specific to the type of protection concerned.
- The two samples tested for resistance to hydraulic liquids for mining applications shall be submitted then to the tests for resistance to impact, then to the drop test (if applicable), then to the tests for degrees of protection (IP) if applicable, and finally to the tests specific to the type of protection concerned.

Also, each supplementary test comprised in the test sequence is important in order to verify the explosion protection characteristics.

For the impact test, the electrical equipment shall be submitted to the effect of a test mass of 1 kg falling vertically from a certain height which is specified according to the application of the electrical equipment. The resistance to impact test shall be made on electrical equipment which is completely assembled and ready for use; however, if this is not possible (for example, for light-transmitting parts), the test shall be made with the relevant parts removed but fixed in their mounting or an equivalent frame. The points of impact shall be the places considered to be the weakest and shall be on the external parts which may be exposed to impact. If the enclosure is protected by another enclosure, only the external parts of the assembly shall be subjected to the resistance to impact tests. When the impact head strikes the test sample, it may exhibit one or more “bounces”. The impact head shall not be removed from the surface of the test sample until it has come to rest. When, at the request of the manufacturer, electrical equipment is submitted to tests corresponding to the low risk of mechanical danger, it shall be marked with the symbol “X” to indicate this specific condition of use. When the electrical equipment has an enclosure or a part of an enclosure made of a non-metallic material, including non-metallic fan hoods and ventilation screens in rotating electrical machines, the test shall be carried out at the upper and lower test temperatures (SR EN 60079-0:2013, 2013).

In addition to being submitted to the resistance to impact test, hand-held electrical equipment or electrical equipment carried on the person, ready for use, shall be submitted to the drop test (if applicable) dropped four times from a height of at least 1 m onto a horizontal concrete surface. The position of the sample for the drop test shall be that which is considered to be the most unfavourable. For electrical equipment which has enclosures or parts of enclosures made of non-metallic material, the tests shall be carried out at the lower test temperature. The resistance to impact and drop tests shall not produce damage so as to invalidate the type of protection of the electrical equipment (SR EN 60079-0:2013, 2013).

The degree of protection (IP) test is performed when a degree of protection is required for a specific type of protection. In this, the test procedures shall be in accordance with IEC 60529, except for rotating electrical machines which shall be in accordance with IEC 60034-5 (SR EN 60079-0:2013, 2013). The IP testing provides evidence on ensuring adequate protection against ingress of water and dust inside equipment enclosure.

If one or more of the enclosure samples do not withstand these tests of enclosures after exposure to one or more of the chemicals, the enclosure shall be marked with the symbol “X” to indicate this specific condition of use, i.e. exclusion of exposure to specific chemicals during use (SR EN 60079-0:2013, 2013).

2.2. Testing technology

Considering the specific requirements for performing the tests of resistance to chemical agents for Group I electrical equipment previously described, it was found that for performing the specific tests, the following are required:

- oil No. 2 according to the annex "Reference liquids" of ISO 1817;
- fire-resistant hydraulic fluid intended for operating at temperatures between –20 °C and +60 °C, comprising an aqueous solution of polymer in 35 % water;
- metallic tubs for placing the testing oil/liquid and equipment (parts of equipment) under test;
- climatic chamber or oven in order to provide adequate conditions for testing – temperature of (50 ± 2) °C;

In this conditions, oil No. 2 according to the annex "Reference liquids" of ISO 1817 is represented by the IRM 902 oil – provided by Fuchs and the fire-resistant hydraulic fluid is represented by the Hydransafe HFC 146 hydraulic fluid provided by Total.

Three metallic tubs are provided for the tests, for placing the testing oil/liquid and equipment (parts of equipment) under test, having the dimensions:

- tub 1: 50 x 50 x 30 cm
- tub 2: 40 x 40 x 30 cm
- tub 3: 60 x 50 x 40 cm

For performing the resistance to chemical agents test the enclosure (parts of enclosure) made of non-metallic materials will be placed in the testing liquids and conditioned (heated) to the temperature of (50 ± 2) °C in a climatic chamber (Fig.1) or oven. This is going to be made in case of both tests (with oil No. 2 and with the fire-resistant hydraulic fluid intended for operating at temperatures between –20 °C and +60 °C, comprising an aqueous solution of polymer in 35 % water).

At the end of the test, the enclosure samples concerned shall be removed from the liquid bath, carefully wiped and then stored for (24 ± 2) h in the laboratory atmosphere (SR EN 60079-0:2013, 2013).

Fig. 1. Climatic chamber

3. Conclusions

The tests for resistance to chemical agents for Group I electrical equipment are important tests in order to verify the explosion protection security characteristics of electrical equipment designed for use in underground mines endangered by firedamp.

These tests are applied to electric equipment of Group I whose enclosures or parts of enclosures are made of nonmetallic materials (other than glass or ceramics) that can be exposed to the action of the chemical agents like oils and fats and / or hydraulic fluids for mining applications.

The testing technologies developed for these tests take into consideration all the aspects with respect to the standardized requirements, provided by SR EN 60079-0.

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Power quality study in order to comply with European Norms

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Abstract

In the electric energy transmission process besides the real electric power also appears the reactive electric power. The most alternating current networks are providing with series reactance and shunting capacitances.
When the electric charge and the power factor are modified one can observe that there are many disturbances of the voltage and current waveform.
In order to eliminate the dynamic disturbances and to ensure an efficient control of the voltage and current waveform, the reactive power control must be done very quickly.
The problem being quite intricate, when approaching the problem of compensating the distorting running, we have to take into account both the voltage variation in the mains and the power factor compensation.
The scale development of power electronics and electrical drives adjustable particular made of static converter-motor system was a new source of customers deformed, resulting in decreased quality of electricity supply by injecting network of current and voltage harmonics.
Presence of harmonic current and voltage in electric networks causes: increased power losses, poor power factor, low yield, improper operation command and control systems, interference with frequencies telemetric stations, etc.
This paper makes a study of the harmonics in the electrical network introduced by electrical rectifier drives - power. Based on this study we used a computer program which is determined by the values of voltage and current harmonics which characterize deforming regime.

Keywords: voltage harmonic, current harmonic, electric energy quality, data acquisition, PWM converter.

1. Introduction

Electricity is a product and like any product must meet their quality requirements. For electrical equipment to function properly, it is necessary for electricity to be supplied at a voltage of a certain band around the nominal value. Much of the equipment used today, especially electronic and computer devices, requires good power quality. However, the same equipment often causes distortion of the supply voltage installations due to their non-linear characteristics, which give rise to a sinusoidal current when sinusoidal voltage is applied. Thus, maintaining satisfactory quality electricity is a shared responsibility between supplier and user of electricity.

According to EN 50160 is the supplier who provides electricity via a public distribution system and the user or consumer is the purchaser (buyer) of electricity from the supplier. The user is entitled to receive from an energy supplier with consistent quality. In practice the level of power quality is a compromise between user and supplier. If there is not enough quality to user needs, measures are needed to improve quality and they will be subject to a cost-benefit analysis. However, the cost of poor power quality electricity than usually necessary steps to improve cost - it is estimated that losses caused by inadequate quality electricity industry and trade costs the EU about 10 billion per year.

The main document refers to the requirements for the "provider" is EN 50160 characterizing parameters related voltage electricity in the public system. This is a European standard but he filled in some regions and countries through other additional standards.

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2. Measuring equipment and methods used in deforming regime

Proper functioning of electrical equipment requires a supply voltage as close to nominal. Even relatively small deviations from the nominal value can produce sub-optimal operation of equipment that is functioning with a reduced efficiency or increased power consumption with additional losses and reducing life.

For electric motors the most significant factor is the fluctuation (variation) torque which depends on the square of the supply voltage. Problems can occur during startup of heavy loads (high) since starting current causes an additional voltage drop in the installation. In practice, for most three-phase electric motors, switching normally occurs in approximately 85% of rated voltage heavy loads (high) and about 70% for light loads (small). So the EN 50160 related to voltage fluctuation are satisfactory in this case.

For other electrical equipment the relationship between voltage and power or efficiency may be significant. For most devices, the variations of tension in the band (0.9-1.1) Un does not lead to negative consequences, particularly in the case of the current heating devices. For equipment with a higher sensitivity to supply voltage must be provided adequate protection.

Measurement and verification of voltage quality according to EN 50160, requires specialized equipment and methods of measurement. This regulation enables continuous monitoring over a period of seven days, the following parameters:

- Voltage on the three phases;
- Frequency;
- Total Harmonic Distortion Factor of Voltage THDU;
- Voltage unbalance factor, which is the ratio of positive and negative component of voltage;
- Fast and slow variations in blood, which are defined as factors severity brief flicker (Pst) and long term (Plt). This type of device also enables measurement of dips and interruptions, their frequency and duration.

Depending on the category in falling measurement, should be described by reference conditions, characteristics of measuring instruments, measuring methods, information processing module.

A note is required on cases in which voltage is measured in the secondary transformers. In this case the interpretation of results is a delicate process that exceeds this report.

A second observation is occasioned by the fact that the measurement parameters of voltage can be influenced by variation of another parameter which gives a special character measurement parameters set by SREN50160. In other words, the prescribed parameters are and sizes of influence. The most important condition is valid as framing tension within +/- 15%. ANRE requirements set the limits of validity of the supply voltage at + 15 / -20%. Another condition for the validation of measurement is framing in 20% total harmonic distortion of the voltage waveform.

Frequency is measured as an average over a period of 10 seconds and must be within +/- 1% in over 95% of the week and never go out of +4 / -6% - the reference value nominal 50Hz. Tool measures must error of less than 50MHz. Regarding the conditions in which the measurement is considered irrelevant measurements in conditions where total harmonic distortion voltage is greater than 20%.

The effective average voltage measured over the 10 minutes it has that 95% of the week to fit in +/- 10% of nominal value. It is recommended that the meter accuracy to be better than 0.5%. Similar restriction to measure the frequency - is considered relevant measurements during which total harmonic distortion voltage does not exceed 20%.

3. Quality Measurement of Energy

Measurements were performed to study the deforming regime and quality power drive systems introduced by existing technological line from E.C. Roşia. The measurements were performed with an apparatus for analyzing power quality type HIOKI 3197, connected in the substation that supplies technological equipment in line. Voltage and current probes were installed in cells measuring the substation.

Single line diagram of the substation no. 3 in which measurements were made is given in Figure 1. How to connect the meter is given in Figure 2.

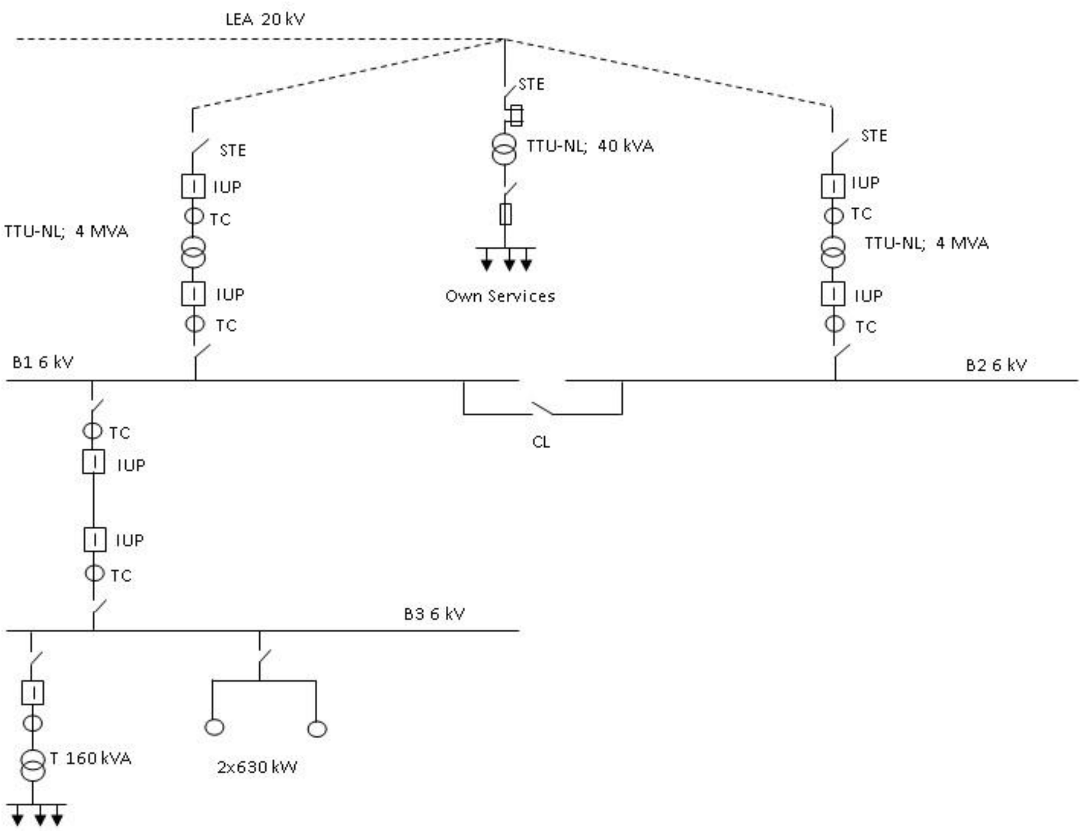

Fig. 1. Single line diagram of the station 20/6 kV EM Rosia

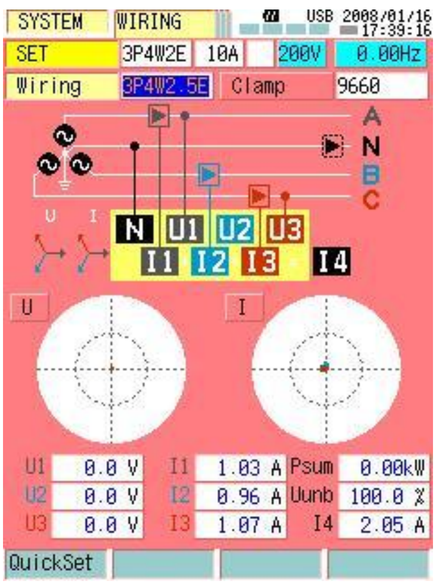

Fig.2.

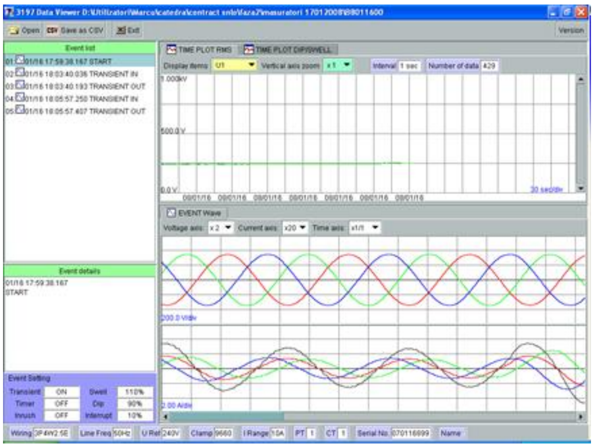

Fig.3. RMS Voltage Variation

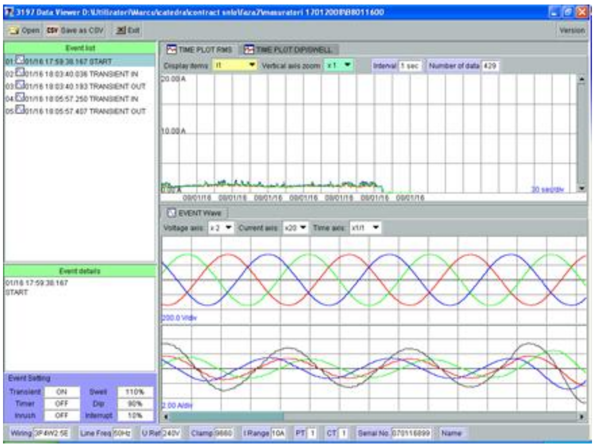

Fig.4. RMS Current Variation

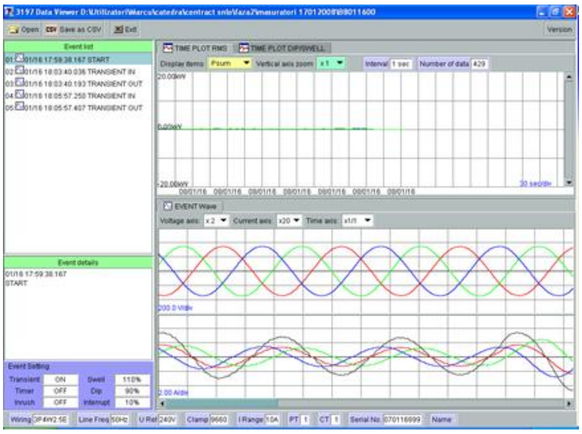

Fig.5. Active Power Variation

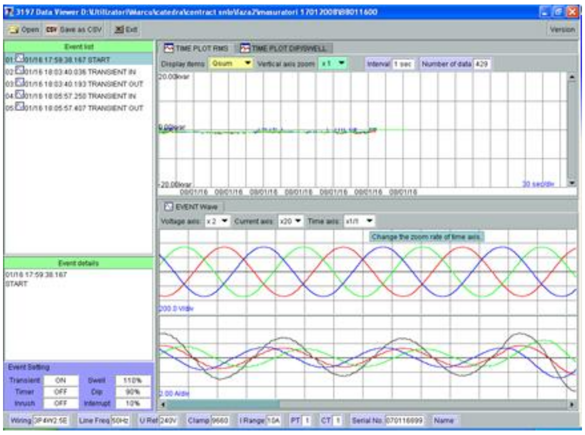

Fig.6. Reactive Power Variation

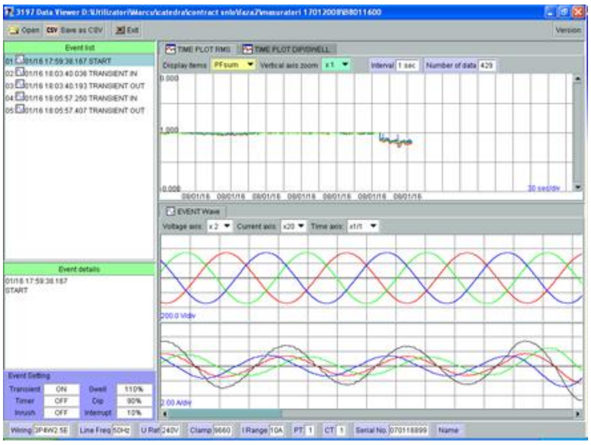

Fig.7. Power Factor Variation

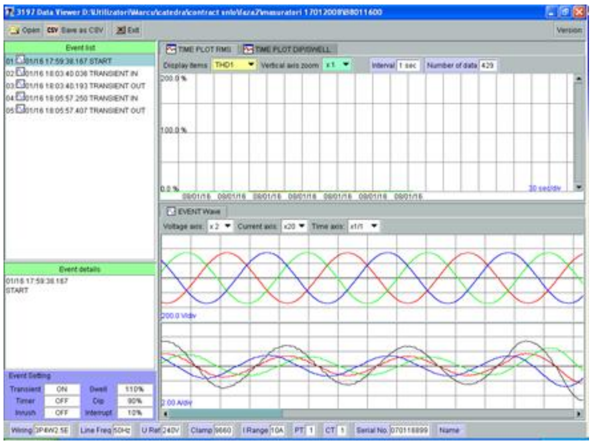

Fig.8. Distortion Factor Variation

For this reason it has further catches with power quality analyzer, which presents readings, harmonic analysis and time variation of current and voltage at different points in time (fig.11). Based on these catches were calculated current and voltage harmonic amplitudes and ratios characteristic of deforming regime.

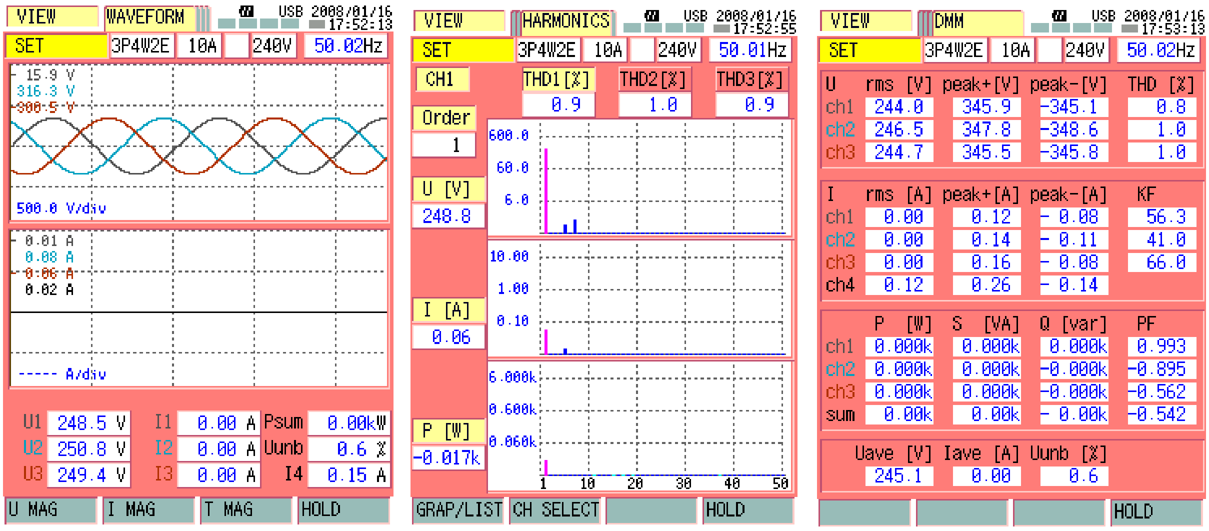

Fig.9. Measured Values by Quality Analyzer

The analysis of these graphs it can be concluded that there is strong interference, even power factor variation is normal. As regards the factor of deformation, it is low in these graphs is not clear conclusions can be drawn. This is why catches are presented with power quality analyzer, the measurement values are given, harmonic analysis and time variation of current and voltage at different points in time. Based on these catches were calculated current and voltage harmonic amplitudes and ratios characteristic of deforming regime.

Based on these charts was calculated harmonic current values and features coefficient values given in Table 2.

Table 2. Harmonics regime coefficient values

No.	Parameter	Effective Value Voltage (V) Current (A)	Distortion Factor TDH (%)	Weighted Distortion Factor Dw	Harmonic Factor HF
1	U	6220,2156	0,83	0,0529	0,004
	I	6,184	24,25	1,212	0,108
2	U	6145,213	0,83	0,0529	0,0033
	I	99,0197	1,99	0,379	0,0045
3	U	6127,5676	0,46	0,028	0,002
	I	122,0243	2	0,099	0,0049
4	U	6125,1104	0,6	0,038	0,0024
	I	109,049	2,9	0,397	0,011
5	U	6102,5677	0,46	0,028	0,002
	I	133,0066	1	0,189	0,0022
6	U	6110,1696	0,74	0,049	0,003
	I	192,0277	1,7	0,05	0,0106
7	U	6207,793	1	0,063	0,0038
	I	123,086	0,037	0,189	0,024
8	U	6215,288	1,11	0,074	0,0043
	I	157,0258	2,59	0,34	0,0109
9	U	6215,388	1,11	0,074	0,0043
	I	145,1032	3,8	0,10	0,024

4. Conclusions

The requirements of EN 50160 are not difficult to meet the electricity suppliers. Parameters supply voltage must be within certain limits for 95% of the testing period, while 5% for the remainder of the permitted deviations are much higher. For example, the average 95% of the time should be between 90% and 110% of rated voltage. That means that in an extreme case, consumers can be fed continuously at 90% of nominal voltage and, for 5% of the time, the voltage can be much lower. If, in a such situation, other parameters are at the limit applicable standard, for example harmonic voltages or voltage unbalance, the equipment will probably work improperly.

The standard could be improved. For example, asking that the average values of voltage parameters measured throughout the test period within ± 5% would ensure that the supply voltage can not be maintained for a long time to lower or upper limit value.

The number of dips permitted (up to 1000 a year) and the number of short and long outages are rather high from the point of view of consumers. Voltage dips below 30% of nominal voltage lasting less than 0.3 s can result in driving the protection of minimum voltage contactors or the onset of motor circuits. Thus, the real number of process interruptions will be much higher than would be expected as a result of interruption of voltage.

EN 50160 must be understood as a compromise between supplier and consumer. He asks the supplier to ensure, as a minimum requirement, only one supply of appropriate quality. Most vendors currently exceed these requirements to a large extent, but does not guarantee it. If the consumer has higher requirements must be taken to improve or must negotiate a separate agreement for quality. However, the important advantage of this standard is to:

- defining important parameters voltage power quality;
- quantitative determination of values that are benchmark in assessing power quality.

Load electricity regulator is to establish a level of quality that requires a very good activity provider, but not to raise too high because it leads to an increase in the price of electricity for all.

The cost of power quality problems, in terms of lost output and disruption varies widely depending on the type of industry. However, the cost of mitigation, often criteria of return in business and industry, payback is 2 ··· 3 years. Of course, the cost of prevention - by avoiding problems at the initial design stage - is 10% of the cost ···20 mitigation measures into a working installation.

Power quality is a complex area, covering an area of more than a dozen problem areas, for which a large number of solutions. Currently, many energy-intensive sites suffer to some extent by poor power quality, but many sites have already adopted some solutions. They consist typically the purchase of generator, adopting True RMS measurements and supplemented by a series of other measures, such as earthing network using active filters etc.

It is unlikely that a single solution will be effective. It Careful design of a solutions tailored to power quality problems that occur, and based on a detailed understanding of the causes of power quality problems.

It is estimated that power quality problems cost industry and commerce in the EU about 10 billion Euro/year, while spending on preventive measures are below 5% of it.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Considerations regarding the mechanical strength to torsion and simultaneous bending for the mining electrical cables

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Abstract

Compared to other elements in the electrical-mechanical installations used in Ex dangerous areas, the electric cables represent a vulnerability in the sense of ensuring and maintaining the required safety level, taking into account that the cable networks are laid down along various workings, on large lengths and various paths; they are exposed to accidental mechanical, technological or geological stresses; by their nature, electric cables cannot be manufactured having an Ex type of protection, similar to those applied in case of electric/non electric equipment or protective systems.
In order to minimize risks and increase explosion safety and protection, within the cable networks performant electric cables should be used, certified for this purpose, with a sturdy construction specific to mechanical stresses applied when laying them down, mounting or in operation, that should contain all the required elements to get electric and thermic protection, as well as protection against flame propagation.
Using non-performant materials and an improper construction of electric cables used in Ex dangerous areas may lead to short-circuit occurrence, especially dangerous since these develop heat, electric arcs and metallic drops that might constitute an imminent danger of flames, fires or explosions, and implicitly environment pollution.

Keyword: potentially explosive atmosphere; electric mining cables; simultaneous torsion and flexion.

1. Introduction

Power, instrumentation, control and command electric cables are installed in electric networks and used for a long period of time, in all industrial branches as well as in those branches where there is a likelihood of potentially explosive atmospheres occurrence (underground firedamp and non-firedamp mines, quarries, chemical and oil industry, flammable gas manufacture, processing, transportation, storage - gas, vapor, mists, liquids and/or combustible dusts).

Unlike normal environments, the potentially explosive atmospheres environments bring frequently explosions/fires, as result of ignition by various ignition sources of explosive mixtures, resulted from different technological processes or accidental leakages. Analyzing the way an explosive atmospheres forms results in several steps to be taken. The first step is combustible part dispersion (gas, vapor, mists, dusts, fibers, lint) in air.

In the second stage mixing of the combustible part (gas, vapor, mists, dusts, fibers, lint) with air takes place, resulting in potentially explosive atmosphere formation and explosive atmosphere formation when the concentration of the combustible/flammable substance in air is within its field of explosivity.

In the third step ignition of the pre-formed explosive atmosphere takes place, by an ignition source, efficient as temperature and energy. In the last stage the combustion reaction develops, and its character is defined by the reaction rate: combustion, explosion (detonation, deflagration) forming flames with a high temperature, heat releasing and pressure building up.

If for the electric and non-electric equipment or components and protective components used in areas with explosion hazards specific types of protection had been designed according to the dangerous zone the equipment is intended to be used and to the chosen category of equipment, in the case of electric cables especially in large electric networks where particularly dangerous short-circuits may occur, since short-circuits develop heat, electric arcs, and metallic droplets that may represent an imminent danger of occurrence of unwanted events: fires or explosions and environment

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pollution. (Vătavu, 2015)

In all the areas with explosion hazard (groups I, II or III) due to the high vulnerability of the cables employed in electric networks, only certified cables should be used, insulated conductors in protective tubes or conduits, and rods with sealed capsulation, explosion-proofed by a type of protection, according to the intended group of explosion and the zone.

2. Safety requirements for mine electric cables

For the mining industry, development of mechanization, electrifying and automatization processes of the mining activities had been accompanied by a constructive evolution of the power and tele-installation electric cables.

This evolution aimed to use materials with improved properties for conductor insulation and protective sheath or to adopt adequate constructive forms through which to increase the mechanical strength of command conductors in the power cables, to achieve control of the insulation resistance on two levels for powering the face-wall machines, to fulfill a proper protection against outer electromagnetic fields and an increased strength of the outer sheath at flame propagation, taking into account that combustion of cable sheath and insulation releases gas with unwanted influence on humans and environment (Vătavu, 2016).

Cables having mining construction are certified cabled for this purpose and have to fulfill from a constructive, operating point of view, as well as from the point of view of physical, chemical, mechanical, thermic, electric performances, the requirements of the specific standards for power or tele-installation electric cables and, additionally, the performance requirements in STAS 10411, mandatory standard in Romania for electric cables admittance in the mining industry (STAS 10411, 1989).

According to this, in order to fulfill the goal of work safety and health, in the case of electric cables two ways of achieving this are in practice:

- use of electric cables constructively sturdy, specific to mining stresses, that contain the required elements to ensure electric protection;
- adopting the adequate electric protection.

Taking into consideration the mechanical stresses in the mining industry (dynamic and static crushing, simultaneous torsion and flexion, alternate torsion and flexion), the flexible mine electric cables with natural or synthetic rubber insulation, as well as the mine armoured cables with polyethylene or PVC insulation and PVC sheath, intended for use in electric installations and equipment for powering, signalling, telecommunications and telemechanics, in the underground and quarries mine workings have to assure a strength appropriate to these stresses (Vătavu, 2014).

As result of the dynamic crushing test, in order for the cable to pass the test, insulation faults, short-circuits or phase breaks shall not occur, and the preventive disconnection coefficient shall be lower than the unit.

$$k = \frac{n_1^{'}}{n_2^{'}} \qquad (1)$$

where:

$$n_1^{'} = \frac{\sum_{i=1}^{5} n_{1i}}{5} \qquad (2)$$

$n_1^{'}$ - represents the mean value of the number of strikes when an insulation fault occur, signalized by the relay for insulation resistance control;

$$n_2^{'} = \frac{\sum_{i=1}^{5} n_{2i}}{5} \qquad (3)$$

$n_2^{'}$ - represents the mean value of the number of strikes when a short-circuit between the phases or a phase break occur

As result of the static crushing test, in order for the cable to pass the test, insulation faults, short-circuits or phase breaks shall not occur, and the preventive disconnection coefficient shall be in accordance with the product standards.

$$k^{'} = \frac{P_1^{'}}{P_2^{'}} \qquad (4)$$

where:

$$P_1^{'} = \frac{\sum_{i=1}^{5} P_{1i}}{5} \tag{5}$$

$P_1^{'}$ - represents the mean value of the crushing force at which an insulation fault occur, signalized by the relay for insulation resistance control;

$$P_2^{'} = \frac{\sum_{i=1}^{5} P_{2i}}{5} \tag{6}$$

$P_2^{'}$ - represents the mean value of the crushing force at which a short-circuits or phase break occur.

As result of the simultaneous torsion and flexion test, in order for the cable to pass the test, insulation faults, short-circuits or phase breaks shall not occur, and the disconnection coefficient shall be in accordance with the product standards.

$$k^{"} = \frac{n_1^{"}}{n_2^{"}} \tag{7}$$

where:

$$n_1 = \frac{\sum_{i=1}^{3} n_{1i}}{3} \tag{8}$$

n_1 - represents the mean value of cycles when a when an insulation fault occur, signalized by the relay for insulation resistance control;

$$n_2 = \frac{\sum_{i=1}^{3} n_{2i}}{3} \tag{9}$$

n_2 - represents the mean value of the cycles when a short-circuit between the phases or a phase break occur

3. Tests of mine electric cables for conformity certification in the voluntary domain

For the certification in the voluntary domain the flexible mine electric cables with natural or synthetic rubber insulation, as well as the mine armored cables with polyethylene or PVC insulation and PVC sheath, intended for use in electric installations and equipment for powering, signaling, telecommunications and telemechanics, in the underground and quarries mine workings shall undergo dynamic crushing test, static crushing test, simultaneous torsion and flexion test and alternate flexion test. In order to perform these tests, in the ENExEMEIP laboratory had been conceived and carried out test stands with software interface for measurement / signalling / control / recording of the test cycles of static and dynamic stresses, and simultaneous torsion and flexion (Vătavu, 2015).

In order to ensure support for the certification body for conformity assessment of mine electric cables with the applicable health and safety requirements, in the LENExEMEIP laboratory of INCD-INSEMEX, through the research project PN 07-45-02-50/2014 “Study of safety performances and development of an innovative technology for mine electric cables and their accessories testing - code PSDCEA” and PN 16-43-02-10/2016 “Researches concerning the mechanical strenght to torsion and simultaneous bending of the mining electric cables” (Vătavu, 2014).

Within the framework of NUCLEU program of research had been carried out the following stands: stand for dynamic and static tests, stand for simultaneous torsion and flexion.

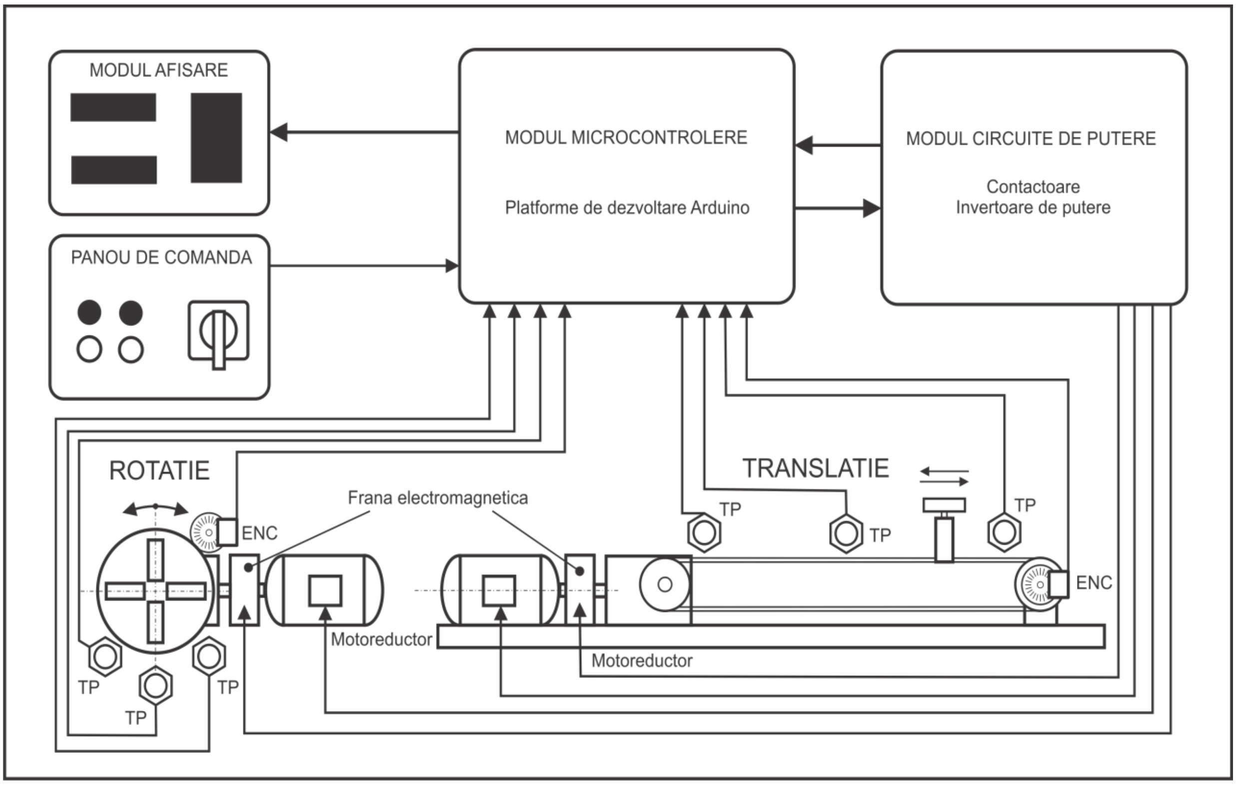
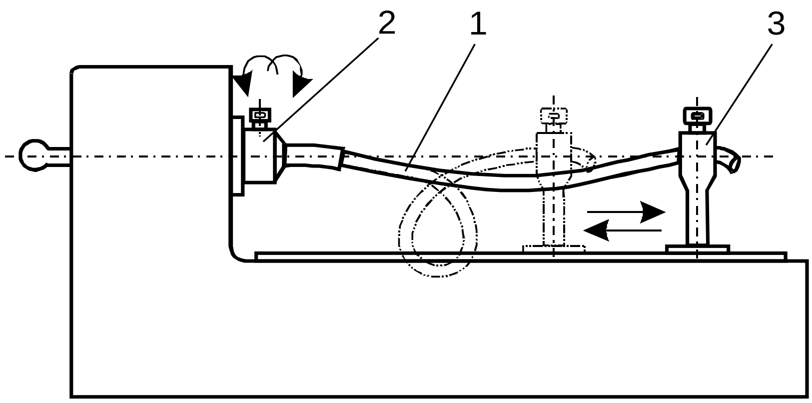


Fig. 1. Automation installation block scheme

Based on the installation scheme an automation installation block scheme was designed – fig. 1 – and a high performance system for data measurement, control, acquiring and recording had been realized, consisting in a AGILENT TECHNLOGIES system with several development platforms with ARDUINO type of micro-controllers and a computer for data storage, for surveying the weight height of falling on the cable sample, number of successive hits, static pressure on the cable sample, the number of rotation and translation cycles, and signalling of occurred faults (short-circuit, phase interruption or insulation fault).

The simultaneous torsion and flexion test is realized with the equipment and installation scheme presented in fig. 2. After applying the translation motion, the cable sample shall be twisted in one way (until it forms loops) and at the stroke back motion the sample shall be untwisted. At the next going stroke the sample shall be twisted in the other way (until it forms loops), and the cycle shall be repeated three times.



1 - cable test sample; 2 -device generating rotary motion; 3 - device generating translation motion

Fig. 2. Installation for simultaneous torsion and flexion test

After performing tests and assessments was found out that the most adequate power cable construction is the one having the protective conductor evenly distributed around each phase. For these cables, the risk of phase breaking or occurrence of a short-circuit before insulation faults is significantly lower than in case when the protective conductor is placed between the outer sheath and the inner sheath or when it is separated as an individually insulated conductor disposed between the insulated phase conductors.

4. Conclusions

The electric cable network in underground are carried out with mine electric cables that, together with the assembly of electric equipment and device in the electromechanical installations, have the role of ensuring protection against electrocution, fire and/or explosion hazards.

In order to increase safety and health at work, explosion protection and environment protection, in the Ex dangerous areas performant electric cables should be employed, certified in this purpose, having a sturdy construction specific for the mechanical posing, mounting or operation stresses, corroding and aggressive chemical agents, and containing the required elements in order to achieve electrical and thermic protection, as well as protection against flame propagation.

The laboratory tests reproducing specific stresses of mines' underground are the dynamic crush and static crush tests, simultaneous twisting and bending test and increased resistance to flame propagation.

In this sense, for the need of performing laboratory tests on electric cables for certification in the voluntary field, a modern test stand had been carried out, for performing mechanical stresses tests on mine electric cables and their accessories (cable boxes) provided with a software interface for measurement / signalling / control / recording of testing cycles at dynamical and static stresses, and simultaneous torsion and bending stresses. These test stands comply the requirements of SR EN 17025, the tests can be included in the accredited field of testing laboratory.

Acknowledgements

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Optimizing the orientation of photovoltaic panel to achieve higher energy conversion

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Abstract

Due to increasingly human needs of energy, new technologies and energy sources must be used to supply the demand of clean energy in the context of environmental issues. Renewable energy sources like solar energy has one of the most potential and it is studied here. Periods of morning and evening when the sun's rays make an small angle with the solar panel generates a smaller amount of energy. Using 2 actuators for both axes of motion for photovoltaic panel can follow the position of the sun from sunrise to sunset.

Keywords: solar, photovoltaic, energy, conversion, orientation

1. Solar radiation during clear sky

Photovoltaic performance meaning electricity generation depends to a large extent of the incident solar radiation on photovoltaic module positioned with different orientations, but most data received from weather stations are based on the horizontal surface. Thus, forecasting solar radiation on inclined surfaces is crucial because as usual photovoltaic panels are inclined to receive maximum sunlight yield as possible.

Direct radiation, diffuse irradiance and reflected irradiance are the components of global radiation on inclined surfaces.

$$R_{Tt} = R_{bt} + R_{dt} + R_{rt} \tag{1}$$

where R_{Tt} is equivalent radiation, R_{bt} is the direct beam, R_{dt} is the diffuse irradiance R_{rt} is the reflected irradiance.

Direct Solar Irradiance (R_{bt})

Direct solar radiation on inclined plane is mathematically represented as follows:

$$R_{bt} = R_b \cdot \cos\theta_{AOI} \tag{2}$$

Where R_b is the direct radiation on the horizontal surface and θ is the angle of incidence between the normal to the surface and the incoming solar direct beam. (Luis and Sivestre, 2002; Marcu et al., 2014)

Diffuse solar irradiance (R_{dt})

The model of the diffuse irradiance that arrives at a site on inclined solar systems with equal intensity from all direction as sky is considered as isotropic is expressed as:

$$R_{dt} = CR_b\left[\frac{1+\cos\beta}{2}\right] \tag{3}$$

Where the C is the sky diffuse factor:

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$$C = 0.095 + 0.04 \cdot \sin\left[360 \cdot \frac{(N-100)}{365}\right] \tag{4}$$

Reflected Solar Irradiance (R_{rt})
The reflected solar radiation is given by:

$$R_{rt} = \rho \cdot R_b(\sin\gamma_S + C) \cdot \left[\frac{1-\cos\beta}{2}\right] \tag{5}$$

Where ρ is the reflectance.
The intensity of this radiation depends largely on the reflectivity of the surface at that location.
The equivalent equation of solar radiation incident on a tilted photovoltaic solar panel was rewritten using previous equations:

$$R_{Tt} = E\exp\left(-\frac{k}{\sin\gamma_S}\right)\left[\cos\gamma_S \cdot \cos(\alpha_S - \phi_{AZ}) \cdot \sin\beta + C\left(\frac{1+\cos\beta}{2}\right) + \rho(\sin y_S + C) \cdot \left(\frac{1-\cos\beta}{2}\right)\right] \tag{6}$$

2. Orientation of the solar panel towards the Sun

Biaxial orientation of the photovoltaic panel is required to meet the goal of a performance increase of solar energy conversion into electricity. The orientation of the PV generator so that the incidence of solar radiation beam is perpendicular to the photovoltaic panel obviously will lead to a power generation at full capacity for a longer period of time than if it would have a fixed position. (Marcu et al., 2014)

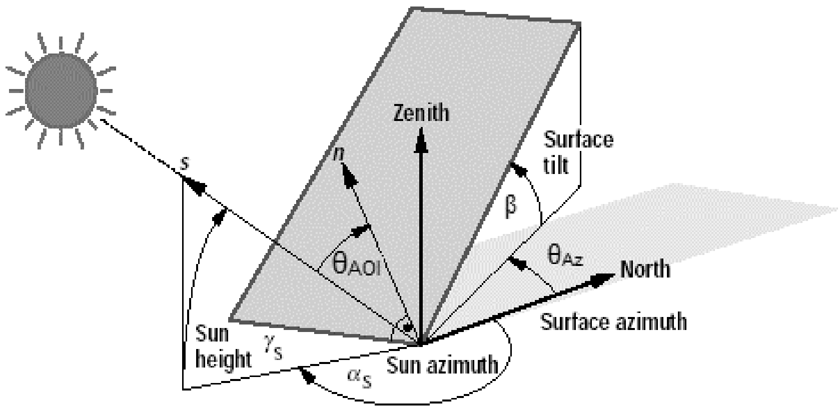

Fig. 1. Sun angles relative to the photovoltaic system

ω - hour angle is the angular displacement of local meridian from east to west due to Earth's rotation on its axis by 15 degrees per hour;
δ – declination angle is the angle between Earth-Sun line and plane along the equatorial circle;
γ_s- solar height is the angle formed by the Earth-Sun line and the horizontal plane of that location;
θ_{AOI} – the angle of incidence is the angle of sunlight beam that comes from the sun and the normal to the surface;
β – inclination of the photovoltaic panel;
ρ - is the reflection coefficient;
n – normal to the photovoltaic panel plan.

Periods of morning and evening when the sun's rays make an small angle with the solar panel generates a smaller amount of energy.
Using 2 actuators for both axes of motion photovoltaic panel can follow the position of the sun from sunrise to sunset. Declination photovoltaic panel is associated with solar altitude, which will change its position every 5 days.

Tracking the sun during a day it is performed by the second actuator that changes the angle of once every 5 minutes.

Simplifying and knowing that the sun moves at an hourly speed of 15 ° / h, the pitch diurnal angle, conducted by the equatorial orientation system, achieves on average a 1° angle of incidence that lasts approx. 1 h / 15° = 60 min / 15° = 4 min /° C. [102] This period has however momentary different values, depending on the slope of variation of declination during the year, β declination is approximately constant throughout the day, leading to a seasonal variation of the β angle.

The orientation of the photovoltaic panel during the measurements was made to south where the photovoltaic panel had fixed orientation with β with values of 30, 35 and 45 degrees. (Naing, 2010)

In the case of biaxial orientation of the solar panel two actuators - one for changing the β angle and one for the surface modification of the panel with respect to the azimuth of the sun - they were operated every 5 minutes corresponding to the position of the sun in order to achieve an perpendicular incidence to the beam coming from the solar disc. (Rekioua and Matagne, 2012)

3. Measurements upon the selected options

Measurements were carried out for four cases respectively 30, 35, 45 degrees and optimal orientation.

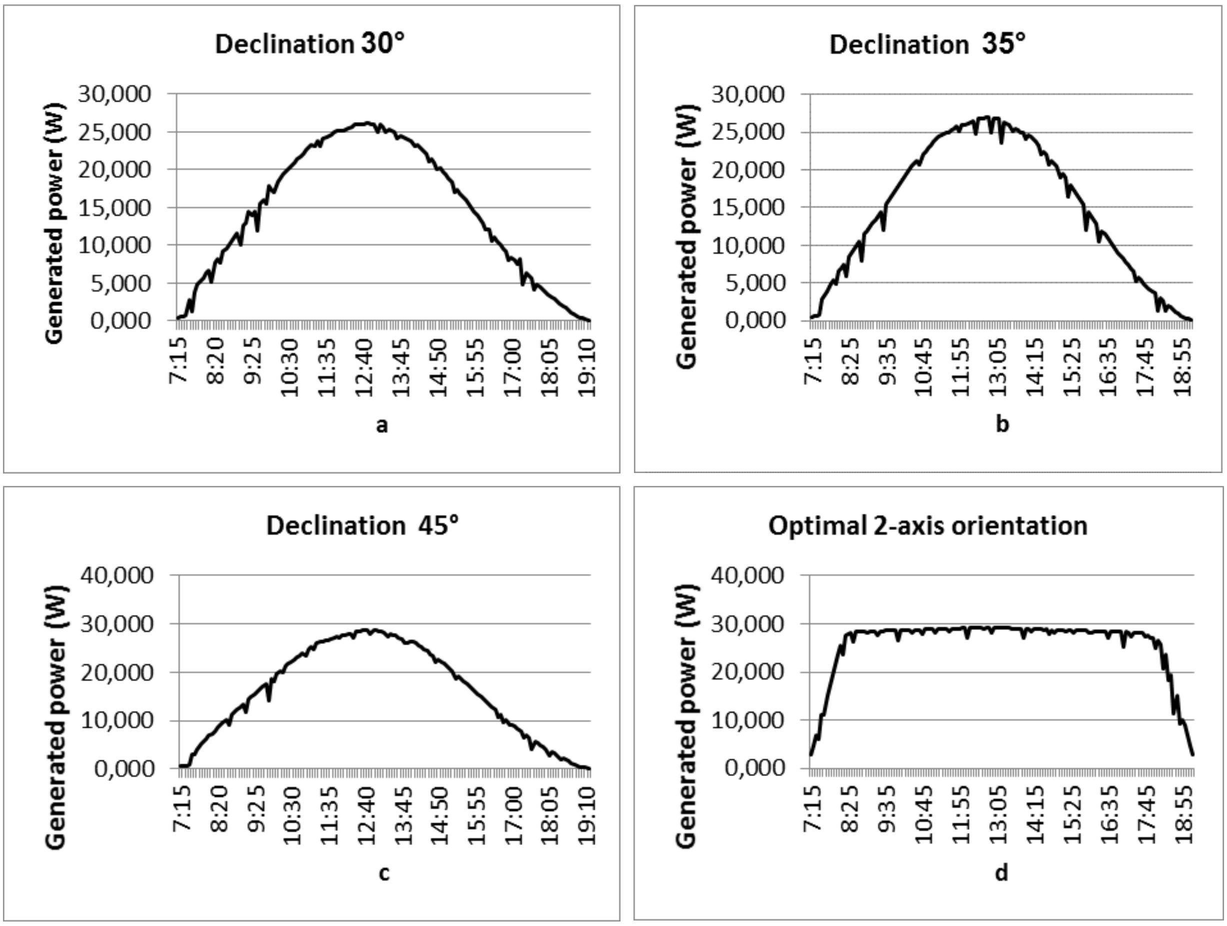

Fig. 2. Generated power for different setups of the photovoltaic system

For the first measurement the photovoltaic panel was positioned at an β inclination of 30 degrees, and it can be seen that the peak daytime appears at about 12:35 and the recorded value of the generated power is around 26W.

Throughout the day, for an inclination of 35 degrees, the conversion efficiency increases by approximately 4% compared to the declination 30 degrees and the maximum instantaneous power approaching 28W.

The gradual increase in the first hour after sunrise or decreasing at the end of the day due to the distance it traverses the light beam from entering the atmosphere to solar cell. Conversion efficiency in this case related to the declination of 45 is higher by 61%.

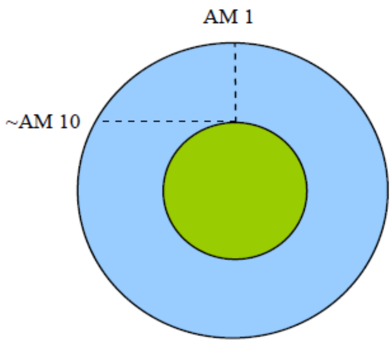

Fig. 3. Schematic illustration of the air mass, representing the relative distance that light travels through the atmosphere

AM = 1 corresponds to the incident radiation and the radiation coming from the horizon can increase the value to more than 10. This factor has the effect of "tempering" of solar radiation in the first and last 1-2 hours of the day thus reducing power generated by photovoltaic panel it is directly proportional to the amount of air mass.

Values of power generated by photovoltaic panel were filtered so as to obtain the arithmetic and they can be used in a comparative chart for a visual assessment to make clear to them.

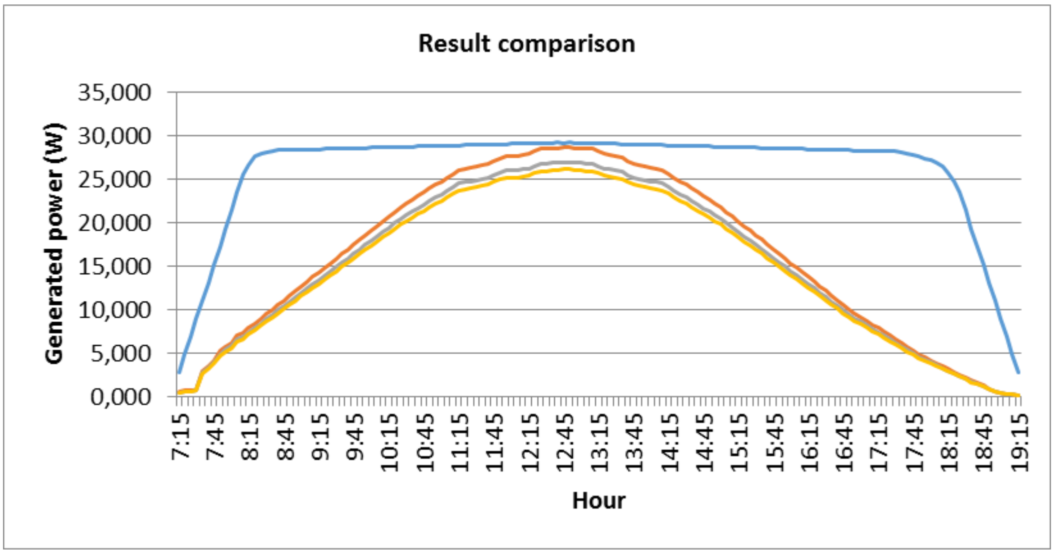

Fig. 4. The values recorded at different inclinations of solar panel during the day

4. Conclusions

In this paper were studied several positioning systems, that were set at 30, 35, 45 degrees and the biaxial system and from this research resulted that generated electricity with the fixed system at 45 degrees facing south is higher by 9% relative to the amount of energy produced by fixed system at 30 degrees; the amount of electricity produced by the system fixed at 35 degrees southern orientation is higher by 4% relative to the amount of energy produced by the fixed system at 30 degrees and the biaxial orientation system generated 61% more energy than the first setup.

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Evaluation of primary and secondary galvanic cells for electrical equipment intended for use in potentially explosive atmospheres

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Abstract

The insertion and placement on the European market of equipment intended for use in potentially explosive atmospheres is governed by Directive 2014/34/EU, generically named ATEX, being transposed into the Romanian legislation by Government Decision 245/2016.
The explosion protection principle for electrical equipment designed for operation in potentially explosive atmospheres by limiting the energy charged in a circuit, is covered only by the type of explosion protection intrinsic safety, symbolized "i". This type of protection is very suitable for mobile and portable electrical equipment which are supplied from autonomous sources. In view of the acceptability of using these types of equipment in potentially explosive atmospheres, with power supplies made from secondary and primary cells, they must be evaluated and tested in compliance with specific technical standards required by the ATEX Directive.

Keywords: intrinsic safety, explosive atmospheres, secondary and primary cells

1. Introduction

The explosion protection principle for electrical equipment designed for operation in potentially explosive atmospheres by limiting the energy charged in a circuit, is covered only by the type of explosion protection intrinsic safety, symbolized "i". This type of protection is very suitable for mobile and portable electrical equipment which are supplied from autonomous sources. In view of the acceptability of using these types of equipment in potentially explosive atmospheres, with power supplies made from secondary and primary cells, they must be evaluated and tested in compliance with specific technical standards required by the ATEX Directive.

Assessment and testing of the equipment which is part of an explosion protected system, for the purpose of certification is very important in order to minimize the risk of explosions, to ensure security of life and health, to prevent damage goods and not the least environmental damage.

The explosion protection types are implemented by using specific requirements which are applied to electric equipment in order to prevent ignition of explosive surrounding atmosphere. These days it could be noticed the trend of using the wireless connection for data transfer especially but not exclusively. But, obvious all equipment need energy supply therefore also it could be noticed the increasing of primary and secondary cells.

For the purpose of intrinsic safety type of protection „i” assessment, the samples provided by the manufacturer are subsequently submitted to a series of tests which have in view the most unfavorable scenarios which could occur. The assessment of explosion protected equipment containing cells is conducted by tests specified in IEC 60079-0 for general requirements and IEC 60079-11 for intrinsic safety requirements.

All equipment which is part of an explosion protected system used in area endangered by explosions should comply with requirements below listed:

- to be adequate explosion protected;
- to maintain explosion protection level for all environment conditions for which was meant;
- to cope all stress inherent the process of storing, transport, erection and operation.

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Intrinsic safety type of protection rely on limitation of energy transmitted to protected circuit. According to failure scenarios had in view for maintained explosion protection there are three levels of protection: „ia”, “ib” and “ic”.

2. Test rig and test procedure

Intrinsic safety type of protection has in view two possibilities for using cells thus: cells which does not need to be replaced in hazardous area or other which need to be replaced in hazardous area, (Csaszar et al., 2011).

For first case the cells should be placed in a special closed compartment and other should be encapsulated together with the limitation devices such that just protected circuit parts could be exposed.

For the purpose of spark test ignition of the cells maximum open circuit voltage should be considered. Otherwise, for thermal ignition tests should be used rated voltage (see figures 1 and 2). For the scope of the article will be considered further thermal ignition tests.

According to the standard it is needed to test 10 samples. But before the thermal test it is necessarily to conduct another test for rated cell capacity confirmation. The minimum accepted threshold for capacity is 95% from rated capacity.

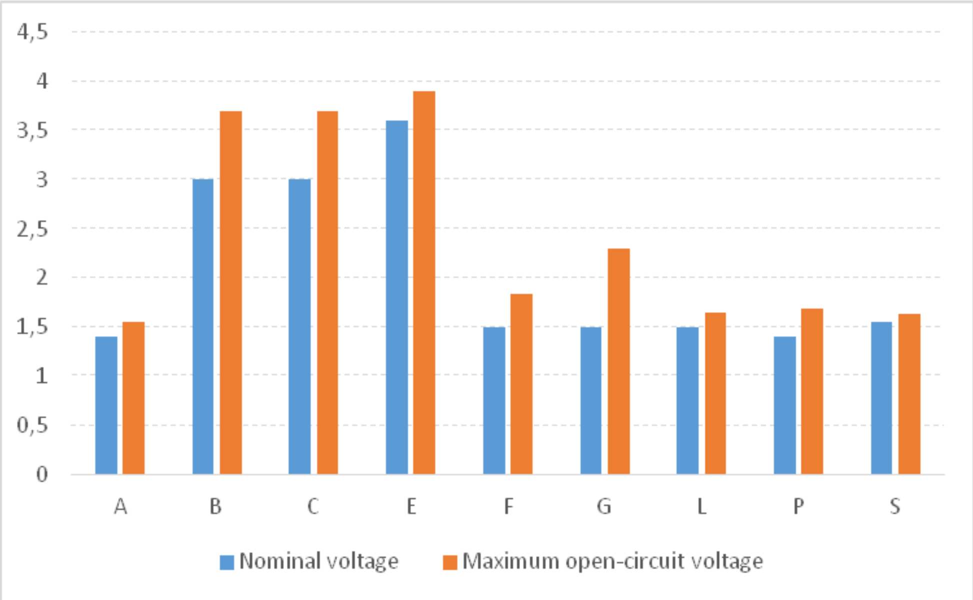

Fig. 1 Nominal and peak voltage for primary cells of types A to S (3)

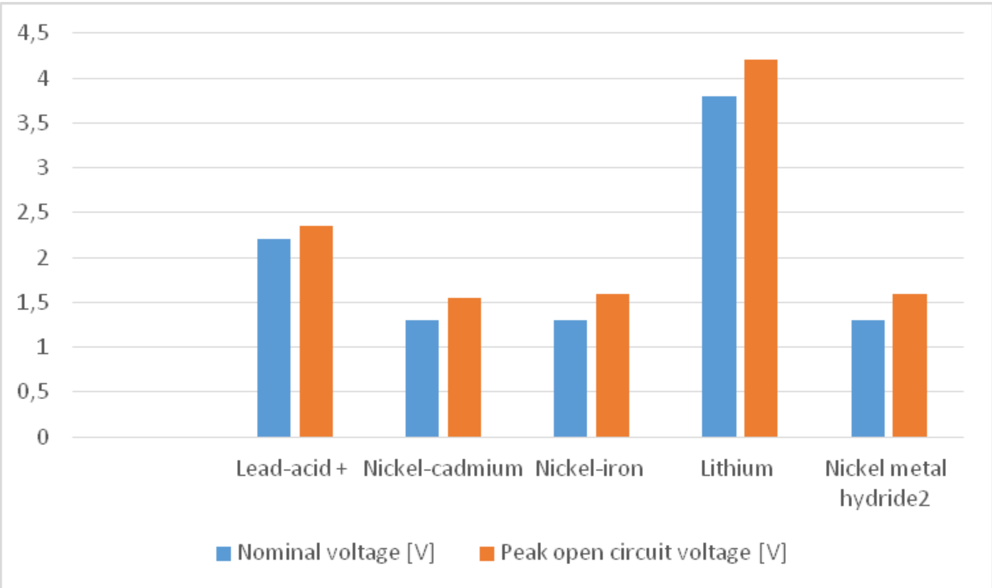

Fig. 2 Nominal and peak voltage for secondary cells of different electrochemical system

3. Test rig

In order to test of the cells at INCD INSEMEX Tests Laboratory Group it was created a test rig (see figure 3) (Csaszar, 2015).

The achieved test rig rely on monitoring (measurement) system with channels for:

- ambient temperature;
- maximum temperature at the middle of the cell;
- discharging current of the cell;
- voltage of the across the cell.

The principal part of the test rig is the device for the electronic short-circuiting of the cell. Additionally for test operator protection the test rig contains a transparent cover having thickness of 20 mm.

Fig. 3 Test rig for maximum surface temperature of the cells

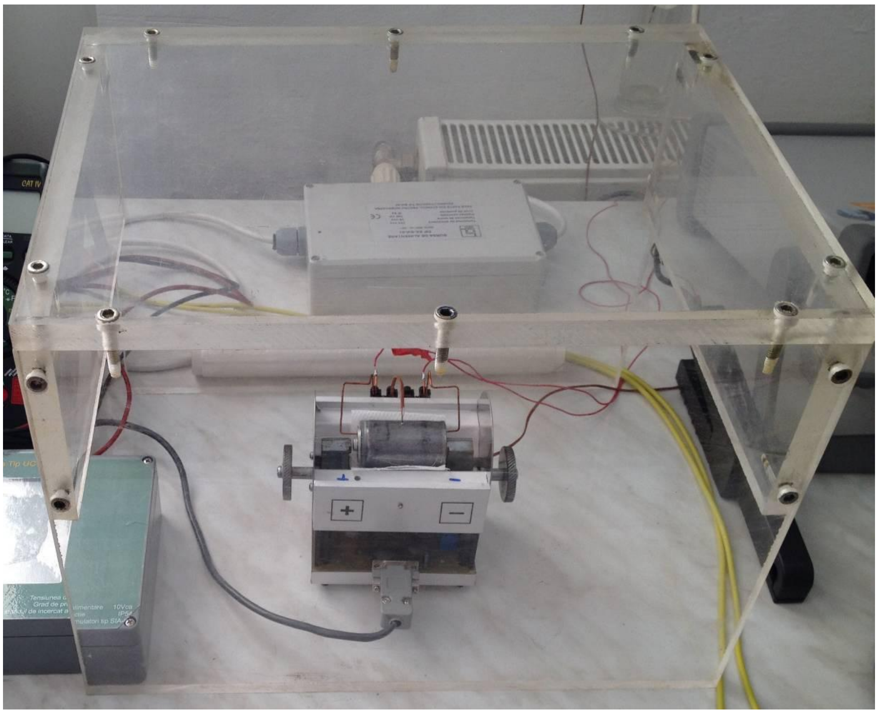

Fig. 4 Zoomed detail of electronic short-circuiting device of test rig.

4. Test results

The test results are shown in figures 5 to 8.

It was tested primary cell type TOSHIBA R20KG SIZE D Un=1,5 V.

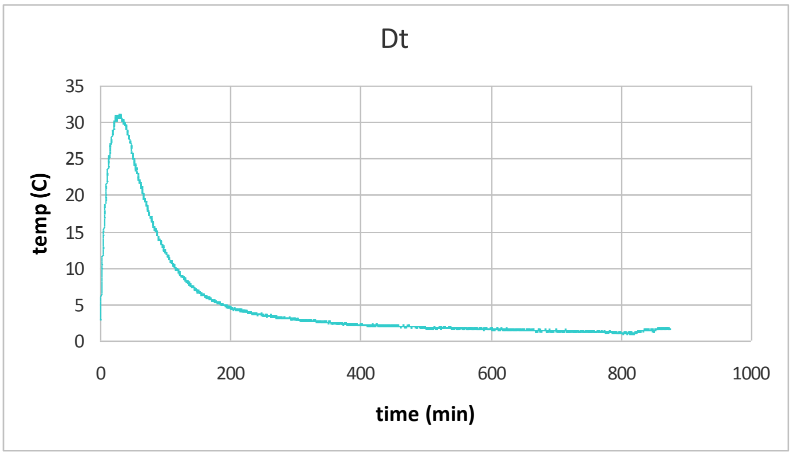

Fig. 5 Measured temperature at the middle of the cell

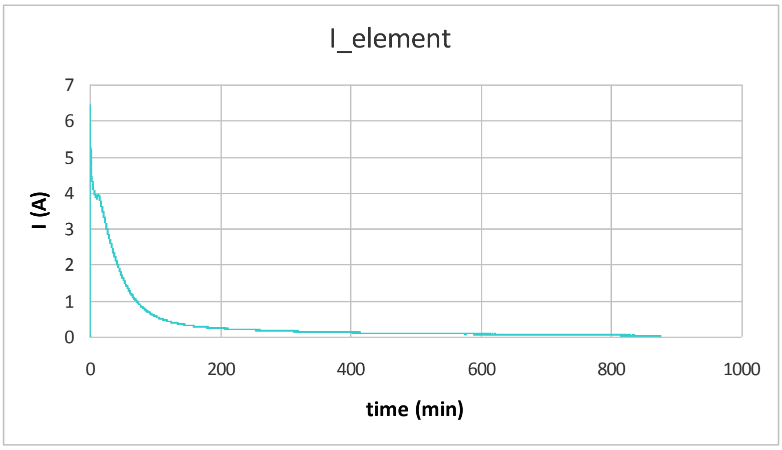

Fig. 6 Electrical current variation across the cell

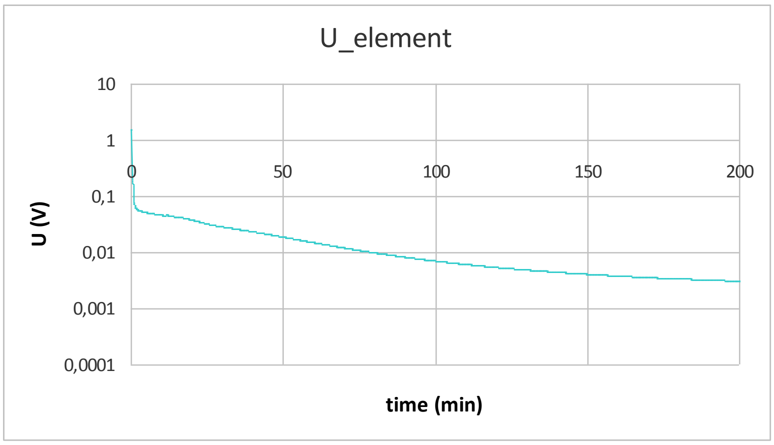

Fig. 7 Voltage across the cell

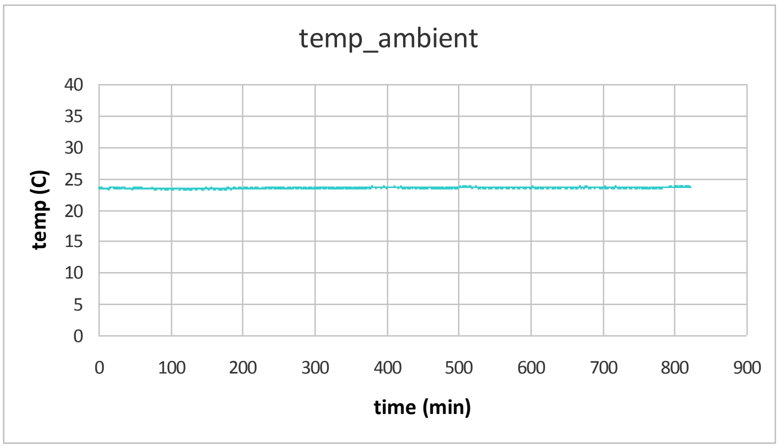

Fig. 8 Ambient temperature

For the purpose of computing the energy delivered by the cell could be used formula (1):

$$W = \int_0^T u(t) \cdot i(t) dt \qquad (1)$$

Additional the internal resistance of the cell which is relevant for spark test ignition could be computed with formula (2):

$$r = \frac{\max[u(t)]}{\max[i(t)]} \qquad (2)$$

For the tested cell total delivered energy is 624,4735 Wh, and minimum internal resistance is 273,77 mΩ

5. Conclusions

Test results of cell type TOSHIBA R20KG SIZE D, are:

- needed time for completely discharging of the cell is about 14 to 16 hours;
- the cell maximum surface temperature is 32 °C above the ambient temperature;
- the electrical current exponentially decrease with respect the time;
- delivered energy is about: 624,5 Wh
- internal minimum resistance is: 273,77 mΩ

Acknowledgements

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*** IEC 61951-1, *Secondary cells and batteries containing alkaline and other non-acid electrolytes – Portable sealed rechargeable single cells – Part 1: Nickel-cadmium*.
***IEC 61951-2, *Secondary cells and batteries containing alkaline and other non-acid electrolytes – Portable sealed rechargeable single cells – Part 2: Nickel-metal hydride*.
***IEC 61960, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Secondary lithium cells and batteries for portable applications*.

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Investigations on real-time implementation of a particle filter to estimate the state-of-charge of Ni-MH batteries in hybrid electric vehicles

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Abstract

In this research we investigate the on-board implementation in real-time MATLAB simulation environment of a Particle Filter (PF) estimator applied to estimate the state-of-charge (SOC) of a generic nickel - metal hydride (Ni-MH) battery. It is integrated into the battery management system (BMS) structure in order to drive a hybrid electric vehicle (HEV). The Particle Filter (PF) estimator can be used as a possible alternative to Kalman filters (KF) techniques, such as the most popular Extended Kalman Filter (EKF) and Unscented Kalman Filter (UKF) nonlinear Gaussian estimators. Similar as the concept, the particle filtering methods becomes today the most popular class of numerical on-line algorithms for optimal estimation of nonlinear and non Gaussian state-space dynamic models. The novelty of this approach is that the applicability of Particle Filter estimator is extended from routinely computer vision, econometrics, tracking problems, robotics and navigation fields to BMSs in automotive industry. Furthermore, it can be tailored to estimate the battery SOC of different chemistries, and also in fault detection and isolation (FDI) applications to detect , isolate and estimate the severity of possible BMS faults. The preliminary results obtained in this research are encouraging and reveal the effectiveness of the real-time implementation of the proposed PF estimator in the Battery Management Systems for driving the Hybrid Electric Vehicles (HEVs).

Keywords: Particles Filter; Kalman Filters; Battery Management System; Ni-MH Battery State-of-Charge; Estimation; Fault Detection and Isolation

1. Introduction

The battery state-of-charge (SOC) can be defined as the available capacity of a battery, more precisely as a percentage of its rated capacity. Its estimation is an essential operational condition parameter for battery management system (BMS) (Young et al., 2013). The most advanced and promising battery technologies existing in manufacturing automotive industry to drive the both Hybrid Electric Vehicles (HEVs) and the Electric Vehicles (EVs) are the nickel-metal hydride (Ni-MH) and lithium-ion (Li-ion) batteries. The both batteries have a great potential to reduce greenhouse and other exhaust gas emissions (Young et al., 2013). Theirs environmental impact is a key issue on the enhancing the battery technologies (Nordelof et al., 2014). The selection criteria to integrate in a HEV/EV BMS structure of one of these batteries are the cost, the specific power and energy, cycle life, and the presence of poisonous heavy metals (Young et al., 2013, Nordelof et al., 2014). From our purpose the Ni-MH batteries fully meet all these requirements. The main drawback of the Ni-MH batteries is given by the persistence of “memory” effect that reduces the battery's life. To avoid this effect is needed that the battery to be repeatedly completely discharged (Young et al., 2013, Johnson, 2001, Tremblay, 2007, and Tremblay 2009). Furthermore during the charging cycles the Ni-MH battery dissipates a significant amount of heat that increases considerably when operating at heavy loads. For simulation purpose we choose the simplest Ni-MH battery model, easy to implement in real-time the battery SOC Particle Filter (PF) estimator and to prove its effectiveness. Summarizing the paper is organized as follows. In section 2 and 3 is presented the battery terminology and a brief description of the Ni-MH battery model, necessary to build the proposed PF estimator. In section 4 is presented briefly the PF estimator approach. The simulation results and the performance analysis of the proposed PF estimator are presented in section 5. The contribution of this research and the future investigations are summarized in section 6.

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2. Ni-MH Battery Terminology

In order to have a good understanding of the battery pack and about its model the following terminology need to be introduced as in Young et al., 2013, Johnson, 2001, Tremblay, 2007, and Tremblay 2009, Plett, 2004a, and Plett 2004b:

- Battery cell - is a complete battery with two electrodes, holding compartment, separator, and electrolyte.
- Battery module – consists of a small amount of cells connected in series, parallel or in parallel-series configurations.
- Battery pack - consists of a few modules connected also in series, parallel or parallel - series.
- Battery Management System (BMS) - is an integrated battery structure consisting of measurement sensors, controllers, serial communication, and computation hardware with software algorithms.
- The voltage measured between the battery pack terminals when no load is applied is called open-circuit voltage (OCV).
- The voltage measured between the battery pack terminals when a load is applied is called battery terminal voltage or measured output of the battery model.
- C-rate - represents a charge or discharge rate equal to the capacity of a battery in one hour, e.g. for a 6 Ah battery, C is equal to charge or discharge the battery at 6A; in the same way, 0.1C is equivalent to 0.6 A, and 2C for charging or discharging the battery at 12A.
- Ampere-hour (Ah) capacity - is the total charge that can be discharged from a fully charged battery under specified conditions.
- The rated Ah capacity is the nominal capacity of a fully charged new battery under the conditions predefined by the catalogue specifications of the battery, e.g. the nominal condition could be defined as room temperature 25°C and battery discharging is at 1/25 C-rate.
- Specific energy (gravimetric energy density of a battery) - is used to define how much energy a battery can store per unit mass. Specific energy of a battery is the key parameter for determining the total battery weight for a given mile range of EV.
- State of charge (SOC) of the battery - is the ration between the remaining capacity of a battery and its rated capacity:

$$\mathrm{SOC} = \frac{\text{Remaining capacity}}{\text{Rated capacity}} \tag{1}$$

More precisely, the SOC for a fully charged battery is 100% and for an empty battery is 0%, defined as:

$$\mathrm{SOC}(t) = 100(1 - \frac{1}{\text{Ah capacity}}\int_0^t i(\tau)d\tau)\ (\%),\quad i(\tau) \geq 0 \tag{2}$$

Furthermore, the relation (2) it is useful to estimate the battery SOC, its dynamic being described by following first order differential equation:

$$\frac{d}{dt}(\mathrm{SOC}(t)) = -100\frac{i(t)}{\text{Ah capacity}},\ i(t) \geq 0 \tag{3}$$

It is worth to mention that the battery SOC is a critical condition parameter for battery management system (BMS), since it is affected by its operating conditions (load current and temperature), and therefore an accurate estimation of battery SOC is crucial for the battery health, and for its safe operation.

3. Ni-MH Battery Model

A simple battery model is given in Tremblay, 2007, and Tremblay 2009, that can be written in state-space representation as a second order model with two states, first one representing the battery SOC state variable:

$$\frac{dx_1}{dt} = -\frac{\eta}{Q_{nom}}i(t) \tag{4}$$

$$\frac{dx_2}{dt} = -B_{exp}x_2 i(t) \tag{5}$$

$$y(t) = E_0 - \frac{K}{x_1} + x_2 - Ri(t) = OCV - Ri(t) \tag{6}$$

where x_2 is the polarization voltage term of the following form:

$$x_2(t) = A_{exp} \times \exp(-B_{exp} \times \int_0^t i(\tau)d\tau) \tag{7}$$

more precisely, the exponential battery voltage rate.

- $y(t)$ is the terminal battery output voltage, and $i(t)$ is the battery cell current.

For simulation purpose the coefficients of the model are set for a particular NREL 6.5 Amps-hours Ni-MH battery and 1.3 Amps nominal current as follows (Johnson, 2001, Tremblay, 2007, and Tremblay 2009).

- η (the columbic efficiency) = 1 for discharging cycle, and η = 0.85 for charging cycle,
- Nominal battery capacity Q_{nom} = 5.2 (Ah),
- Exponential capacity coefficient B_{exp} = 2.3077 $(Ah)^{-1}$,
- Polarization coefficient K = 0.01875 Volts,
- OCV, $E_0 = 1.2848$ Volts,
- The charging and discharging battery resistance $R = 4.6\ m\Omega$ (milliohms).

This model is capable to reproduce accurately the manufacturer's OCV characteristic curves for the Ni-MH battery under investigation versus its state of charge (SOC) (Johnson, 2001, Tremblay, 2007, and Tremblay 2009).

The OCV discharging curve shown in figure 1 is obtained by injecting in a cell a constant discharging current $i(t)$, for example if the discharging current is set to 0.2 C rate = 0.2 $\times$ Q = 0.2 $\times$ 6.5 Ah = 1.3 A, then the battery will be completely slowly discharged in almost 5 hours (50 samples $\times$ 0.1 hours). In order to analyze the performance of the selected Ni-MH battery model for different driving conditions (urban, suburban or highway) different current profile tests can be used. For comparison purpose we can use the results of the tests under standard initial conditions on a HEV generic car in an Advanced Vehicle Simulator (ADVISOR) environment, developed by US National Renewable Energy Laboratory (NREL) (Johnson, 2001, Tremblay, 2007, and Tremblay 2009, Plett, 2004a, and Plett 2004b). Among different driving cycles current profiles provided by the ADVISOR US Environmental Protection Agency (EPA) we choose for our case study a single cycle (1370 seconds ≈ 23 minutes) Urban Dynamometer Driving Schedule (UDDS) current profile as is shown in figure 2.

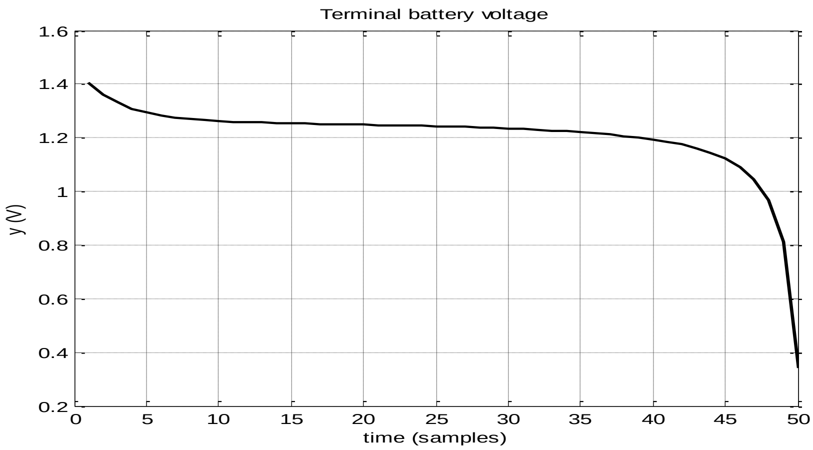

Fig. 1. The Ni-MH battery OCV discharging curve
Legend: 1 sample = 0.1 hours

4. Particle Filter Estimator

The Kalman filter is a very useful tool for state and parameter estimation of a wide range of industrial processes. More precisely, in mathematical terms we can consider that a Kalman filter estimates the states of linear and nonlinear systems (Simon, 2001, and Simon 2006). The Kalman filter is working well in practice, and also it is theoretically attractive since of all possible filters it is the one that minimizes the variance of the estimation error (Simon, 2001). Kalman filters are often implemented in embedded control systems because in order to control a process, an accurate estimate of the process variables is required.

The Kalman and Particle filters are algorithms that recursively update an estimate of the state and find the innovations driving a stochastic process given a sequence of observations. The Kalman filter accomplishes this goal by linear projections, while the Particle Filter does so by a sequential Monte Carlo method (bootstrap filtering), a technique for implementing a recursive Bayesian filter by Monte Carlo simulations (Gordon et al., 1993, Arulampalam et al., 2002). The state estimates are used to predict and smooth the stochastic process, and with the innovations can be estimated the parameters of the linear or nonlinear dynamic model. The basic idea of Particle Filter is that any probability distribution function (pdf) can be represented as a set of samples (particles) (Gordon et al., 1993, Arulampalam et al., 2002). Each particle has one set of values for the state variables. This method can represent any arbitrary distribution, making it good for non-Gaussian, multi-modal pdfs. The key idea is that it is easier to find an approximate representation for a high complexity non Gaussian dynamic model (any arbitrary pdf) rather than an exact representation of a simplified Gaussian dynamic model (Gordon et al., 1993, Arulampalam et al., 2002). In comparison with standard approximations methods, such as EKF (Plett, 2006a, and Plett 2006b), the principal advantage of PF methods is that they do not required any local linearization techniques (Jacobean matrices) or any rough functional approximation. Also the PF can adjust the number of particles to match available computational resources, so a tradeoff between accuracy of estimate and required computation, and are computationally compliant even with complex, non-linear, non-Gaussian models, as a tradeoff between approximate solution to complex nonlinear dynamic model versus exact solution to approximate dynamic model.

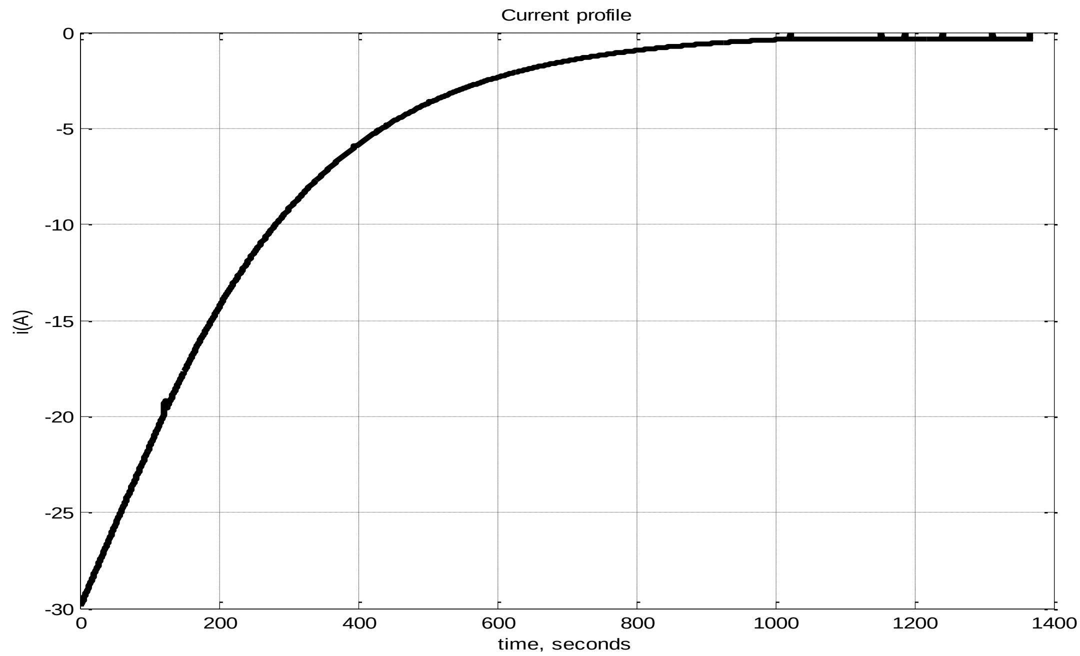

Fig. 2. The ADVISOR EPA UDDS current driving cycle profile

In the Bayesian approach to dynamic state estimation the PF estimator attempts to construct the posterior probability function (pdf) of a state based on available information, including the set of received measurements. Since the pdf embodies all available statistical information, it can be considered as the complete solution to the optimal estimation problem. More details about real-time implementation of Particle Filter estimator can be found in Arulampalam et al., 2002, tutorial. The simulation results in MATLAB 2013 environment of the PF estimator applied to estimate the Ni-MH Battery SOC can be seen in the next section.

5. Simulation Results

The performance of the PKF estimator in terms of SOC estimation, battery voltage, and robustness is shown in the figures 3 - 6. The number of filter particles is set to 100. Figure 3 reveals a high accuracy in battery SOC estimate value compared to ADVISOR and true values. Therefore the simulation results from figure 6 reveal the robustness of the PF estimator to the big changes in the initial SOC guess value. The simulation results from figure 5 reveal also a very good filtering of the PF estimator in the battery terminal voltage to the measurement and process noises injected in the model. In figure 4 we can see a slow convergence of polarization voltage estimate of PF estimator. The repeatability of the results can be proved by Monte Carlo simulations.

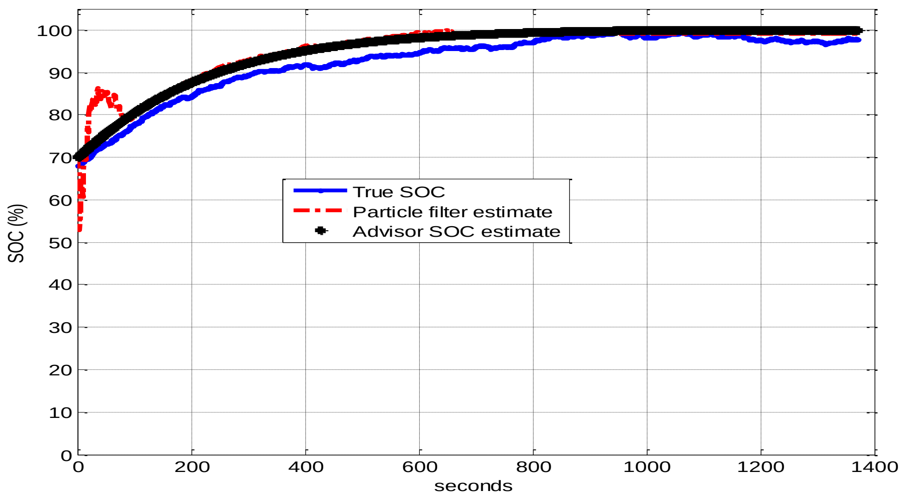

Fig. 3.The Battery SOC estimated by PKF estimator

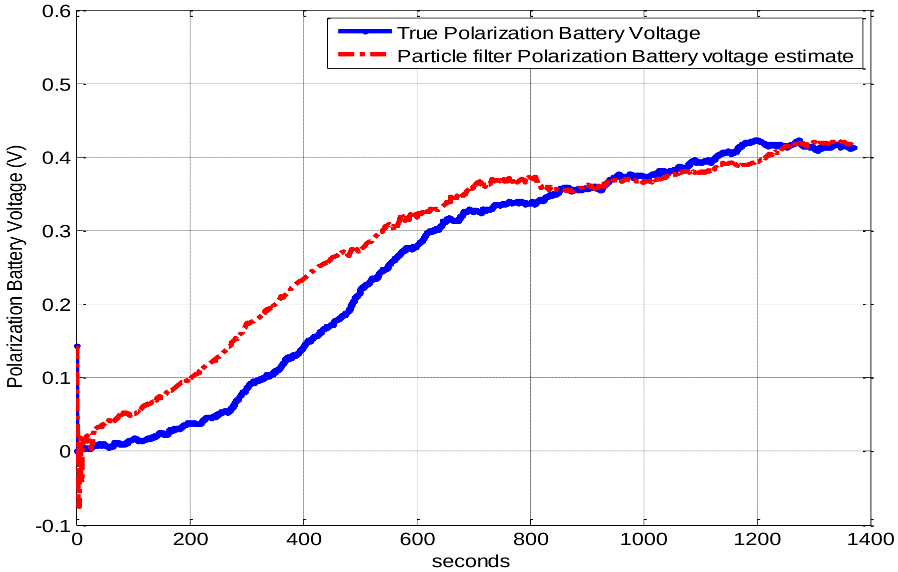

Fig. 4.The Battery Polarization Voltage estimated by PKF estimator

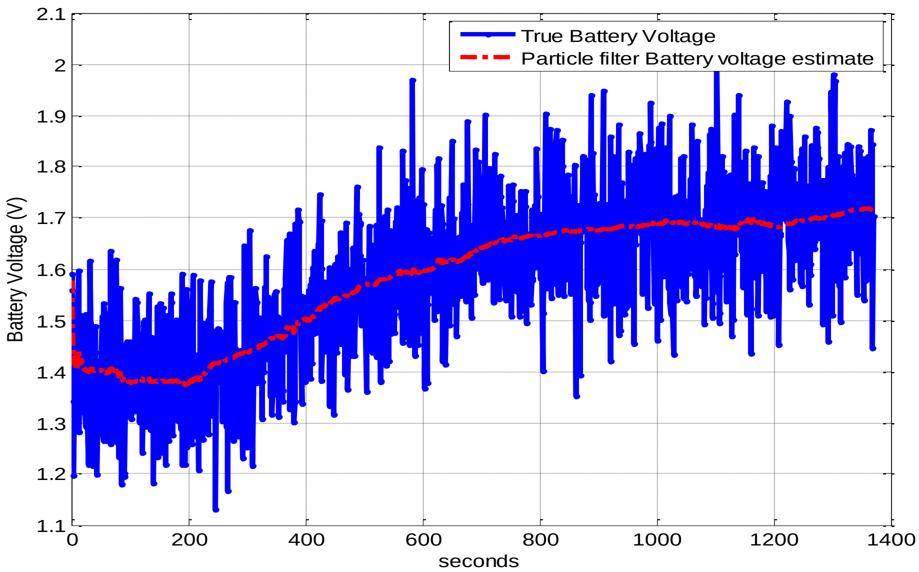

Fig. 5.The Battery terminal Voltage estimated by PKF estimator

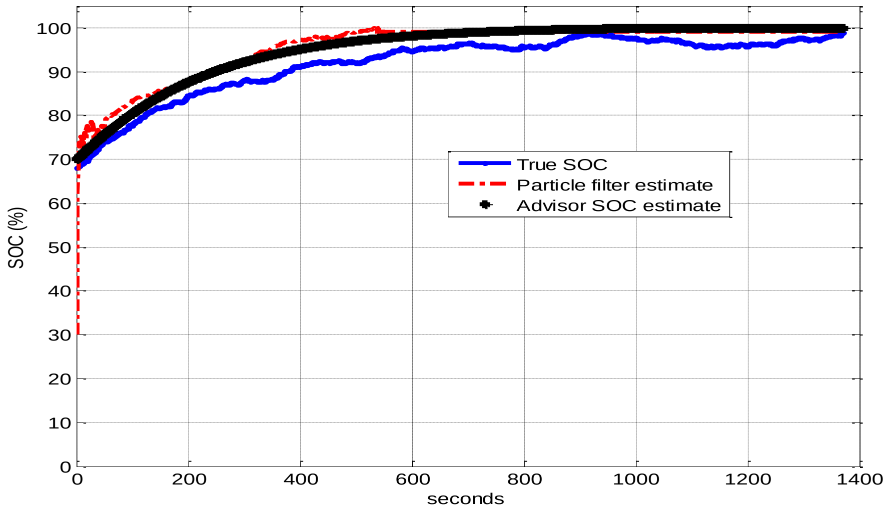

Fig. 6.The Robustness of PKF estimator to the changes in SOC initial value

6. Conclusions

The novelty of this paper is the implementation in real time of a robust PF estimator capable to estimate with high accuracy the Ni-MH battery SOC based on a simple battery electric circuit model without disturbance uncertainties. The simulation results obtained in a real-time MATLAB simulation environment reveal that the PF estimator is a most suitable alternative to UKF estimator for this kind of applications. The number of tuning parameters for PF is much smaller than for UKF estimator (Simon and Uhlmann, 1997, Tudoroiu and Khorasani, 2007). The PF estimator proved in this kind of applications its effectiveness and its implementation simplicity, and also more accurate estimation feature, so can be considered as one of the most suitable nonlinear estimator (Gordon et al., 1993, Arulampalam et al., 2002). Future investigations will be made to enlarge the applications field of PF estimator by developing the fault detection and isolation strategies to detect the faults inside the Ni-MH battery cells.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Increase the quality of measurements using virtual instrumentation built with open-source electronic platform

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Abstract

In this paper we present a way to use the open-source electronic platforms that are programmed through LabVIEW graphical programming environment. The application that is made is a programmable instrument used for measuring the short distances based on time of flight of sound waves in an environment with known propagation properties. Based of obtained results are made assessments on the quality of information obtained.

Keywords: transducer; time of flight; Arduino; LabVIEW; virtual instrument

1. Introduction

Electronic platforms open – source offer users the possibility to create its own hardware structure based on a core developed around a microcontroller. Their usefulness is essential in the realization phase, and especially in prototyping phase of the technical systems requiring a central processing unit like microcontroller type (Oxer J., Hugh B., 2010).

There are many areas where such hardware equipment is used for prototyping integrated hardware and software applications which are designed. Thus, one can find in various areas, from industrial, audio or video electronics (such as Arduino, Netduino, Neuros Digital Audio Computer, Neuros OSD), the computer systems (such as Ben NanoNote , ICub multi-touch, Open Compute Project), robotics (such as ArduCopter, ICUBE, OpenROV) to the environment (Air Quality Egg, Open Source Ecology) or automotive (Riversimple Urban Car, OSCAR open source car).

In order to achieve the virtual instrument that we propose in this paper we used the Arduino platform. This is a development board achieved in various configurations, every of these using various microcontrollers ATmega and can be used for building digital devices and interactive objects that can sense and control physical devices. To do this, the microcontroller has ports which give the access to a suite of ports or pins of input/output to interact with the environment. Arduino is both a software product and a concept through which is made the extension of the term open-source over the particular technical achievements (schemes, electronic wiring, etc.). The software component of the platform is integrated into a graphical user interface (GUI), IDE type, which is based on programming language named Processing (Durfee W., 2008).

The programming of the physical platform is done using the Arduino programming language which is used for writing software that can be uploading on Arduino physical platforms. The interface is written in Java programming environment used open-source programming languages like Processing, AVR-GCC. The interface is multiplatform and can run in Windows, MacOS or Linux operating systems (Evans W.B., 2014). The program can be obtained both as executable specific a work platform specific and the form of source code that can compiled under specific work conditions.

2. Ultrasonic displacement measurement principle

The virtual instrument that we propose in this paper is a measurement programmable system used to measure small distances up to 400 cm. As mentioned above at the Arduino development board can connect various sensors and

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actuators. Thus for distance or displacement measuring a transducer is used and its functionality is based on the echo effect of an ultrasonic wave.

Ultrasonic displacement transducers emit an ultrasonic sound wave that is reflected from the target. The distance between the target and the transducer can be calculated by measuring the time it takes the wave to reflect and the wave's propagation velocity in the medium between the probe and target (Alan S. M., 2009). The signal conditioning is able to detect the time required for part of the wave to reflect from the back face of the material to the front face. Fig. 1 illustrates a typical ultrasonic displacement transducer that is used into this application, i.e. HC-SR04.

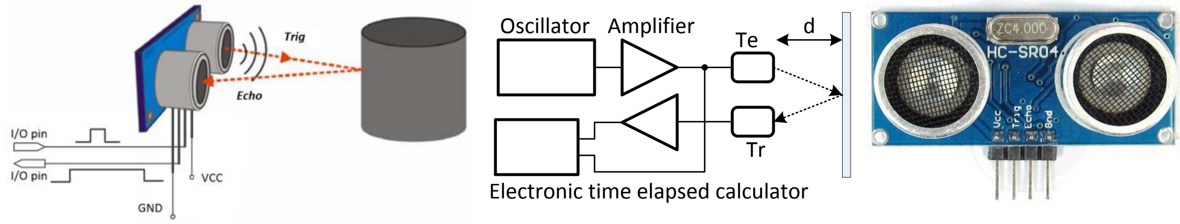

Fig. 1. Principle ultrasonic displacement transducer operation (a) and measurement (b); (c) HC-SR04 ultrasonic displacement transducer operation

Ultrasound is an acoustic wave with a frequency higher than the audible range of the human ear, which his 20 kHz. The basic principle for the use of ultrasound as a measurement tool is the *time-of-flight technique*. The pulse-echo method is one example. In the pulse-echo method, a pulse of ultrasound is transmitted in a medium. When the pulse reaches another medium, it is totally or partially reflected, and the elapsed time from emission to detection of the reflected pulse is measured. This time depends on the distance and the velocity of the sound. When sound travels with a known velocity *v,* the time *t* elapsed between the outgoing signal and its incoming echo is a measure of the distance *d* to the object causing the echo (Dunn C. W., 2006).

$$d = \frac{v \cdot t}{2} \tag{1}$$

The transmitter *Te* and the receiver *Tr* could be the same device or also they could be separated like is shown in this figure.The oscillator generates an electric signal with a typical frequency of 40 kHz. This electric signal is transformed into mechanical vibrations of the same frequency in the transmitter. These vibrations generate sound waves that are reflected by the object. The reflected sound echo causes an electric signal in the receiver. For precise measurements, the speed of sound is a crucial parameter. A typical value in air at 1 atm pressure and room temperature is 343 m/sec, but the speed of sound is influenced by air pressure, air temperature, and the chemical composition of air (water, CO2, etc.).

Measuring distances in an environment with large temperature gradients can result in erroneously calculated distances. As an advantage, ultrasound waves are robust against other disturbances such as light, smoke, and electromagnetic interference (Webster G. J. et al., 2000).

3. Hardware structure

The ultrasonic displacement transducers HC-SR04 is connected to the Arduino development board through digital pins which are used for transmit the ultrasonic wave, respectively for receipt the echo. To do this the digital pins 9 and 10 are used like transmitter source respectively receiver, so the block structure is shown in fig.2.

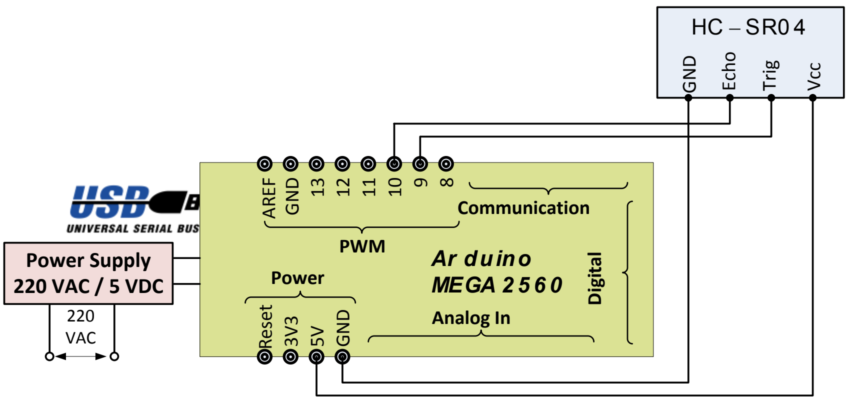

Fig.2. Hardware structure

The timing diagram of the ultrasonic transducer HC-SR04 is shown below, fig.3.

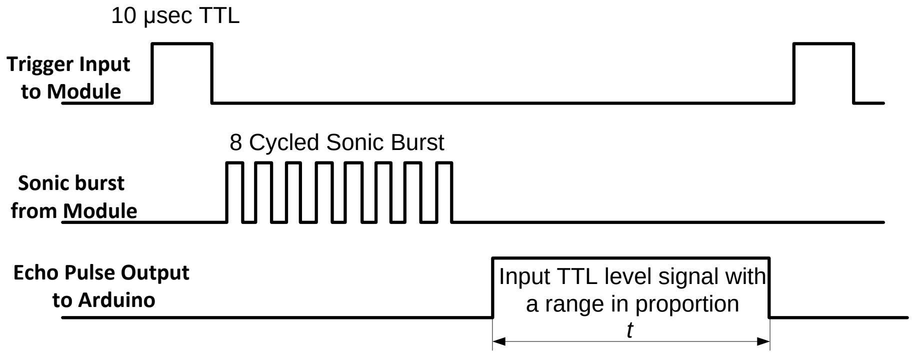

Fig.3. Timing diagram of the HC-SR04 ultrasonic transducer

To obtain the complete functionality of this transducer need to supply a short 10 µsec pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion. Having the echo pulse output it is possible to calculate the range through the time interval between sending trigger signal and receiving echo signal.

To compute the distance *d* based on measured echo signal width *t* it can use the relation *(1)* in which the sound speed *v* can be considered a constant. If the sound speed is considered as a constant, usually v = 340 m/sec, the distance *d* can be compute, in centimeters or inch, in a simplified manner using the following formula:

$$d[cm] = \frac{t[\mu sec]}{58} \text{ or } d[inch] = \frac{t[\mu sec]}{58} \qquad (2)$$

The trigger input signal, having width 10 µsec and TTL level, is generate to the HC module by the Arduino prototyping platform through pin 9 from PWM port. The echo signal, from HC module, is received also by the Arduino through pin 10 from the same PWM port. The ultrasonic module manufacturer suggests using over 60 msec measurement cycle, in order to prevent trigger signal to the echo signal.

Is evident that, the accuracy of distance measurement is directly proportional to the precision with which the speed of sound wave is used in the formula of calculation. Also it is known that the actual speed of sound is a function of both the composition and temperature of the medium through which the sound travels. Considered the air as medium through which the sound travels, the dependency between the speed of sound wave and temperature of the air is shown in fig.4.

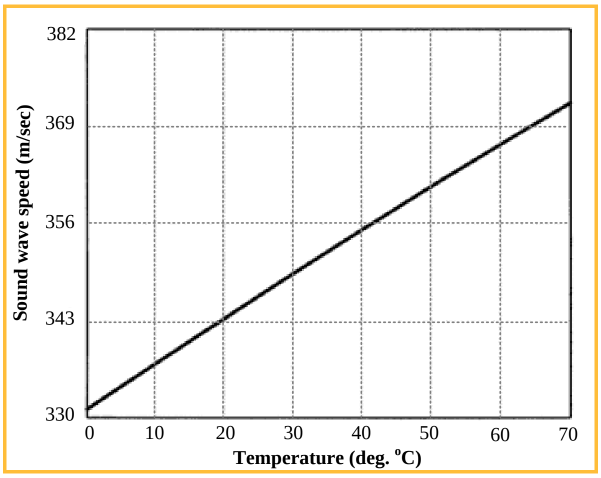

Fig.4. The dependency between the speed of sound wave and temperature of the air

Taking into consideration the effect of temperature *Tc* [°C], the speed of sound in air varies as a function of this temperature by the relationship:

$$v(Tc) = 331.31 \cdot \sqrt{1 + \frac{Tc}{273.16}} \text{ [m/sec]} \qquad (3)$$

and based on *(1)* result the relation which can be compute the distance *d* having the temperature *Tc* and echo pulse duration *t*:

$$d = 1002 \cdot 10^{-6} \cdot \left(\sqrt{373.16 + Tc}\right) \cdot t \ \ [m] \qquad (4)$$

where:
- *v(Tc)* is the speed of sound wave in air as a function of temperature in meters per second
- *Tc* is the temperature of the air in ^{o}C

4. Software structure

The software used is a virtual instrument (VI) which is an application built in LabVIEW programming language. LabVIEW is a graphical programming language that uses icons instead of lines of text to create applications. In contrast to text-based programming languages that use instructions to determine the order of program execution, LabVIEW uses dataflow programming. In data flow programming, the flow of data through the nodes on the block diagram determines the execution order of the VIs and functions. Such a virtual instrument has three components, two of which mean the block diagram and the front panel is functional components and the third, which is the icon/connector, is used in development of software with a hierarchical structure (Beyon J.Y., 2001, Derenzo E. S., 2003).

4.1. Block diagram

The block diagram represents the program itself for functioning of the virtual instrument and contains necessary operations, functions and programming structures. In this application we use two block diagrams, one of these represent the target, represents the data acquisition component and it is compiled into microcontroller from Arduino board and the other is the graphical use interface (GUI) and represents the data processing component.

To program the Arduino development board is used The Arduino™ Compatible Compiler for LabVIEW produced by Aledyne – TSXperts (TSXeperts Alledine, 2015). The Arduino Compatible Compiler for LabVIEW is a true compiler, in the sense that a LabVIEW VI will be compiled into the Arduino compatible programming language, downloaded to the Arduino target and will execute embedded in the target. It is important to highlight a basic difference between the actual compilation of a LabVIEW VI into an Arduino target and a simple communication between an Arduino sketch running in the target and a LabVIEW VI, as provided by other existing toolkits, like LINX software. Any Arduino compatible hardware can be a target for the Arduino Compatible Compiler for LabVIEW.

In fig. 5 is showing the VI for this application that was downloaded into microcontroller memory from Arduino platform.

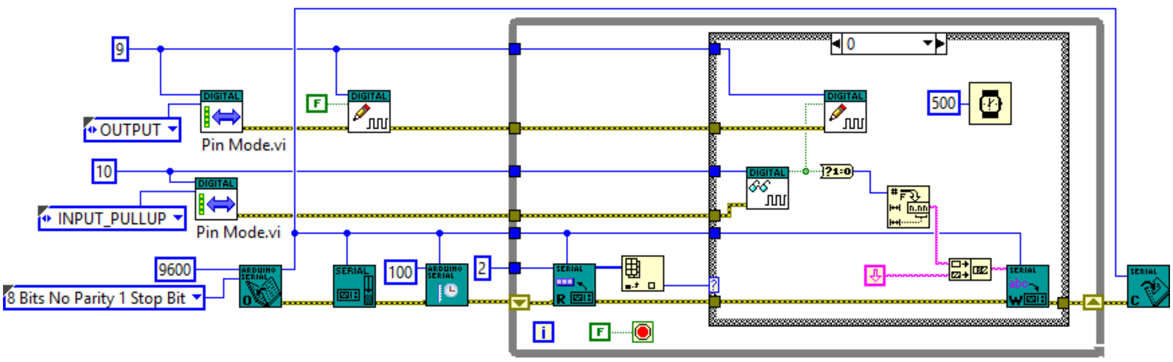

Fig.5. Block diagram of the target virtual instrument

In this VI, first are defined the functions for used pins from Arduino, using the *Pin Mode.vi* functions, corresponding to the hardware structure shown in fig.2, so the pin 9 is an output pin and the pin 10 is an input pullup pin. Further, specific functions are invoked and used, as follows:

1. Call *Serial Open.vi* to open a serial connection to the host PC
2. Call *Serial Flush.vi* to make sure the serial drive functions wait for the transmission of outgoing serial data to complete
3. Call *Serial Set Timeout.vi* to set the maximum time the *Serial Read.vi* will wait for serial data
4. Execute the While loop once a second if it is transmitting data points or once every 500 msec.
5. Loop indefinitely
6. Transmit a value corresponding to the with a line feed (\n) as termination character
7. Call *Serial Write String.vi* to transmit the data points via serial communication

8. Call *Serial Close.vi* to close the serial connection to the host PC

With this VI, which once loaded into the microcontroller ensures standalone functioning of it, the values representing echoes duration pulses are transmitted every 500 msec.

The data are received also through serial connection by the host PC. Here run the VI used for data processing and display the needed information over the user interface. The block diagram of the host PC virtual instruments is shown in fig.6.

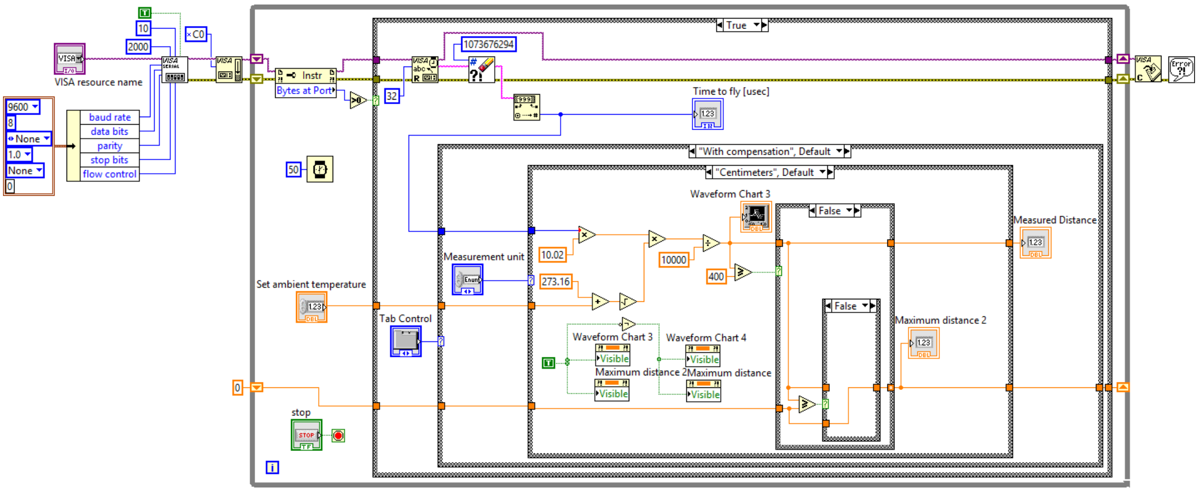

Fig.6. Block diagram of the host PC virtual instruments

It can observe here that the host PC resident program begins by establishing the serial communication between PC and the Arduino target by setting the parameters for VISA functions used for this communication (Sumathi S., Surekha P, 2007). From the Arduino are read values representing echoes duration pulses *t* (*Time of flight*). The reading value is used further to compute the distance *d* using either the simplified relationship (2) either the relationship with temperature compensation (4). Choosing one or the other of the options "*Without compensation*" or "*With compensation*" is made through the Case structure having to his selector linked the **Tab Control** switch. Also through the "Measurement unit" switch linked to the selector of another Case structure is possible to choice between centimeters or inches like unit of measurement for distance. The program through which data processing and display of results are made, both numerically and graphically, once launched in execution will run until **STOP** command is activated. This operation is provided by repetitive structure *While*. The program can provide and the maximum for displacement for each of the possible options.

4.2. Front panel

The front panel of the virtual instrument represents the user interface and contains the controls through which the user can introduce the commands or settings values, also contains the indicators through which the user can read the values resulting from data processing.

Two pictures taken from front panel for the two options corresponding at two measurement units, centimeters and inches are shown in fig.7.

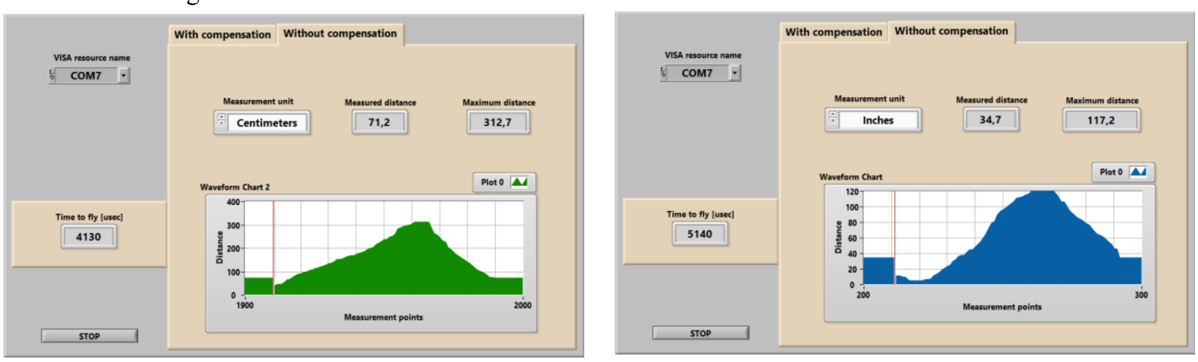

Fig.7. The front panel corresponding to the measurement without temperature compensation.

On the front panel there are three elements of control type through which the user can:

- choose the Arduino development board from the list of connected devices on COM serial ports (**VISA Resource Name**);

- choose the unit of distance measurement (**Measurement Unit**);
- stop the program from running (**STOP**).

Also on the front panel there are three elements of numeric indicator type through which the user gets values about:

- the time measured in microseconds, required to the ultrasonic wave to scroll round trip distance to and from the target (**Time of Flight**);
- the distance value expressed in the selected unit length (**Measured Distance**);
- the maximum distance identified in a measurement cycle (**Maximum Distance**)

and a graphic indicator of distances measured in a cycle (**Waveform chart**).

The user can switch, through Tab Control, to the calculus of the distance by taking into account the effect of temperature on propagation conditions, which corresponds to the situation expressed mathematically by the relationship (4). So the snapshots corresponding to this situation are shown in fig.8.

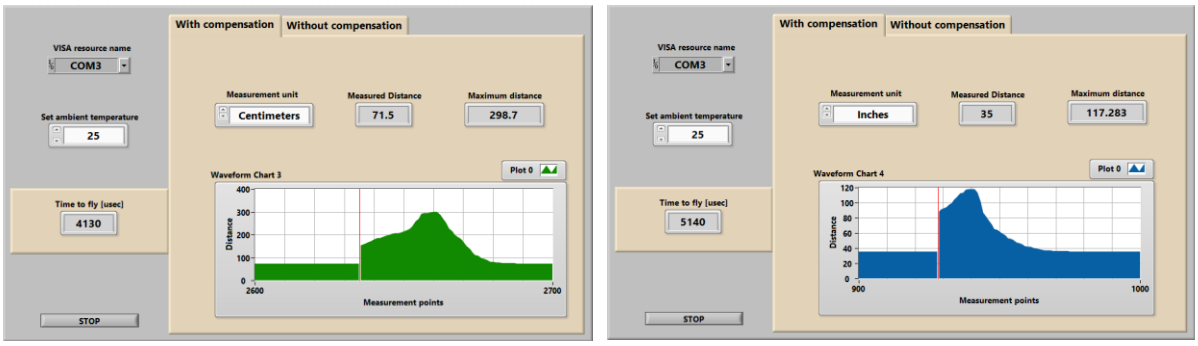

Fig.8. The front panel corresponding to the measurement with temperature compensation.

5. Conclusions

Following the obtained results it can conclude that this virtual instrument can be used to generate a map around the sensor. Elements of this map are represented by the distances between sensor and the objects around it, up to a distance of max. 400 cm. This map can be used further into command of robots or into command of machine tools. Considering the minimum time required between two measurements of 50 msec. result that for a complete rotation per second it can obtain an accuracy of 18 degrees. If distances decrease, because the time between two measurements decreases up to 10 msec. the accuracy increase to approx. 3 degrees between two measurement points on a circle with 100 cm radius.

Also, following the obtained results it can conclude that the accuracy of measurement increases, if is used the temperature compensation.

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Development and research of hybrid polymer composite materials based on phenylone

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Abstract

The article presents the results of studying the designed hybrid compositions based on phenylone reinforced with a mixture of organic and carbon fibers. An example of calculation of molds' construction for the manufacture of composites is given. It has been found that the intensity of wear of the developed composites is significantly higher than that of the initial phenylone, while possessing the reduced coefficient of friction by 1.6 - 2 times, and the increased physico-mechanical characteristics by 10 %.

Keywords: hybrid polymer composites, polyamide, organic and carbon fiber, mold, matrix.

1. Introduction

This century, by analogy with a Bronze or Iron Age, can be called the Composite Materials (CM) Age. The emergence of the term refers to the middle of the previous century, but the concept itself is not new. Combinations of different materials were used in the construction of homes by engineers of ancient Babylon and Rome, the masters of ancient Greece, and Moscow architects (Composite materials, 2013).

Most of the properties of the obtained CM are advantageous over the properties of initial components. The introduction of such materials gave a possibility to selectively choose CM properties essential for particular applications. CM application provides for a new qualitative leap in increasing the engine power, energy and transportation systems, reducing the weight of machines and appliances. CM turned out to be cost-effective and easy-to-design, and are now used everywhere - from the production of toys and tennis rackets to use in spacecraft (insulation, chips, etc.) (Composite materials, 2019; Naberezhnaya & Burya 2016).

Fibrous composite materials are composite materials in which various fibers are used as fillers. The peculiarity of the fiber composite structure is uniform distribution of high-strength, high-modulus fibers in the plastic matrix (where their content can reach 75%). Within fibrous CM, fibers perceive major stresses in the composite material in case of the external loads, and provide for the strength and hardness of the composition in the direction of fiber orientation. Matrix filling interfiber space enables the interaction of individual fibers due to its own hardness and interaction existing at the interface matrix-fiber. Mechanical properties of fibrous CM are determined by three parameters: high strength of reinforcing fibers, rigidity of matrix and binder strength at the interface matrix-fiber (Naberezhnaya & Burya 2016; ZUKM, 2016). There are several papers which examine different characteristics of phenylone. Investigation of creep in phenylone was done by authors (Vikhauskas, et al. 1988). Energy disipation of carbon-filled plastics based on phenylone was done in paper by (Burya, 2005). Curing and thermo-destruction processes of prepreg based on phenylone paper (Khabenko, et al. 1992), influence of aggressive media on tribotechnical properties of phenylone (Burya, et al. 1994). Investigation of the properties of carbon plastics based on polyetheretherketone and temperature fields at consolidation of powder material is given in papers (Burya, et al. 2016a; 2016b).

Fiber composites were obtained for the first time at the beginning of the twentieth century and were represented by phenoplasts with cotton fiber. Usually, a common name of polymer composites corresponds to the nature of fibers: glass -, carbon, ogano-, boroplastics, or - in case of hybrid options - glass carbon plastics, organoboroplastics, etc. (Astanin,

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2011). Depending on the technology of molding, CM indicators may significantly differ. The choice of a technology depends on the product's construction, terms of its exploitation, the volume of production and available production resources (ZUKM, 2016). Wrong organization of the technological process, poor preparation of initial components, failure to comply with technological modes (pressing pressure, duration and temperature of the process, the requirements for the preparation of raw materials), and many other reasons can significantly change the properties of finished products. Therefore, it is essential to organize the process not only correctly, taking into account the construction and exploitation conditions of the products, but also complying with technological modes during implementation. In order to achieve this, current control of technological parameters and properties of the manufactured products must be carried out at all stages of the process (Bobovich, 2016).

When developing products for engineering or instrument construction, wide application of construction plastics is often constrained due to lack of information about the full set of characteristics of new construction plastics, about their behavior in various tribological systems, though their use in the manufacture of products for engineering will significantly enhance the area and operating conditions and will increase the resource of products, knots, mechanisms or constructions (Dariyenko, 2012). On the basis of the mentioned above, an opportunity to develop CM polymers based on thermoplastic matrix has been studied and their properties have been researched.

1.1. Objects and research methods

As a binder an aromatic polyamide phenilon C-1 has been selected (TC 6-05-221-101-71). It is a fine-dispersed pink powder with bulk density of 0.2 - 0.3 g/cm3 and specific viscosity of a 0.5 % solution in dimethylformamide with 5 % of chloride lithium of at least 0.75, characterized by the following properties: shock viscosity of 24 kJ/m2, hardness of 18 HRB, breaking stress at extension of MPa. For reinforcement a mixture of discrete fibers has been used:
• organic (OF) of Tanlon brand, з mm long; elastic modulus at extension of 7.45 GPa, elongation at break of 20-25 %, density of 1.42 g/cm3;
• carbon (CF) Toreyka, 3 mm long, elastic modulus at extension of 220 - 230 GPa, density of 1,76-1,80 g/cm3.

A certain composition (Table 1) has been prepared and carried out by dry mixing within a rotating electromagnetic field (0.12 T) (Burya, et al. 2014).

Table 1. The formulations

Designation of compositions	Filler fiber wt/%				The content of the binder mass. %	
Compositions 1		-		-		100
Compositions 2		4		5		91
Compositions 3	Tanlon	5	Toreyka	7	Aromatic polyamide phenylone C-1	88
Compositions 4		5		15		80
Compositions 5		15		5		80

Processing of the prepared compositions into cylindrical products (10x15 mm) has been made by compression pressing. This method of processing the aromatic polyamide is the preferred one, because the polymer placed in the loading camera mainly experiences compressive deformation, and there is almost no strong shear deformation. Particular attention has also been paid to the choice and maintenance of processing temperature with high accuracy (Burya, et al. 2016).

Studies of microstructure have been carried out with the help of Biolam M microscope on specially prepared samples with the multiplication of 200. Density and Rockwell hardness (HRE scale) of the obtained polymer composites have been determined in accordance with GOST 15139 - 69 and GOST 2422-91, respectively. Tribological properties of hybrid materials have been studied on the disk drive friction machine in the mode of dry friction by the scheme "disk-finger" at specific pressure P = 0.6 MPA and sliding velocity of 1 m/sec, the track of 1000 m.

1.2. Development of molds

Shape and size of a finished product have been formed in specially designed molds. In order to ensure safety and security while operating the molds, the solution of some problems during their construction is required. This especially concerns such factors as creep of polymer materials, stress relaxation, fatigue by static or cyclic loads, aging by changes in the environment. It is extremely important to determine the correct construction of the geometric configuration in order to avoid a sharp increase of stress concentration and as a consequence of high values of product deformations. Local increase of stress in case of linear-elastic behavior of the polymer is characterized by the coefficient of stress concentration Ks (Naberezhnaya & Burya 2016), (1):

$$K_H = \frac{\sigma_{Max}}{\sigma_{HOM}} \qquad (1)$$

which is a ratio of the maximum local stress σмax to the nominal stress σnom.

For the manufacture of prototypes, molds have been developed consisting of the following details: matrix, upper poinson, sign, lower poinson.

One of the main details of technological application is the matrix in which the product acquires the necessary configuration and sizes. The matrix is a cylinder with holes in it, relevant in size to outer dimensions of the manufactured products. In the process of operation the matrix experiences stress, different in intensity, therefore, calculation of mechanical strength of matrices' walls is required. The calculation of the thickness of the matrix walls has been carried out by the formula (2).:

$$\delta = r \cdot \left(\sqrt{\frac{\sigma_p + 0{,}4 \cdot P_o}{\sigma_p + 1{,}3 \cdot P_o}} \right) \qquad (2)$$

where δ is the wall thickness, m; r is the radius of a shaping nest, m; P_o is the specific pressure of molding, N/m^2; σex is the allowed tension at extension, N/m^2.

The height of the matrix, which often plays the role of the loading camera, is not really calculated. Depending on the specific amount of material it is accepted as being 5-6 times as high as the height of the pressed products. Mechanical strength of other details of technological application is not calculated, their dimensions are determined by the size of the pressed details taking into account the shrinkage (relative reduction of the product size compared to the size of forming areas of molded details). These dimensions are determined by the expression (3).

$$l_{FA} = l_D \cdot y_0 + l_D \qquad (3)$$

Where l_{FA} is the size of the forming area, mm; l_D is the desired size of a product, mm; y_0 is relative linear shrinkage of the processed material, %.

Correctly selected technological modes of pressing products made of polymeric materials are some of the most important prerequisites of achieving the desired strength properties. As a result of an incorrectly selected production mode the following problems may occur:

- partial crystallization of the melt;
- high degree of polymer orientation;
- lack of filling within the forming cavities of the mold;
- porous formation caused by failure to maintain a given pressure during product cooling;
- cold junction formation

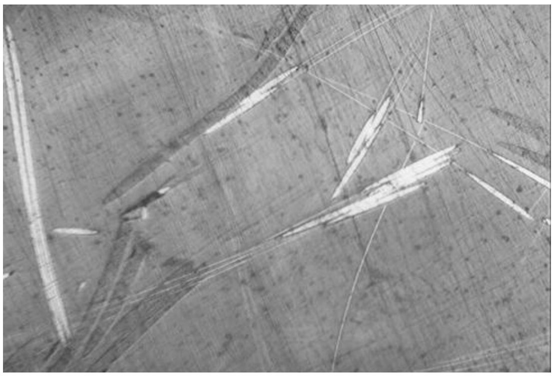
During exploitation, the details of technological application are subject to long-term heating and are affected by chemically active agents. Therefore, materials of which mold details are made, must possess minimum deformation during thermal processing, high hardness after heat treatment, and must be well processed. With this concern, mold details have been thermally treated to the hardness of 48-51 HRCe, and the purity of the surface of the forming elements made Ra 0.10 - 0.16 mcm.

Mold details (matrix, upper and lower poinsons, sign) were made of stainless heat-resistant steel ХВГ GOST 5950-73, and auxiliary equipment (heating plates, out-pressing sleeves, plates, etc.) was made of ordinary carbon steels Art. 3, Art. 5, Art. 20.

Samples of hybrid compositions for their complete study have been obtained by means of previously (Sokolov, 1975) selected optimal processing modes.

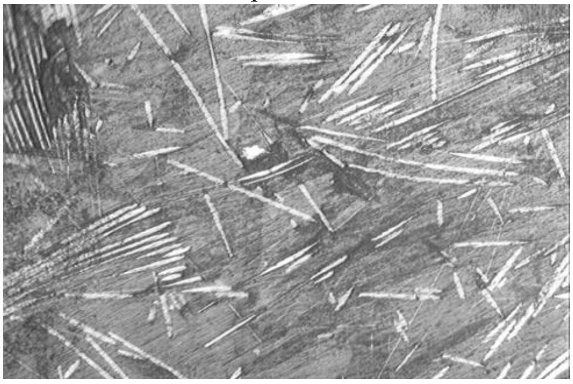
1.3. Results and discussion

The analysis of the microstructure of the received samples has shown that the selected way of products processing does not disturb uniform distribution of fibers within the polymer matrix (Fig. 1).

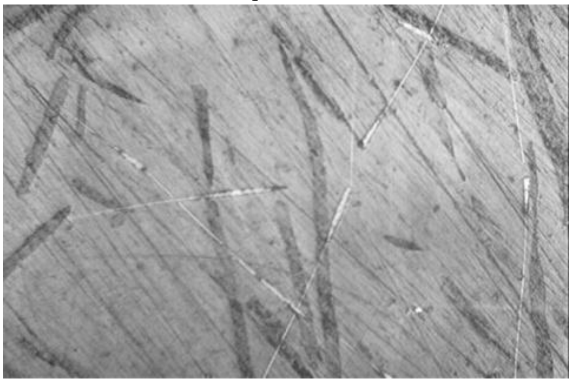


Compositions 2

Compositions 3



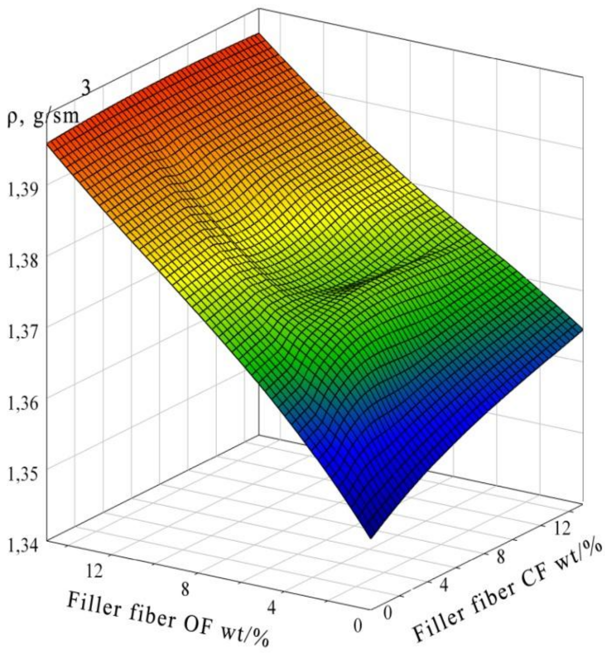
Compositions 4



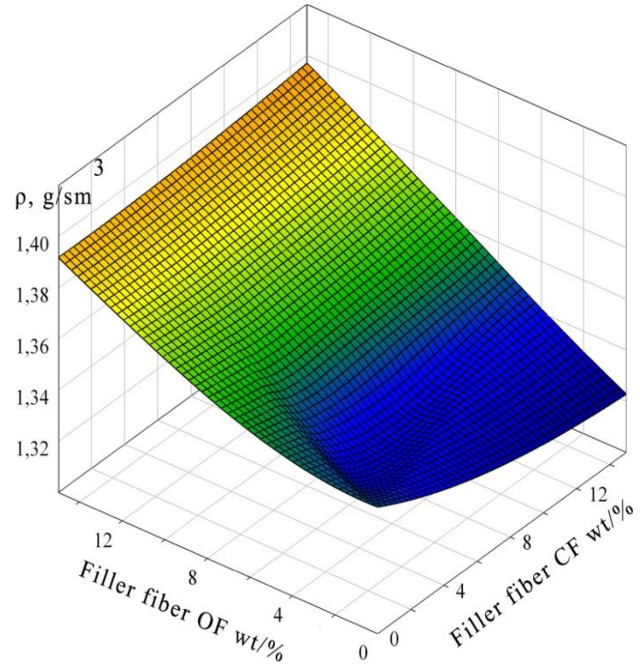
Compositions 5

Fig. 1. Microstructure of hybrid compositions (multiplication 200)

Nowadays one of the most important tasks is the reduction of construction mass. This can be achieved by means of replacing metal details with polymer ones, as they have significantly lower density and not inferior mechanical characteristics. It has been found that the developed PCM possess low density (Fig. 2), namely: its values are changing in the range of 1.34 - 1.39 g/ sm^3, which is almost 7 and 6 times below bronze OCS 5-5-5 (most widely used for the manufacture of rubbing details) and steel, respectively.



a



b

Fig. 2. Calculated (a) and experimental (b) density of hybrid compositions based on phenylone

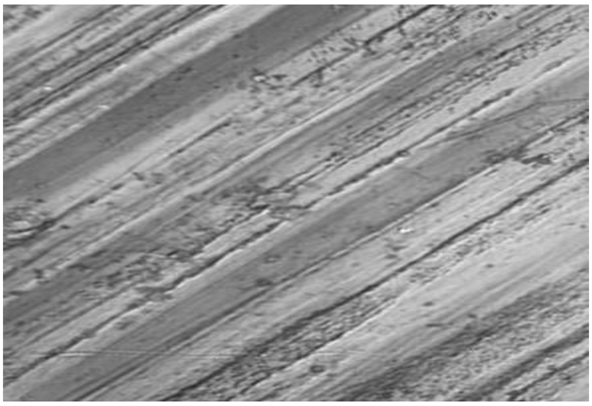
Analyzing the obtained dependency curves of density on the content of filler in the matrix, it is possible to say that during the experiment more porous structure of the samples compared to the calculated data is formed. This is due to the fibers' hardness and the lack of the embracing ability of the polymer. Taking this into consideration, it seemed particularly important to study the influence of a reinforcing component on mechanical properties of the obtained materials.

For many materials a clear dependence between the hardness of a material and its mechanical and technological characteristics (strength, wear resistance, stability under stress) has been set. Therefore, a study of hardness has been conducted, and it turned out that reinforcement leads to an increase in this index by 10 % compared to pure phenylone (Table 2), reaching the maximum value of 103 HRE in case of filling a binder with a mixture of fibers at the amount of 15 wt.% of organic and 5 wt.% of carbon ones.

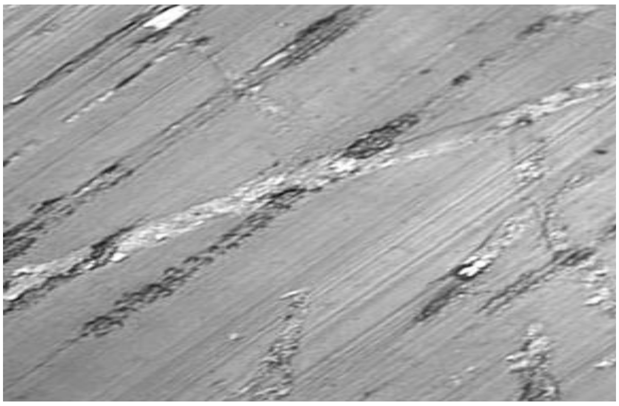
Table 2. Properties of hybrid polymer composites

Indicators	Compositions 1	Compositions 2	Compositions 3	Compositions 4	Compositions 5
Rockwell hardness (HRE scale)	97,3	101,3	102,2	102,5	103
Coefficient of friction	0,52	0,259	0,294	0,310	0,320
Intensity of wear	$2{,}2\cdot10^{-8}$	$2{,}43\cdot10^{-9}$	$1{,}36\cdot10^{-9}$	$1{,}94\cdot10^{-9}$	$3{,}9\cdot10^{-9}$

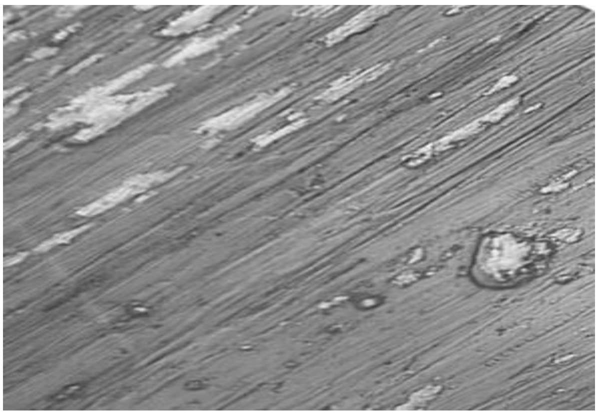
During the test aimed at defining tribotechnical characteristics, it has been found (Table 2) that the intensity of wear of the obtained compositions is significantly superior to the initial polymer, while reducing the coefficient of friction by 1.6 - 2 times. This is obvious in the study of microstructure of the friction surface (multiplication 200), where the reduction furrows and friction tracks have been clearly seen (fig.4.).



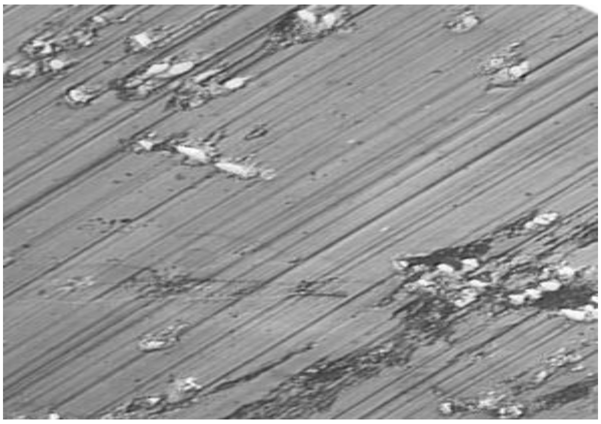
Compositions 1



Compositions 2



Compositions 3



Compositions 4

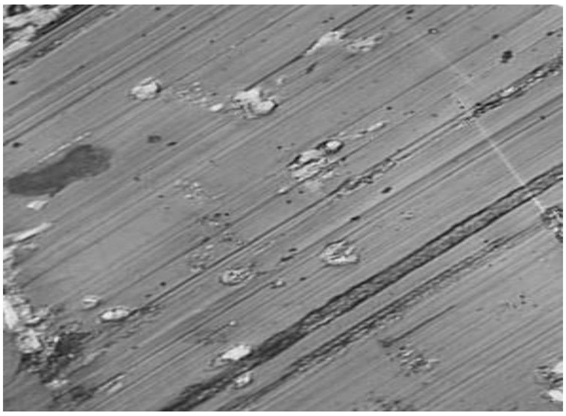


Fig. 4. Friction surface of polymer hybrid compositions, multiplication x 200

Compositions 5

This fact is most likely due to a good adhesion between the components of compositions, as well as to structuring of the overmolecular structure - transition of a globular structure of phenilon (Spumaker 2004) into the fibrillar one.

On the basis of the obtained results, we can conclude that the developed new construction materials based on polymers are able to operate as the details of friction knots in hard dry conditions with quite high loads.

It has been shown that the reinforcement with a mixture of fibers of different nature improves both tribotechnical and physico-mechanical properties. This can easily recommend materials used as structural components and responsible use.

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Analysis of OBD2 communication protocols

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Abstract

With the development of technology, protocols have become more secure, very reliable and give a quick transfer data for vehicle manufacturers. Over the years, have been used several communication protocols, each automobile manufacturer developing or using one of the five communication protocols. OBD2 use the protocols of communication in the automotive industry to create a connection between car and driver. This connection is defined by the transmission of information from the car by the driver, using: Witnesses panel, communication via OBD2.

Keywords: automotive, K-Line, CAN, ECU.

1. Introduction

Nowadays, there can be considered that a vehicle has its own "life". It gives information about the problems that it encounters and warns if these minor faults or problems are highly hazardous to the driver of the vehicle and its passengers.

All this communication with the driver is done through the luminous indicators on the car dashboard which are also called WITNESSES PANEL. Some in-car systems can have faults, problems, errors or breaks, and this witnesses panel announces these things. The color of the witnesses panel reflects the seriousness of the problems appeared at the vehicle.

All these codes sent by ECU (Electronic Control Unit) through an OBD2 (On Board Diagnostics), announce the detected problem in order to be solved. This OBD2 has 5 communication protocols to decrypt the messages received from the ECU.

These 5 protocols are used by various vehicle manufacturers. The most common protocol used today is the CAN (Control Area Network) protocol. The CAN protocol qualities are secure communication, high speed and a big distance (Dzhelekarski, 2005).

2. Protocol SAE J1850 PWM (Pulse Width Modulation)

It is a protocol used by Ford. It has a transfer speed of up to 41.6 kb / sec through two wires (twisted), the 5V differential signals. The 0 logic signal range is between 0-2.2V and the logical 1 signal range is between 2.8-5V. The data frame has from 0 to 8 bytes.

The message sent consists of a maximum of 12 bytes that includes the CRC (Cyclic Redundancy Check) byte.

Advantages:

- speed of 41.6 kb/sec, higher than other protocols

Disadvantages:

- message length is 12 bytes, shorter than other protocols
- there are required two wires for communication (pin 2 and pin 10) - differential signals

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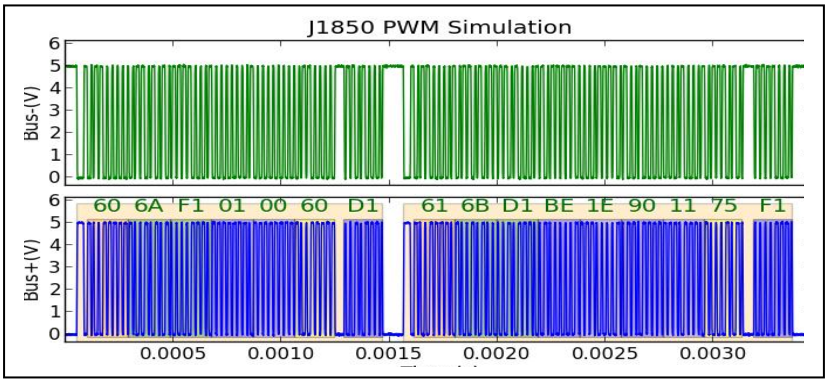

Fig. 1. SAE J1850 PWM protocol

3. Protocol SAE J1850 VPW (Variable Pulse Width)

This is a protocol used by General Motors, Chrysler, Harley Davidson and Toyota. The transfer speed is up to 10.4 kb / sec. Data transmission is done on a single thread and the maximum voltage is of 20V. The 0 logic signal is in the range 0-3.5V and the logic signal 1 is in the range 20-4.5V. Data frame length is from 0 to 8 bytes.

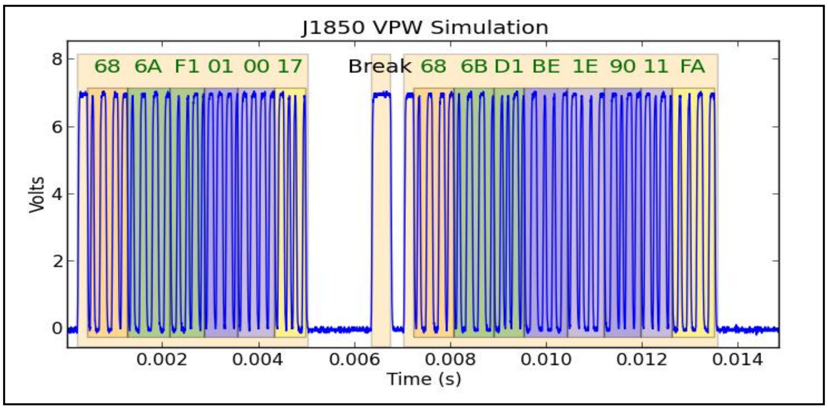

Fig. 2. SAE J1850 VPW protocol

Advantages:

- communication on a single wire (pin 2)
- maximum voltage of 20V, ensuring high flexibility

Disadvantages:

- speed 10.4 kb / sec, lower than other protocols
- message length is 12 bytes that includes the CRC byte, shorter than other protocols

4. Protocol ISO 9141-2 (10.4 kB/sec)

This is a protocol used by General Motors, Chrysler, Harley Davidson and Toyota. The transfer speed is up to 10.4 kb / sec. Data transmission is done on a single thread and the maximum voltage is of 20V. The 0 logic signal is in the range 0-3.5V and the logic signal 1 is in the range 20-4.5V (International Standard ISO 9141-2, 1994). Data frame length is from 0 to 8 bytes.

In figure 3, the message that is sent to the ECU is 0x6A 0x68 0x01 0x00 0xC4 0xF1, that contains the header bytes "0x6A 0x68 0xF1", the byte 0x01 signifying the mode (Mode 01 - show the current date), and the byte 0x00 signifying the PID (Parameter ID) (PIDs supported) (Dovleac, Lorincz, Ionica, Leba, 2016).

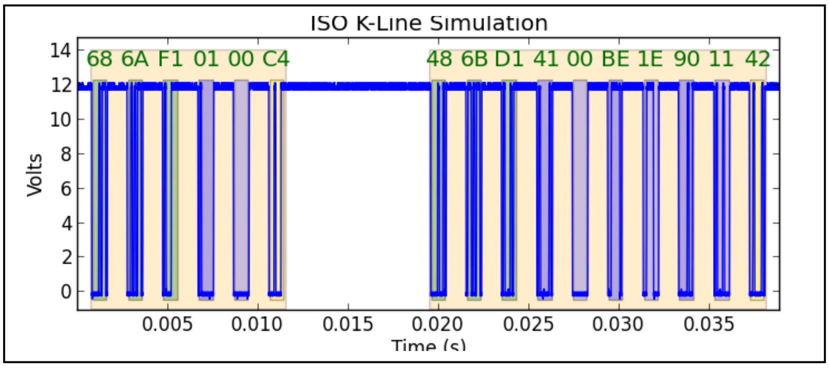

Fig. 3. ISO 9141-2 protocol

The answer received from the ECU is presented in the following table:

Hex.	B				E				1				E			
Bin.	1	0	1	1	1	1	1	0	0	0	0	1	1	1	1	0
PIDs	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10
Hex.	9				0				1				1			
Bin.	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1
PIDs	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20

PIDs supported: 01, 03, 04, 05, 06, 07, 0C, 0D, 0E, 0F, 11, 14, 1C 20.

<u>Advantages</u>:
- communication on a single wire (pin 7) and on an optional wire (pin 15)
- message is 260 bytes and data is 255 bytes

<u>Disadvantages</u>:
- speed 10.4 kb / sec, lower than other protocols
- initialization 5 bauds, different from the communication speed

5. Protocol ISO 14230 KWP 2000 (Keyword Protocol 2000)

It is a protocol similar to ISO 9141-2 and uses pin 7 and optional pin 15 for data transmission. Data transfer speed is in the range 1.2 to 10.4kb / sec and is bidirectional. The received message can contain up to 255 bytes in the data field.

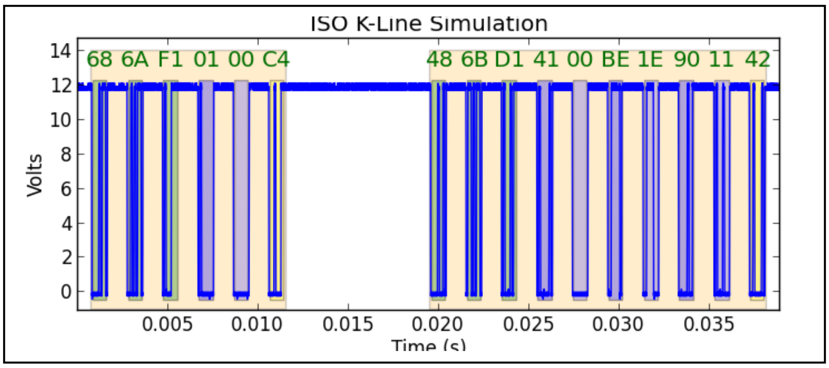

Fig. 4. ISO 14230 KWP2000 protocol

<u>Advantages</u>:
- speed from 1.2 up to 10.4 kb / s, ensuring flexibility in synchronization
- communication on a single wire (pin 7)
- message length of 255 bytes

<u>Disadvantages</u>:
- maxim speed of 10.4 kb / sec, lower than other protocols

6. Protocol ISO 15765 CAN (250 kB/sec or 500 kB/sec) (Control Area Network)

This protocol is a product of Bosch and is used in the automotive industry but not only. The data transfer speed is divided into two categories: 250 kb / s and 500 kb / sec. This protocol uses for data transfer the following pins: pin 6 (CAN High) and pin 14 (CAN low). The transmission is done by two twisted wires that transmit the differential signal.

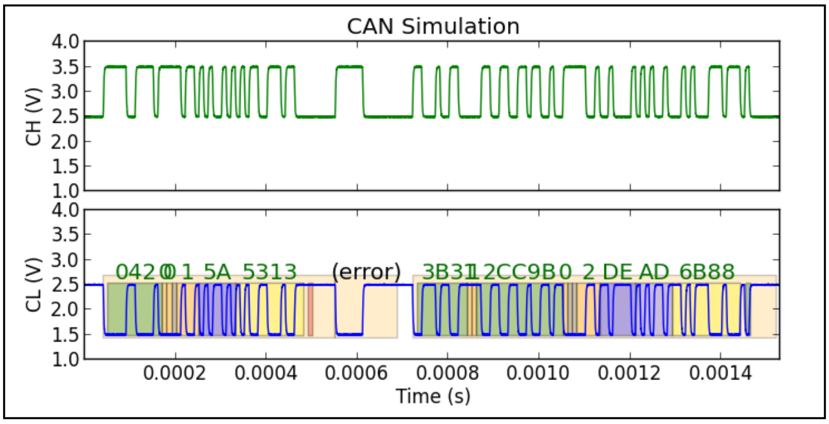

Fig. 5. ISO 15765 CAN protocol

Advantages:
- two speeds of 250 kb / s and 500kb / sec
- most modern communication protocol

Disadvantages:
- high expenses for software development
- undesirable interaction more probable
- danger of incomplete technology for the customer

7. Conclusions

The communication protocols used by OBD2 evolved in time and the most modern protocol currently used is CAN. Compared to other protocols, the speed in CAN is very high for data transfer and the cabling has very low costs. It can work in poor conditions (interruptions on wire, grounding or short-circuit to + 12V).

The older protocols have the advantage of time. During the years they were used, they generated a lot of programming experience, they have been refined over time and the software has become simple and highly understandable for programmers.

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Some examples of video surveillance as a service applications

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Abstract

Video Surveillance as a Service (VSaaS) has undergone significant scientific development since its inception. Development of cloud technologies significantly influenced surveillance market which is expected to entirely replace traditional surveillance systems. Economic analysis show positive growth of surveillance equipment and systems and in the coming years VSaaS is expected to have a larger stake of the security market. In the paper are given examples of Video Surveillance as a Service (VSaaS) applications in current surveillance systems implementations. We also review the existing literature and propose how to apply advancement into future frameworks.

Keywords: Video Surveillance as a Service (VSaaS); Intelligent Video Surveillance as a Service (IVSaaS); cloud technology;

1. Introduction

Surveillance systems have been in use for several decades now since the invention of Closed-circuit television (CCTV) cameras and tape recorders. Over time these systems advanced to using computer system and IP cameras to capture, store and reproduce recordings which quickly reached limits in size, power requirements, processing, analysing and especially storage. Main obstacle is that they are all on site based solutions. Cloud computing introduced a novel approach to how data is being managed which reflected to video surveillance as well. This brought to the idea, utilizing cloud computing enormous network, storage and processing capabilities (Dašic, et al. 2016). Video surveillance as a Service has undergone significant scientific development since its inception. Notable research done in the area covers universal environmental surveillance system (Chen, et al 2013), intelligent surveillance video analysis service (Chen, et al. 2016; Tomforde, 2013), automatic configuration of video-surveillance (Conejero, 2015), remote display solution (Song, et al. 2015). Authors (Dautov, and Paraskakis, 2013) introduced a novel approach to developing autonomic cloud application platforms, based on vision of treating cloud platforms as sensor networks. This approach is based on intelligent re-usage of existing solution strategies and products (specifically, Stream Reasoning and the Semantic Web technology stack), to create a general-purpose autonomous framework.

Key areas of cloud based video surveillance are video-based detection and tracking (García-Rodríguez, and García-Chamizo, 2011), video-based person identification, and large-scale surveillance systems. A significant percentage of basic technologies for video-based detection and tracking were developed under a U.S. government-funded program called Video Surveillance and Monitoring (VSAM) (Collins, et al. 2000).

2. Applications of Video Surveillance as a Service (VSaaS)

Applications of VSaaS include sectors of tourism (hotels, restaurants), healthcare (hospitals, care centres), education (schools), finance (banks, trade centers), retail (shops, malls), data centers (high tech companies), airports (terminals, runways), ports (incoming vessels), government (buildings, municipalities areas, landmarks, police, military), transport (roads, highway, railway, parking areas), industrial (plants, equipment, open areas), telecommunication (equipment, service centres). Alongside listed applications VSaaS is applicable in homes and estates of common people looking for easy and affordable security measures. More on specific video streaming application can be found in publications for

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urban traffic management (Esteve, et al. 2007), networking applications for emergency services (Frank, R. et al 2009), vehicle surveillance system (Fu, 2010). Further, we will present and discuss current applications and supporting technologies for Video Surveillance as a Service.

Remote access to live and recorded surveillance video using mobile devices is a standard feature in VSaaS. It is applicable in both civilian and military environment with native encryption algorithm support for high security of content flow. In paper by (Philp, et al. 2009) is proposed an addition security measure for video transmission using watermarking as another layer of authentication. Authors (Abu-Lebdeh, et al. 2012) have developed a novel system architecture for mobile video surveillance applications using 3GPP 4G Evolved Packet Core (EPC), with key components of service architecture: service development platform (SDP) and the machine to machine (M2M) gateway. Another application of VSaaS in mobile segment is the research done by (Paul and Park, 2013) who developed a system for object classification and recognition using a mobile phone as image acquisition device. Images or video material is sent to cloud system for analysis processing which then sends back the results of multiclass natural objects recognition to mobile device. Analysis is performed using high dimensional feature vectors using clustering algorithm and classify and recognize using native Bayes classifier. (Yu, et al. 2012) developed intrusion detection system (using machine learning technique) for android mobile platform which performs robust people classification in diverse scenes in real-time. Their video surveillance systems is intended to function within Wireless Sensor Networks (WSN) environment.

On Fig. 1 is given a graphical representation of VSaaS applications and features.

Fig. 1. Applications and features of VSaaS. Source: authors

VSaaS brought significant improvements in open area surveillance allowing the utilization of sophisticated tracking and analysis software to run in real-time processing large amounts of data. VSaaS for open area surveillance can be used virtually anywhere through simple internet networks, existing fiber networks or mobile 3G/4G networks providing coverage for large urban areas. In paper by (Chen, et al. 2014) is given a proposal of a unified computational framework, whose purpose is the integration simplification of various video analysis techniques. The framework is developed upon cloud architecture which enable it to handle massive data analysis. Authors (Weng, et al. 2013) developed an open mobile could architecture “Pics-on-Wheel” for tracking taxi vehicles in urban environment which can be used for surveillance purposes such as: vehicle location, driving duration, incident recording, driver monitoring as well as provide detailed analytics. A multimedia surveillance backend system architecture was developed by (Dey, et al. 2012) and is based on the Sensor Web Enablement framework and cloud based “key-value” stores. Their framework obtains data from camera/edge device simulators, splits media files and metadata and stores those in a segregated way in cloud based data stores hosted on Amazons EC2.

Cloud-based video surveillance enables the possibility of smart interaction between software and on-site mechanical-electrical devices. For example, one of the applications is the usage of robots in servicing incursions and other threats in risk areas (e.g. nuclear facilities). (Park, et al. 2012, 2013) have developed sub-optimal decision making algorithms for such robots where Unattended Ground Sensors (UGS) detect a threat and the robots service the alerts by visiting the alert location and collecting evidence in the form of video and other images and transmit them to the operator.

Healthcare industry can greatly benefit from cloud based surveillance, especially from video analytics software such as motion analysis. Authors (Lee, and Chung, 2012) developed an algorithm capable of detecting falls of patients in healthcare institutions and removing shadows from objects thus greatly increasing false detection. Such a system of detection can be implemented to monitor patients movement in real-time by automatically notifying hospital staff of unfortunate event such as falling or undesired movement.

VSaaS can be implemented for maritime video surveillance both ground-based, harbors and dock, and on-vessel implementation. Authors (Auslander, et al. 2011) analysed and compared anomaly detection algorithms for local maritime video surveillance. In paper by (Guo, 2012) were presented key technologies of intelligent monitoring for middle line of the south to north water transfer. The application of VSaaS could improve real-time surveillance from boats, mass transit screening for boat passengers, crane safety cameras for docks and perimeter security. (Gómez, et al. 2015) developed a surveillance system that possesses several highly advanced features which can be best utilized through VSaaS application. The features include: 3D environment change detection, a multiview-based acquisition method to monitor wide-sized indoor environments, analysis of the elements detected to identify intruders, new and missed objects, fusion of color and 3D features to create an accurate 3D model of the scene, real-time surveillance algorithm based on the tilt-angle movement and support for absence of illumination by automatic IR adjustment.

Cloud based video surveillance can serve as a data source for Applied behavior analysis (ABA) which can help researcher to better understand human habits and behavior patterns. For example authors (Kröckel and Bodendorf, 2010) presented a concept of using data mining methods on images obtained by video surveillance. The analysis is performed for customer trajectories, paths through the retail environment, while image processing is done using OpenCV Computer Vision Library. Results about patterns and clusters are obtained by different method of data mining. Education sector has proven to have reduced incidents (Tanner-Smith, 2016) with installed physical security measures. Application of VSaaS in schools can greatly influence the early detection of incidents (fights, falls, unauthorized access, vandalism), reduce overall security costs (less security personnel needed, less hardware and technical maintenance personnel, no Digital Video Recording (DVR) devices required) and can provide behavioral analysis.

Military sector relies heavily on video surveillance for internal and as well mission purposes. Usage of drones, robots, unmanned aircrafts accompanied with advanced data analytics is the backbone of military operations. One of the developed techniques applicable in military environment is s 3-D imaging technique which pairs high-resolution night-vision cameras with GPS to increase the capabilities of passive imaging surveillance. The technique was developed by (Schwartz, 2011) and uses camera models and GPS to derive a registered point cloud from multiple night-vision images. These point clouds are used to generate 3-D scene models and extract real-world positions of mission critical objects. This enables precise geo-positioning in low-light environment. A supportive hardware solution comes from company Avigilon, which developed Light Catcher technology capable of capturing video with color detail in extreme low-light environments.

3. Conclusion

This paper presented modern applications of Video Surveillance as a Service from both scientific and general public view. Available literature covers a wide scope of application issues and solutions, however more effort is needed in automation of intelligent data analysis since the amount of data exceeds current software and hardware capabilities. Beside intelligent data analysis more development is needed in area of video compression and transfer to support high definition streaming without the need of using intermediary storage with pre-compression function. Maintaining secure environments is of imperative importance especially in times of increased terrorist activities, political and economic crisis and unstable conflict regions. VSaaS reduces overall costs and offers unsurpassed technological possibilities compared to traditional systems which should be fully utilized.

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Arduino webserver used for electrical energy monitoring

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Abstract

This paper details how to build a simple energy monitor that can be used to measure how much electrical energy you use in home place. It measures current, but uses an assumed fixed value for voltage and calculates apparent power and show the dates in one web page. Although not as accurate as a monitor that measures voltage as well as current, it is a method commonly used in commercially available whole house energy monitors for reasons of simplicity and cost. This paper then highlights selected approaches to monitoring and evaluation and the conditions under which each might be useful, and how and by whom lessons are to be learned. Attention is paid to key elements of monitoring and evaluation such as the development of indicators and the measurement of impacts. In the light of the many failed energy projects, this paper closes with some suggestions of how monitoring and evaluation processes and capacity may be improved.

Keywords: arduino; webserver; energy; monitoring.

4. Introduction

Everyone wishes to save energy and money. Minimizing your monthly electricity bill is a good place to start. What makes it difficult, is that your bill only tells the total amount of electric energy that was consumed during a long time window, typically one month. Hence, testing the effect of a change in behavior as an energy consumer is not practical. A working solution would be to frequently log the values from your energy meter to a notebook, and then draw a graph to reveal the before-after effect. But things like this need to be automated to become practical. So we will use a home PC, and build a measurement device that can be simply attached on top of the electricity meter.

With increasing fuel costs and electricity to large consumers it became necessary to optimize consumption. In most production activities, energy consumption has a significant impact on cost, so it is imperative to know the real situation of consumption and efficiency.

Achieving this requirement requires the collection of information on water consumption, heat, natural gas, industrial water, process steam, compressed air, wastewater or any other specific size and profile beneficiary involving energy consumption of different types.

Using these systems ensures automatic data reading from specialized measuring equipment and metering, data storage in databases, data processing and their transformation into information and displaying the information obtained in the form of reports.

Energy consumption monitoring systems provide a complete solution for energy management. For this purpose require the use of the most modern measurement technology, communications and information processing. For example, the electric field they must be used in exchange points of the producing companies, transmission, electricity distribution and commercial and industrial consumers.

5. Specifications and implementation of metering systems

Metering systems provide information used to streamline the operations of the companies and improve energy management, implementing the latest technologies in monitoring and energy management in a system with an open architecture. These provide the capability to monitor and analyze the production, distribution and consumption of energy and to identify potential methods to reduce costs.

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Such a system must meet the following requirements:

• to be able to monitor hundreds or thousands of analog electrical quantities (current, voltage, power factor) and non (temperatures, pressures, velocities, flow rates); analog values originating either from sensors or transducers, either from the local control loops.

• to be able to track tens or hundreds of digital sizes (electric switches state);

• frequency readout input channels to be large enough. It is considered that the minimum performance that we have to provide a system for monitoring energy parameters are read at intervals of one second and the maximum state parameters of the process reading within 5 seconds. Frequency readings must, of course, coupled with dynamic parameters monitored process and shape characteristics of energy used.

• to store the input values over a fairly large.

• to issue warning signals operator in an emergency or overcoming preset limits in the process, or if a fault in the monitoring system.

• to be able to work, put in a usable form for operator and display the monitored values in a manner most advantageous, easy to interpret (tables of values, drawings, graphics and three-dimensional plane, histograms etc.)

In addition to these general requirements may include others such as:

• allowing identification of the facility monitored loss, damage or parasites consumers;

• allow consumption analysis separately for each part of the installation monitored (sections, important individual consumers, etc.);

• ensure electronic data reading;

• in certain circumstances it is necessary to provide simultaneous reading of all measuring points;

• the possibility of centralized dispatching display of measured values;

• ensure all consumptions reading in one system

• comply with the requirements of an open system, so as to enable further development and expansion of the system.

Continuous monitoring and evaluation of energy efficiency (Monitoring and Targeting, M&T) is a structured system of management of energy consumption within a socioeconomic system. It aims to achieve control and management of energy consumption.

Monitoring energy consumption is achieved using a system of meters and other measuring equipment. They are installed within an area called "center energy management."

The use of energy performance parameters are determined by the correlation between energy consumption and other quantities which influence (the amount of products produced within the specified period). The result of this analysis is to determine the laws of limit values (or target) for consumption - an action called "targeting".

Performance evaluation of energy consumption is achieved through regular reports highlighting deviations from target values, generally in the form of financial gains or losses.

After this analysis should be established and responsibilities for energy consumed regularly, conducting analyzes in order to find methods to improve the energy performance of the process and ways of practical application of these methods.

It is necessary to create a feedback mechanism within the socio-economic system by implementing a system to motivate staff so as to engage in action to find new ways to increase energy efficiency.

Steps to be taken to implement such a system are:

1. Conducting an audit to estimate its efficiency

The purpose of this audit is to establish the maximum amounts that can be spent to achieve the system so that these expenses are justified.

2. The data collection

The main data to be collected by the monitoring system are:

- Consumption of energy carriers;
- Production values;
- The values of environmental factors (temperature, etc.)
- Other auxiliary data.

Data collection frequency is variable being preferred automatic collection. Generally not recommended to collect data that can not be processed. One must also consider that the frequency readings can influence the quality of analysis.

3. Data Analysis

The first stage of determining objective values in terms of energy consumption to establish for each center energy management quantities shaping the energy values, and so that will be monitored. These quantities are called variables.

The purpose of the analysis stage is to establish a new feature that gives dependence on energy consumption of variable values. These functions can be simple phrases (ie linear) or complex, depending on the specific monitored system.

Data analysis can be performed manually (very difficult when the number of variables is large), using spreadsheets or using a specialized software for operating monitoring systems. The latter solution is the simplest but requires the existence of specialized personnel. The operational phase of collection continuously monitored quantities and values of objective comparison of consumption.

4. Application of measures to reduce energy consumption

An M&T seeks not only evaluating energy performance in one unit, but also the establishment of a system for the use of this information in order to establish concrete measures to reduce energy consumption. A monitoring system is always a special case, which must conform to actual installation of surveillance. To implement the beneficiary of the app, is based on a monitoring system "standard", which contains many core modules, hardware and software, and is performed onsite concrete equipment specific for each major energy consumer.

Often the implementation of such a system is achieved in stages, milestone dates are:

a. Initially, there are a relatively small number of monitored parameters (e.g., analog inputs 2-300) from the main machine, or which has the greatest consumption.

b. Based on preliminary results, the software modules are redesigned to meet the requirements of effective monitoring process. Also, the graphical user interface is adapted.

c. It identifies problems to be solved.

d. It gradually expanding network of sensors and transducers to other machines or production sections, the structure with suitable hardware and application programs.

e. In the next phases, the system is developed according to the specific needs of the beneficiary, both quantitatively (increasing the number of entries, to inspect all machinery) and in terms of functionality.

6. Practical implementation

Project to undertake monitoring electrical energy consumption of a home via the Internet, that supervision power consumption of the house in which we live. It will measure the current and voltage consumed instantaneously and on a timeframe that will be displayed in a web page as a graph.

Materials required:

- Arduino Nano or Arduino Mini
- a current sensor (preferably 30 A).
- a voltage sensor that we will achieve power transformer and installation, to separate all the installation of network galvanic 220v the house to prevent damage caused by a short circuit. It is 12V and 1A.
- a stabilized source of 5V and 1A.
- an alternating current circuit to recover read current sensor (coil version). The circuit is actually a precision rectifier with a gain of about 40. It converts the output of the negative peak of the current sensor voltage of about 0 ... 5V in a range of about 0 - 50 A, the linearity and accuracy of approximately 0.1A.
- memory database that can store data recorded on 4 weeks.
- a network card, Arduino W5100.

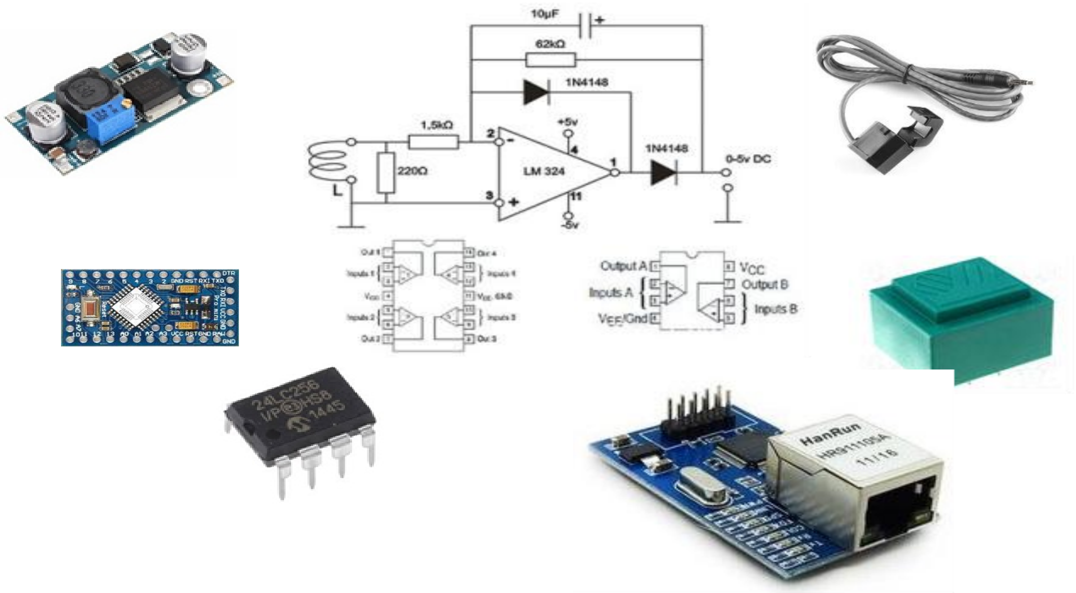

Fig.1 The hardware project

Programming is made in Arduino programming environment. Codebase contains several files:

- serverWeb_Energy.ino

- database.h
- debug_out.h
- general_string_data.h
- page_printer.h
- page_string_data.h

Actual loading of the source code and then compiled to run is via a module FTDI interface - USB (type FT232R) with reset.

After making installation and loading of source code (sketch), the current sensor is mounted on the housing phase wire or thread phase of a prize for illustration. Network card LEDs begin to pulsate, a sign that it is trying to connect. You have to look in the settings from Internet router IP whom received the device achieved.

Open a browser and the IP that the webpage.

Now you can read the instantaneous current and voltage power network of the dwelling and active electrical energy displayed depending on the time displayed on the buttons at the bottom. Reset button deletes the entire database.

Of course, if the code is modified, it can make various patterns web page or Internet can send various other measurements from other sensors.

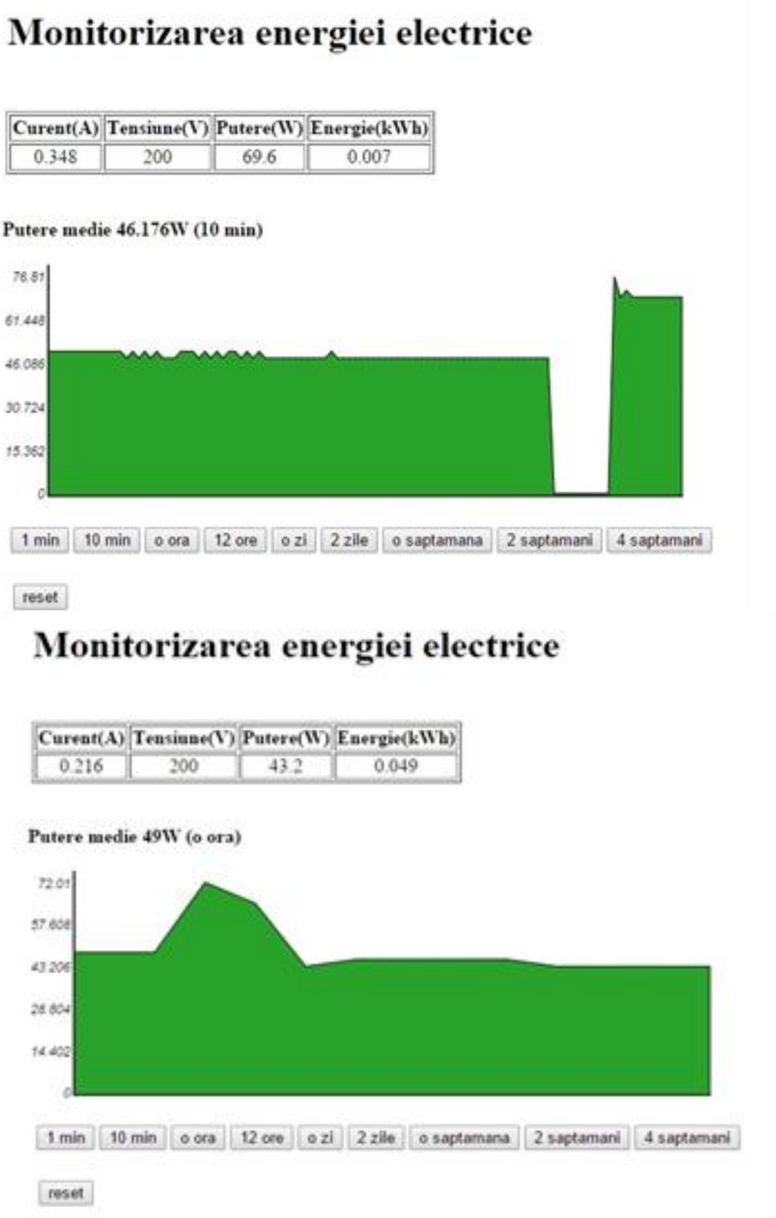

Fig. 2 Data representation through a diagram on a web page

4. Conclusions

Monitoring electricity consumption of a home is a good start to achieve technical and functional infrastructure to ensure the reduction of electricity consumption in order to reduce overall costs. In other news regarding infrastructure major energy Romania has adopted the standard EN 16001: 2009, which specifies the requirements for establishing, implementing, maintaining and improving a system of energy management for continuous improvement in the sense of energy use sustainable and more efficient. Development and adoption of EN 16001: 2009 helps stimulate continuous improvement process leads to more efficient use of energy. This encourages organizations to implement a plan to monitor and analyze energy. According to the specifications of EN 16001: 2009 management system Efficient energy use is due in practice: the possibility of taking decisions to improve energy efficiency, continuous improvement Annual and improving performance in energy consumption, a deeper analysis areas with potential for energy saving. Developing predictive management by managing data and statistics on the development for long term secured with online monitoring systems and data transmission to dispatcher station for centralizing and storing them in a database.

The data can be used for studies and projects of modernization and efficiency, energy audits, for comparison with data subsequently recorded modernization processes. An argument pro - level management of public lighting and domestic lighting is the degree of comfort and safety in use they offer a well-controlled and monitored. It is essential that a study to implement a monitoring system for public lighting in a city or in a housing estate to be done within an organization competent and neutral, to remove temptations traders to sell the equipment in any form. Information obtained through monitoring are essential for optimal measures to improve power quality and energy efficiency. From measurements made in network studied (electronic laboratory) values were obtained in addition to those specified quality standards on consumption. From their analysis gave directions to reduce costs while preserving or even improving the quality of energy. As regards public lighting to increase power factor, for example, it needs to replace some electronic electromagnetic ballasts equipped with controls to reduce lumen. An important component in monitoring the efficiency of public lighting, household or business is the data. This allows optimization of the systems within the limits set. The proposed solution enables monitoring and wireless data transfer via a router. For offline monitoring, data are recorded on the internal memory. High energy savings achieved by implementing energy efficiency grade grow the plant optimized with positive influences on cost reduction.

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Analysis of a Smart House Elements

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Abstract

In this paper there is presented an introduction to the Internet of Things, the field that led to the concept of Smart House as we know it today. Then, there is analysed the current state of smart houses development with requirements and perspectives. The main part of the paper consists in a case study for a smart house having eight rooms equipped with intelligent sensors and control systems. For prototyping reasons there were used Arduino platforms.

Keywords: smart device, sensor, communication, control;

1. Introduction

Internet of Things which is also named internet of objects refers to network interconnection of daily objects and these are usually named smart objects.

A smart object is a bit of internet of things, it is actually another name for an embedded system connected to the internet.

Nowadays, in most cases, each smart device uses its own standard, related to the equipment manufacturer, and should therefore be controlled by a different application on the smartphone. If we try to equip now a house with all types of smart devices then we would have to use multiple remotes and mobile applications to control all these devices. It is certainly not convenient. It is much more comfortable if we can control all systems with a single application that incorporates all smart devices (Hermann Kopetz 2011).

2. Current state

Smart houses projects have appeared once with automation of some appliances. Currently are developed a lot of smart systems inside the house but still can be found new solutions or improved the current solutions. In a smart house the electronic devices communicates between them to consume fewer resources to be environment friendly without reducing the comfort.

Even if it is not a new building, the challenge in creating a smart house is that the technology must work regardless of the age of the construction.

Smart house is a home that uses information technology to monitor the environment, control electric devices and for communication with outer world. Smart house is a complex technology and at the same time it is developing. A smart home automation system has been developed to automatically achieve some activities performed frequently in daily life to obtain more comfortable and easier life environment.

The smart house can monitor and control temperature, humidity, lighting, fire and burglar alarm or other systems inside the house or outside around it. Surveillance system and motion sensors are used to guarantee family safe. The system also has internet connection to monitor and control house equipment from anywhere in the world (Risteiu et al. 2015).

The interesting part of a smart house represents the facts that it can be controlled from a smart phone, tablet or laptop not being necessary a remote controller for each individual device, a single mobile application managing to incorporate all the equipment and the control and monitor can be realized from anywhere.

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The appliances are interconnected and allow the communication between them to achieve some activities. These type of house is not just able to be remotely controlled, but it will give warnings for appeared problems, will decide and action with predetermined actions for the real-world cases.

These include:

- security system, fire alarm and access system
- water or gas leak detection system
- video surveillance system
- network communication system
- lighting system
- building mechanization (open/close doors and windows, underfloor electric heating etc.)
- Audio Video technique (home cinema, multi-room audio system)
- telemetry - remote tracking system
- IP object monitor – remote control for network system
- GSM monitor – remote information on incidents inside or outside the house
- remote control of electronic devices, actuators and other automation systems

If it is a break entering, the house will alert the owner, the police section and will close all other areas to defend it. If appear a problem to water supply, or with gas supply it will alert the owner and authorized personnel but in the same time it will interrupt supply for damaged system to prevent other damages.

Usually smart house means a varied system of automation subsystems.

2.1 Requirements for a smart house

- Every device is connected thru wireless or wired connection
- The house is connected to the cloud
- Every device has some level of intelligence
- Customer can add new apps or services

2.2 Internet of Things protocols

Internet of things uses many communication technologies that are well known such as Bluetooth, WiFi, ZigBee and 2G/3G/4G cellular, but there are several new arise networking options as Thread as an alternative for home automation applications and Whitespace TV technologies being implemented in major cities for wider area IoT-based use cases.

Depending on the application, factors such as range, data requirements, security, power demands and battery life will dictate the choice of one or some form of combination of technologies. These are some of the major communication technologies on offer to developers.

An important short-range communications technology is of course Bluetooth which has become very important in computing and many consumer product markets. The new Bluetooth Low-Energy (BLE) – or Bluetooth Smart, as it is now branded is an upgrade for old and very common Bluetooth – is a significant protocol for IoT applications. Importantly, while it offers similar range to Bluetooth it has been designed to offer significantly reduced power consumption.

WiFi connectivity is often an obvious choice for many developers, especially given the pervasiveness of WiFi within the home environment within LANs. It requires little further explanation except to state the obvious that clearly there is a wide existing infrastructure as well as offering fast data transfer and the ability to handle high quantities of data.

Any IoT application that requires operation over longer distances can take advantage of GSM/3G/4G cellular communication capabilities. While cellular is clearly capable of sending high quantities of data, especially for 4G, the expense and also power consumption will be too high for many applications, but it can be ideal for sensor-based low-bandwidth-data projects that will send very low amounts of data over the Internet. A key product in this area is the SparqEE range of products, including the original tiny CELLv1.0 low-cost development board and a series of shield connecting boards for use with the Raspberry Pi and Arduino platforms.

3. Smart House Project

We will consider the example of a house containing eight rooms monitored by sensors of temperature, proximity, light and switch (open/close) sensors. The control of the elements will be achieved based on information collected by the sensors, send it to a central hub and then in a database to be stored and processed. Also, remote control can be made manually by a device connected to the internet.

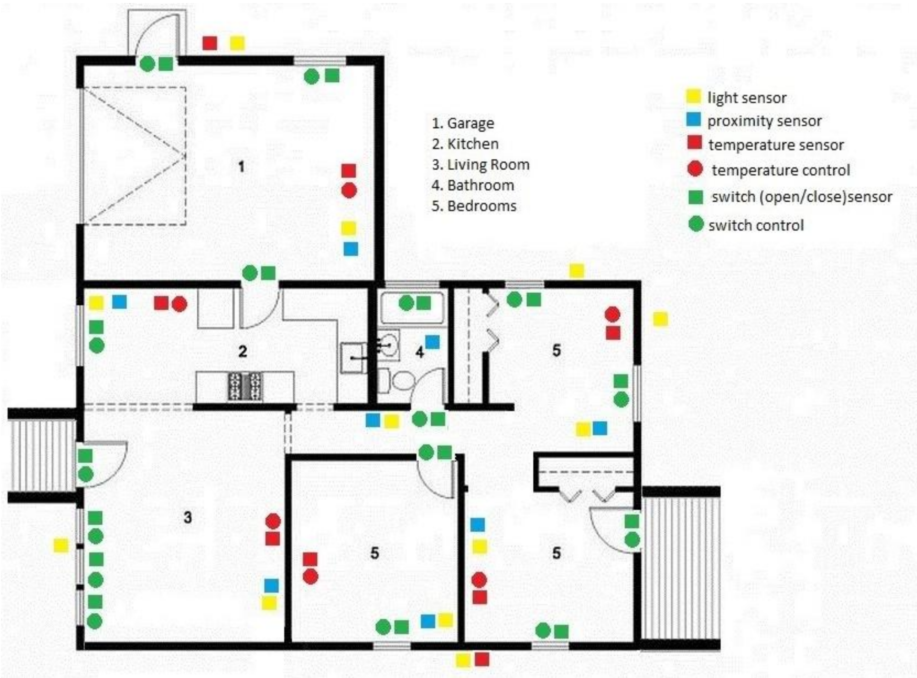

Fig. 1. Blueprint of the smart house

In figure 1 there is presented a case study for a smart house consisting in eight rooms, each having both sensors and control devices connected to one central hub.

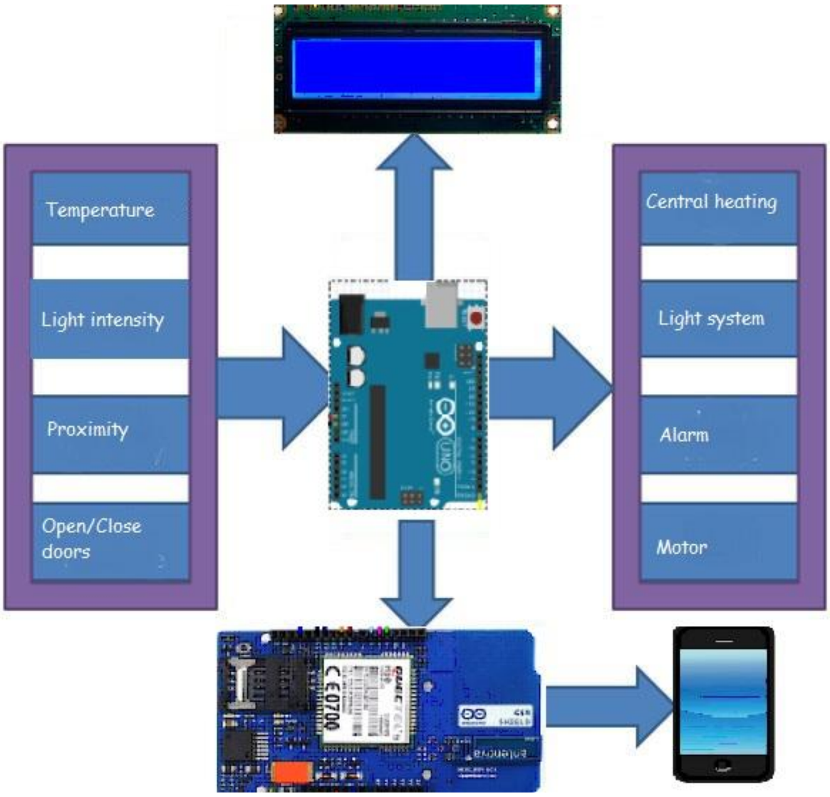

Fig. 2. Mobile connection through Arduino with GSM shield

In figure 2 is presented a mobile connection through Arduino with GSM shield for the monitored and controlled systems.

As can be seen, for each room in the smart house we considered a number of sensors and controls suited for the purposes of the room. Each sensor is wireless connected to a central hub of the house. If the number of rooms or the surface of the house is too big, there can be considered a hierarchy of hubs connected to a central one.

The central hub is connected to a server that contains a cloud solution to store, update, analyse and process the data received from the sensors.

All the data are stored in a cloud database. By analysing and processing the collected data from the smart house's sensors and taking into account the automation algorithm implemented in the control application there are sent information to the control devices from each room also through the central hub. This is the automatic part of the smart house. There also is a manual part that involves the house residents (Risteiu et al. 2015).

They can monitor the smart house on any internet connected device, like laptop, smartphone etc. Also, according to the information received they can manually send control information to the smart house.

4. Advantages and disadvantages

In a smart house electronics and appliances can be centrally controlled from the distance, they can even communicate with each other. Users can for example create automated rules like "if the house temperature drops below 20 degrees Celsius heating starts.

Besides the cool factor and discussions that can arouse when we have guests, smart houses eases life tenants, provides enhanced security and energy efficiency issues should not be neglected today.

One of the disadvantages today in a smart house is the cost. A normal LED bulb is cheaper then one remotely controllable via WiFI or Bluetooth.

Smart thermostats, Internet outlets controlled by temperature sensors, humidity, smoke, burglary and they cost a lot.

Nowadays smart houses are not accessible to all, but the growing interest of the public in the coming years means that we will see a diversification of the range of smart products in conjunction with a significant drop in prices. In addition an intelligent house must be designed from the beginning in this regard, for maximum efficiency, so we talk about design and execution costs higher. If upgrading a typical household you need professional installation of smart devices if they want to communicate intelligently with each other.

Another disadvantage is that anything connected to the Internet is vulnerable to attacks. A good hacker is able to penetrate into a secure and smart homes will use your Internet connection to access control, so they are vulnerable. Changing sticker security firms with those of antivirus software manufacturers will not solve this problem. Cyber attacks are a reality of today unfortunately, so it is wrong to believe that we can not be affected by them.

In addition, in a world preoccupied with privacy becoming more and will collect more data about us through devices always connected to the Internet (Internet of Things). And this must be taken into account and weighed before deciding to 'smart' home.

5. Conclusions

The smart house represents the future of our homes that is building in the present. The paper proposes a system that can be easily adapted to any configuration of a house, by a modular construction principle, with all the components connected to a central hub. The modular principle also allows an easy upgrade of the proposed smart house configuration.

The comparison made in these paper for the protocols used in Internet of Things has been made to decide which protocols can be used in a smart house automation in function of the distance we need to send or receive information. For device interconnection WiFi and BLE are very good but for a long distance communication we must use GSM.

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Drones between big data and big brother

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Abstract

This paper discusses initial application of drone technology in the surveilance and collect data. In this study, a small-scale aerial drone was used as a tool for exploring potential benefits to collect data. A drone is an aerial quadricopter that can be piloted remotely using a smart phone, tablet device or a computer. Since the drone is equipped with video cameras, it can provide safety managers with fast access to images as well as real time videos from a range of interes locations. Autonomous navigation, vocal interaction, high-resolution cameras, and collaborative user-interface environment are some examples of features that can be used. This application of the aerial drone has the potential to improve general safety but need to be traced a clear border between Big Data and Big Brother.

Keywords: drones; big data; big brother.

1. Introduction

This paper explains some general principles of drone regulation by national governments and asks how both air safety and privacy will be shaped by new technologies. It puts forth the claim that taking property rights in the air seriously is a way to allow innovation while protecting safety and privacy. As far back as 1944, when the Chicago Convention on International Civil Aviation established the International Civil Aviation Organization (ICAO), the international umbrella body for aviation regulators, authorities were considering the implications of “pilotless aircraft.” Article 8 of the convention prohibited “aircraft capable of being flown without a pilot” from trespassing over the territory of contracting states without permission and further obligated the fifty-two signatories (nearly all sovereign states now adhere to the convention) to “insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft”. Just what it means to obviate that danger is a question that national aviation regulators around the world are wrestling with.

2. Drones - the possible hazards

The chief danger that unmanned aircraft pose to manned aircraft is accidental collision. This is for two reasons. The first is the sheer number of small unmanned aircraft. There are already more small drones than exist general aviation aircraft, and that number will only grow. The air will become more crowded than ever before. The second is the limited situational awareness that drones have. Though drones can be flown with so-called “First Person View” (FPV) cameras that provide some such awareness, regulators believe (based on a track record of military drones with somewhat similar systems) that FPV systems do not provide awareness comparable to a pilot within an aircraft. At some point in the future, drones may commonly have onboard systems that algorithmically avoid collisions. The vast majority of drones do not have such systems at present. In a century of manned aviation, a number of techniques for airspace management have been developed to prevent collisions. These might sound similar to a layperson but in fact entail distinct technical solutions. The first is to segregate airspace. If manned aircraft and unmanned aircraft fly at entirely different altitudes, then there is no risk they can collide. At worst, unmanned aircraft could collide with one another, which would not involve loss of life. This approach means excluding drones from the vicinity of airports used by manned aircraft and confining them to low altitudes where manned aircraft are already prohibited from flying. However, because of exceptions like medevac helicopters, which must fly at low altitudes and must have freedom to go almost anywhere at

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short notice to complete their missions total segregation is not possible. It is, however, the principle behind restrictions, in many jurisdictions, that confine small drones to low altitudes. However, low-altitude flight implicates privacy; low-flying drones can more easily take pictures that infringe on privacy and can create noise that is an "intrusion upon seclusion". Thus, some have proposed segregated bands for drone flight between, say, 500 and 700 feet (150-200 m) above the ground that would be reserved for unmanned aircraft. Similar bands for larger unmanned aircraft at higher altitudes could segregate them from manned aircraft. If airspace control systems were being designed from scratch, such bands would be a logical solution. However, they are not likely to be implemented in any jurisdiction because they run counter to the legacy of how airspace has been regulated. The next mechanism for preventing crashes is to maintain "separation" between aircraft. This works in controlled airspace, where air-traffic controllers keep track of where both manned and unmanned aircraft are. It allows, for example, Predator drones flown by the U.S. government to patrol the U.S.-Mexico border. It also is what has allowed the airport in Kandahar, Afghanistan, to function. The airport was for some time the world's busiest single runway airport, with more than 800 takeoffs and landings per day civilian and military, manned and unmanned, all mixed together. Air-traffic controllers managed this airspace by keeping a minimum of 1,000 feet (300 m) of separation between drones and manned aircraft and 500 feet (150 m) between one drone and another. There does not exist, for the moment, a system for maintaining separation between small drones. For such a system to work, controllers must be able to both see all relevant aircraft and direct them. Small drones fly at lower altitudes, where radar coverage is difficult; there are many more of them, and because small drones have very limited payload capacity, systems that allow them to interact with air-traffic control and other aircraft must be carefully designed. NASA is developing a system that would act as a global surveillance system for small drones at low altitudes. As a backup in case separation measures fail, passenger aircraft are required (throughout the world) to have a Traffic Collision Avoidance System (TCAS), which is an automated system in which transponders on aircraft communicate with one another and alert pilots to the risk of collision. In smaller aircraft, a pilot's eyes can suffice the pilot is required to be able to "see and avoid" other aircraft. Developing systems for drones to "sense and avoid" other aircraft is an active area of research, as is determining how to regulate such new technologies. Some consumer drones already have limited autonomous sense-and-avoid technologies, such as DJI's "Guidance" system. The capabilities of such autonomous systems are changing rapidly. It is difficult to venture predictions about how they will improve. Systems that work at low speeds won't do much good at high speeds; systems that work well in controlled testing may not be resilient in the real world. However, much may change quickly. Larger drones can carry sophisticated sensors, cameras and gimbals that give the pilot good situational awareness (though not as good as that of a pilot in a manned aircraft).

The FPV systems that smaller drones have provide a similar, though more limited capability. Such FPV systems can be used to race around obstacles at high speed. This does not mean, however, that they provide the sort of peripheral awareness that a pilot in an airplane cockpit has. Latency with such systems is also an issue. Many countries, particularly in the developing world, still do not have explicit regulations governing drones. However, in the United States, Canada, Europe, Australia, and elsewhere, a broad consensus on how to regulate drones has emerged in the past decade. The similarities among the various regulatory regimes outnumber the differences. That consensus is to allow more flexibility for smaller drones. These generally can be flown at low altitudes, far from airports, far from crowds, and within the line of sight. Some countries, France, for instance, permit flight beyond the line of sight for very lightweight drones. This is sensible and likely to become more common. The United States has lagged behind the United Kingdom, France, Germany, Australia, Canada, and elsewhere in the implementation of commercial drone flight regulations, however, the proposed rules which the Federal Aviation Administration (FAA).

In 1942 a chicken farmer outside of Greensboro, North Carolina, sued the U.S. government. He said the frequent, low overflight of military aircraft on the adjacent runway was scaring his birds and damaging his livelihood, and he wanted compensation. The case made it all the way to the Supreme Court in 1946. And one result of United States v. Causby was that the Court set the limits of private airspace: If you own a house, your property rights extend 83 feet (25 m) up into the air. That's a quaint, and thankfully irrelevant, limit when it comes to manned aircraft. The Federal Aviation Administration keeps planes much higher than that, save on approach and take-off, and even then most airports require a decent buffer around them. But the 70-year-old ruling has new importance in the age of drones. It remains the only clear federal statement of law on how far above the ground your property ends. And that has raised concerns among some privacy advocates, who question whether anyone from a pesky neighbor to a police department to Amazon's planned delivery service should be allowed to fly above private property, potentially shooting video from the level of the treetops.

Now a federal lawsuit, which was argued today in the D.C. Circuit Court of Appeals, is trying to force the Federal Aviation Administration to set rules protecting citizens from such privacy intrusions. The action was brought by the Electronic Privacy Information Center (EPIC); among other points, EPIC wants the FAA to make it easy for citizens to find out whether drones flying overhead have surveillance capabilities. The group also wants to protect the privacy rights of drone pilots, who have been required to register with the FAA since December.

This isn't the first time that EPIC has tried to compel the FAA to focus on drones and privacy, but the agency argues that its authority is limited to making sure that drones are safe. For now, the question remains: If the FAA isn't protecting your right to privacy from drone spying, who is?

3. Working with drones - technical issues

While discussing multirotor construction and piloting, it will certainly be useful to have a way of communicating different movements of the multirotor. Fortunately, mathematicians way back in the 1700s came up with a way of describing the orientation of rigid bodies in space. The system they developed uses a set of three angles to describe, in this case, the orientation of the multirotor around the three spacial dimensions. You have probably heard of these angles before, they are called roll, pitch, and yaw.

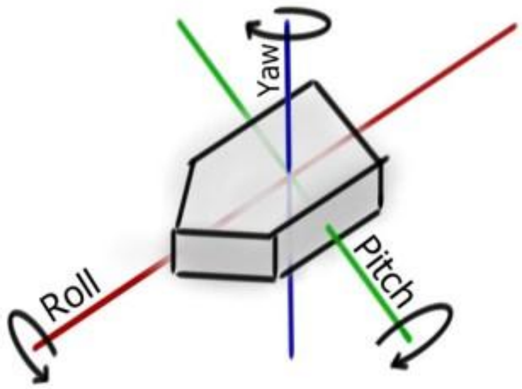

Fig. 1 Angles of rotation

The roll angle of the multirotor describes how the craft is tilted side to side. Rotation about the roll axis is like tilting your head towards one of your shoulders. Rolling the multirotor causes it to move sideways.

The pitch angle of the multirotor describes how the craft is tilted forwards or backwards. Rotation about the pitch axis is like tilting your head in order to look up or down. Pitching the multirotor causes it to move forwards or backwards.

The yaw angle of the multirotor describes its bearing, or, in other words, rotation of the craft as it stays level to the ground. Rotation about the yaw axis is like when you shake your head to say "no."

There is one final bit of terminology we will use to discuss flying the multirotor, and that is throttle. Throttle simply controls the altitude of the multirotor.

Steering

While flying your multirotor, it is very important to understand how the multirotor moves and how we control it. At the root of all the multirotor's movements is the rotational speed of the motors. By adjusting the relative speeds of the motors in just the right ways, keeping in mind that the rotational speed of the motors determines how much lift each prop produces, the flight controller is able to cause the multirotor to rotate around any of the directional axes (roll, pitch, and yaw), or make the multirotor gain or lose altitude.

Roll and Pitch

To make the multirotor rotate about the roll or pitch axes, the flight controller makes the motors on one side of the multirotor spin faster than the motors on the other side. This means that one side of the multirotor will have more lift than the other side, causing the multirotor to tilt.

So, for example, to make a quadcopter roll right (or rotate about the roll axis clockwise), the flight controller will make the two motors on the left side of the multirotor spin faster than the two motors on the right side. The left side of the craft will then have more lift than the right side, which causes the multirotor to tilt.

Similarly, to make a quadcopter pitch down (rotate about the pitch axis clockwise) the flight controller will make the two motors on the back of the craft spin faster than the two motors on the front. This makes the craft tilt in the same way that your head tilts when you look down.

Yaw

Controlling the multirotor's rotation about the yaw axis is a bit more complex than controlling its rotation about the roll or pitch axes. First, let's discuss how we prevent rotation about the yaw axis. When assembling and programming multirotors, we set up the motors so that each motor spins in the opposite direction than its neighbors. In other words, using a quadcopter as an example again, starting from the front-left motor and moving around the multirotor clockwise, the motors' rotational directions alternate, CW, CCW, CW, CCW. We use this rotational configuration to neutralize, or cancel out, each motor's tendency to make the multirotor rotate.

When a prop spins, for example, clockwise, conservation of angular momentum means that the body of the multirotor will have a tendency to spin counter-clockwise. This is due to Newton's third law of motion, "for every action, there is an equal and opposite reaction.” The body of the multirotor will tend to spin in the direction opposite the rotational direction of the propellers.

For example, helicopters have two rotors. One big main rotor responsible for lifting the aircraft, and one small rotor on the tail that adjusts how the helicopter spins. Imaging what would happen if in mid-flight, a helicopter’s tail rotor fell off the aircraft while the big main rotor kept spinning (this by the way is something we hope never happens to any helicopter pilots). You can probably imagine that the helicopter would start spinning. Well this rotation would be caused by the rotation of the propeller in the opposite direction, according to the law of conservation of angular momentum.

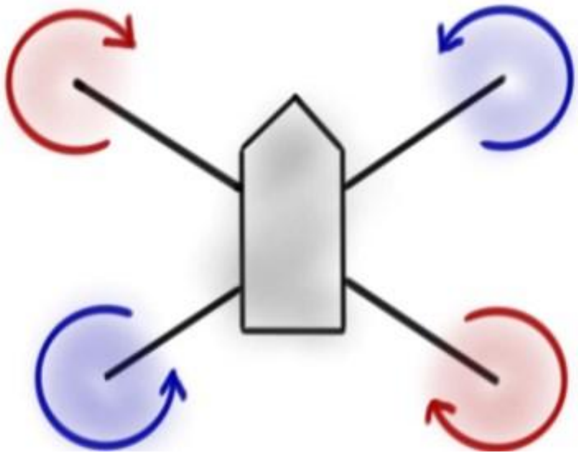

Fig.2 Motors rotation directions

Bringing it all together now, each of the quadcopter’s four rotors tends to make the multirotor rotate in the opposite direction than their spin. So by using pairs of rotors spinning in opposite directions, we are able to cancel out this effect and the multirotor does not spin about the yaw axis.

So therefore, when we actually want the multirotor to rotate about the yaw axis, the flight controller will slow down opposite pairs of motors relative to the other pair. This means the angular momentum of the two pairs of props will no longer be in balance and the craft rotates. We can make the multirotor rotate in either direction by slowing down different pairs of motors.

Hovering/Altitude Control

Now that we understand how steering the multirotor works, let’s quickly discuss a much simpler maneuver, hovering. To make the multirotor hover, which means the multirotor stays at a constant altitude without rotating in any direction, a balance of forces is needed. The flight controller will need to counteract the force of gravity with the lift produced by the rotors.

Throwing a bit of math into the picture now, the force of gravity acting on the multirotor is equal to the mass of the multirotor times gravitational acceleration (which, as far as we are concerned, is a constant as long as we are staying on Earth). The lift produced by the multirotor is equal to the sum of the lift produced by each of the rotors. Therefore, if the force of gravity equals the force of the lift produced by the motors, the multirotor will maintain a constant altitude.

To ascend or descend, therefore, the flight controller disrupts this balance. If the lift produced by the multirotor is greater than the force of gravity, the craft will gain altitude. If the opposite is true, that is, if the lift produced by the multirotor is less than the force of gravity acting on the multirotor, then the multirotor will fall.

Movement

Adjusting the relative speeds of the motors, the flight controller can make the multirotor tilt. Well, the reason we want to be able to tilt the multirotor is that tilting the multirotor causes it to move. By tilting the multirotor in different directions, it can be made to move forward, backward, left, or right (neither altitude control nor yaw control involve tilting). For example, when the multirotor pitches down (clockwise around the pitch axis) it moves forward.

The reason the multirotor moves when it tilts is because while the multirotor is tilting, some of the lift produced by the rotor is directed horizontally while normally all of the lift is directed downward. This sideways component of the lift pushes the multirotor.

Now, you might have realized the problem that happens when we sacrifice some of the multirotor’s downward thrust to move the craft horizontally. Since less thrust is directed downward while the multirotor is tilting, multirotors tend to lose altitude while moving around. Now some flight controllers have a feature called “altitude hold” which means that the flight controller automatically adjusts the motor speeds in order to make the craft maintain a constant altitude while moving. Unfortunately, the KK2.1 flight controller used in the tutorials on this site lacks this feature. This helps keep costs down, but also means that the pilot must manually adjust the throttle to maintain altitude while maneuvering.

4. Privacy laws

Big data is a term for data sets that are so large or complex that traditional data processing applications are inadequate. Challenges include analysis, capture, data curation, search, sharing, storage, transfer, visualization, querying, updating and information privacy. The term often refers simply to the use of predictive analytics, user behavior analytics, or certain other advanced data analytics methods that extract value from data, and seldom to a particular size of data set. Accuracy in big data may lead to more confident decision making, and better decisions can result in greater operational efficiency, cost reduction and reduced risk. Big brother means a person or organization exercising total control over people's lives.

Privacy concerns can lead to hot tempers. Last year, a Kentucky man use a shotgun to blast a drone out of the air above his home. A New Jersey man did the same thing in 2014, and a woman in Seattle called the police when she feared a drone was peeping into her apartment. (The drone belonged to a company conducting an architectural survey). And in November, repeated night-time overflights by a drone prompted calls to Albuquerque police complaining of trespassing, the police concluded that the flyer wasn't breaking any laws.

State laws already on the books offer some privacy protections, especially if a drone is shooting photos or video. Erin E. Rhinehart, an attorney in Dayton, Ohio, who studies the issue, says that existing nuisance and invasion-of-privacy statutes would apply to drone owners. If you could prove you were being harassed by a drone flying over your house, or even that one was spying on you from afar, you might have a case against the drone operator. But proof is difficult to obtain, she says, and not everyone agrees on how to define harassment.

Some states are trying to strengthen their protections. In California, nervous celebrities may benefit from a law signed by Governor Jerry Brown this past fall. The meat of the legislation reads, "A person is liable for physical invasion of privacy when the person knowingly enters onto the land or into the airspace above the land of another person without permission…in order to capture any type of visual image, sound recording, or other physical impression of the plaintiff." And a similar privacy law in Wisconsin makes it illegal to photograph a "nude or partially nude person" using a drone. (Dozens of states have passed or are considering drone-related laws).

Most of these statutes are carefully worded to focus on capturing images, because the states can't control where drones are allowed to fly—that's up to the FAA. Robert Kirk, an attorney who advocates on the part of companies that want to use drones for surveying, thinks that privacy laws that single out drones could be challenged in court. "The FAA has taken the position that any regs that deal with air safety reside solely with the FAA," he says. "The trouble is going to be whenever someone comes after a drone operator and we're moving into privacy and trespass, areas that are more traditionally in the realm of state and local authority." The upshot: Authority is split between the federal government and the states. And no one currently has the authority to broadly protect privacy by preventing drones from flying over people's homes.

5. Conclusions

Someday soon, Amazon promises, drones will zip around neighborhoods, quickly and efficiently delivering small packages. If they do, they are very likely to have the legal right to fly over your house—and the same goes for commercial land surveyors using cameras to prepare maps.

When it comes to the use of drones by law enforcement, the situation is less clear-cut. The Supreme Court has ruled that aerial surveillance by police forces is legal, whether the subject is on private or public property. This came up in two cases in the 1980s, when the Court decided that the police hadn't needed a warrant to take aerial photos of marijuana plants growing in residential backyards. However, the advent of drone technology has made it much easier and cheaper for police departments to conduct such surveillance. And states have been grappling with the implications. Both Nevada and Virginia have passed legislation requiring the police to obtain a warrant before using a drone for surveillance. However, Texas has gone in the opposite direction, saying that law enforcement agencies need only probable cause. This is an issue that could end up being decided in federal court.

The EPIC lawsuit is not the only effort to expand the FAA's role into the privacy realm. A law proposed by Massachusetts Senator Ed Markey, the Drone Aircraft Privacy and Transparency Act, would require the agency to ensure baseline privacy and transparency safeguards, which would apply to both private drone operators and law enforcement.

The ACLU, which supports the Markey bill, argued as far back as 2011 that a lack of oversight could lead to excessive surveillance by law enforcement using drones. Yet some legal analysts warn that the opposite situation also poses dangers: If regulations were poorly written, they could end up protecting government and commercial operators of drones, while restricting everyone else. For instance, some states are considering laws that would prevent journalists from using drones to photograph conditions on big industrial farms, according to Margot Kaminski, a law professor at Ohio State. Kaminski urges patience on the federal level. "Clarity comes at the cost of experimentation, and early law is likely to be over-reaching," she says. Some restrictive laws could end up being struck down in the courts. But by letting states, counties, and towns try to get this right, Kaminski argues, we may end up with a reasonable understanding of when and how drones fit into our daily lives.

And that includes how drones can be used for good, not just as intrusions. These aircraft are already being used for everything from stunning film-making to search-and-rescue operations to water conservation work on farms. Drones can also enhance safety by taking over both such mundane applications as inspections of leaky roofs, and high-profile tasks such as monitoring natural disaster sites. The challenge is to find the right balance between the right to the skies and the right to privacy. Big Data or Big Brother?

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Presentation of the current state of the use of sensor networks and how they process information supplied in special areas

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Abstract

Choosing a communications network in these current world made it necessary to study in detail the current level of development and implementation of wireless sensor networks. They are the main applications of WSN, sensor networks with applications in chemistry, in the military system, the submission of an application used by multinational armed forces, and types of transducers used in mining and upgrading possibilities of the sensor elements used underground.

Keywords: communications network, military system, transducers, underground.

1. Introduction

The explosion in wireless communications technology has allowed widespread development of applications using mobile electronic devices with related services.

Wireless networks are considered third wave revolutionary in the history of wireless communications technology after the mobile TV and radio.

Current trends in the field of sensor networks in this case is based on a specific monitoring and control system using sensors or actuators integrated into these networks generally nodes that form a network connected intelligence.

Information theory has become established in the scientific community and especially the engineers setting a framework for addressing the issues of information processing in sensor special networks. This theoretical framework allows the definition and performance evaluation as well as some fundamental limits for various systems communications Defining general context Battlefield cybernetic of the future will include the conquest of flexibility, robustness and viability operational elements of the strategic concept of "network-based warfare" (NCW), where force will be structured on the principle of joint, included in environmental documents and distant horizon, Joint Vision 2020 or the Army After Next.

RBR will turn information into power factor will increase the responsiveness and accuracy of employment of force. On the other hand, will assimilate the conceptual and technological innovations speed all of the military action. This scientific research project is focused on presenting the current state of the use of sensor networks and the way they process information supplied in special areas. The issues addressed in this project are topical issues identified both in academic research and in industry. The necessity of research conducted on the steady growth in the last decade the use and popularity of wireless communication systems, even in environments where wired communication is not possible.

First node wireless consists of a device that is designed to receive and transmit data over a network, generally speaking, and in our case, wireless. We move on and find that a wireless node is attached touch sensors of all kinds. Such data network choose to transmit them are captured by sensors. We have such devices that do not need cables to connect to a network and can accept portable power sources and sensors low voltage. Networks will be an essential element in industry, agriculture, medicine and household applications. Therefore sensor networks must be of increasingly robust, economical, with a bigger life, resistant to environmental conditions and permanent changes of topology. Moreover, the cost must be minimized as much as possible. Some examples are:

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- are developed sensors to analyze remote locations (weather, the movement of an animal in its habitat, the detection of a fire in a forest);
- in a large and crowded city such sensors are attached taxis to study traffic conditions and to compile a map of the most effective routes to reach various destinations;
- are used wireless sensors in mining to determine the concentration of methane in underground
- networks wireless sensor for the security of a store, a parking lot or for certain facilities;
- networks sensors used in military applications to detect, determine the position or trajectory of potential enemies;
- networks sensors can be used to increase the alert to a potential terrorist attack

2. Aplications of WSN

Intelligent buildings - the large building is a large amount of energy wasted due to inefficiency of control and humidity control, ventilation, the condition air and ultimately not the largest consumer. .In work Rabaey, JM, Ammer MJ, da Silva, JL, Patel, D., Roundy, S. "PicoRadio Supports Ultra-Low Ad Hoc

Power Wireless Networking, "IEEE Computer, Vol. 33, Jun. 2000, pp. 42-48. stated that through WSN can improve the comfort and energy consumption will decrease, being circulated figure of $ 55 billion dollars US only which would reduce carbon emissions by 35 million cubical meters .

Commercial applications - Detection and monitoring of automobile thefts involve sensory nodes that are placed in order to identify possible threats in a geographical area via the Internet and designed to inform the owner means of two possible approaches: the first involves the location of the vehicle in a network node and then this information is transmitted to a centralizer, and the second, the information collected by the sensors are sent to a centralizer which is responsible for finding the location.

Medical applications - A ZigBee application in the monitoring of the patient at home can be, for example, blood pressure measurement and pulse ZigBee portable devices which interfaces with a sensor information sampled at predetermined intervals by a physician. The data acquired in this manner are sent to a local server, a personal computer placed at the patient's home, instead they are made a first analysis of information. Further information is transmitted to the patient's doctor or nurse through the Internet. Applications in environmental monitoring can be used to detect forest fires.

An ad-hoc sensor network is a collection of sensor nodes forming a temporary network providing information without the need to manage and without them offer as support services. In other words, there is a fixed structure. In general sensor nodes using wireless transceivers devices radio frequency broadcast network interface and communication between nodes is performed using multi-hop wireless links. Each node in the network acts as a router, routing packets to neighboring nodes. In order to be widely deployed wireless sensory network that covers a area so broad in terms of possible applications, it is necessary to an understanding of interconnection and management techniques of sensory nodes in a scalable network that resources are consumed efficiently.

3. Prezentation current state of using sensor networks in particular areas

Networks sensors with applications in chemistry

Among the most important contributions we can mention:

- Multimode sensor electrodes used in the diagnosis of chemical change based on enzymes
- Identification of stable isotopes as markers of origin by spectrometric methods
- Research on optimization of anaerobic fermentation to obtain biogas from biomass.

The idea of environmental quality control after landing, we distinguish three types of sensors:

- for the determination of pollutants contaminate environmental factors;
- determining the components of which.

It is made naturally by the environmental factor.

supervised;

- for determination of size dependent.

In recent years they were made amperometric biosensors and potentiometers, which besides redox mediator include biomolecules, resulting in a new class of sensors called electrodes chemically modified based on immobilized enzymes. Principles of construction and operation, as well as the main features and applications chemically modified electrode based on immobilized enzymes.

Contamination of the environment can be carried out with or without human intervention causing changes in the physico-chemical or biological characteristics. When these changes exceed a certain threshold and remain a long time to install pollution. by nature changing balance of agents who produced biologically, physicochemically ecosystem can be defined the following main types of pollution:

- Cleaning;Physical: Thermal,phonic,radioactive.
- sensors to determine the compounds that make up the natural environment factor studied:

Air:

- Determination of the gas composition of the atmosphere unpolluted O2, CO2, etc.

- Determination of moisture

Water:

- Determining conductivity (total content of salts)Determining the degree of turbidity
- Determining the level, flow and / or water speed

Soil:

- Water vapor pressure in the soil.
- Humidity.
- Determining the composition of unpolluted soil carbonates, salt, calcium, magnesium, etc., and the existence of microelements, etc.)

4. Air quality analysis

In the following will be presented meteorological sensors for monitoring indicators of air pollution, after which it will refer to sensors designed to measure key quality indicators atmosphere (nitrogen dioxide, NOx, sulfur dioxide, SOx, VOC organic compounds volatile- , suspended-PM).

Moisture sensors:

Humidity refers to the water vapor contained in the air. Humidity measurements may be subject to a number of terms or units. The three commonly used terms are: absolute humidity, dew point and relative humidity (RH).

Dew point:

The dew point is expressed in ° C or ° F, the temperature and pressure at which gas begins to condense into a liquid.

Relative humidity:

Is abbreviated RH, relative humidity refers to the ratio (expressed in percent) of the moisture content in the air as compared with a saturated humidity at the same temperature and pressure.

This discussion capacitive operating principles, resistivity and thermal conductivity used to measure humidity will highlight the advantages, disadvantages and possible applications.

Capacitive Humidity Sensors

Relative humidity - relative humidity capacitive sensors (RH) are used widely in industrial, commercial and remote measuring meteorological parameters.

5. Sensors surface acoustic wave detection for chemical agents

There was one surface acoustic wave sensor for the detection of chemical warfare agents. The sensor is of the "delay line" conducted on a piezoelectric quartz substrate. Rated operating frequency is 70 MHz, the films are chemically sensitive polymer type. For testing we used two chemicals chloropicrin (CCL3NO2) and hydrogen cyanide (HCN). The minimum level of detectability of 0.08 to 0.13 ppm was 0.08 to 0.18 ppm for chloropicrin and hydrocyanic acid. One of the most popular sensors for the detection of chemical warfare agents is the sensor surface acoustic wave (Suas). For the first time was demonstrated by King in 1964, the capacity of this type of sensor to detect traces of certain compounds. Surface acoustic wave sensor to detect chemical agents is preferred due to its numerous advantages (high sensitivity, stability over time, real-time response, good reproducibility, small, great reliability and low price). Suas must selectively detect a certain specific compound of interest in the presence and interference of other substances in the environment. Within the program "Security and Defence" for the first time in Romania, was carried out a surface acoustic wave sensor for the detection of chemical warfare agents. It is crucial to securing peace in the world, holding a picture of ground surveillance to be complete, timely and accurate. Choosing RQ-4 equipped with MP-RTIP sensor for the NATO AGS air segment reflects the basic requirements of the scheme AGS. Performance parameters of the RQ-4 are unparalleled, with the ability to fly at altitudes up to 20,000 meters for up to 36 hours at speeds of nearly 340 knots, well above commercial traffic busy airspace. Furthermore, RQ-4 has the ability to be deployed 2000 miles marine from its base operating principal with a result on time station over 24 hours, thus ensuring a capability ready for operations worldwide and providing an effective operational capability.

Fig.1. Northrop Grumman RQ-4 Global Hawk

Thus distinguishes one component air and by land, air component data from being complemented by ground radar. All this information will be processed using fixed and mobile ground stations located in all NATO member states. The main operating base will be located at Sigonella Air Base, Italy. By combining information obtained in real time component of the air and land military command will have uninterrupted access to information about any possible threat to the Alliance. Romania has already placed more FPS-117 radars, which are interconnected with NATO's early warning systems.

Fig.2. FPS-117 Radar

This system is available Alliance members, the land being developed related to the supervision of European and Canadian industry. Expecting to become operational in 2013, AGS will be produced by Partnership Transatlantic Industrial Supervision (TIPS), a consortium of EADS, Galileo avionics in part and Romania (Italy), General Dynamics (Canada), Indra (Spain), Northrop (USA) and Thales (France).

Future network development activities aimed at integration "NATO General Communication System" (NGCS), in order to ensure:

-services forces designated to act under NATO command;

-services network forces deployed under NATO command, by developing mobile component;

-realization tactical communications networks and integrate them into the national military communications network.

The soldier of the future - Integrated action in the context of interoperability of NATO is a research and development underway, funded under the National RDI RELANSIN designed to provide the capabilities needed waging combat operations jointly with NATO troops and facilities in command and exercise control to ensure order. The integrated unit includes: integrated headset, computer, radio, weapons, personal protective equipment and optoelectronic equipment. Concept of Army Staff and existing models. To efficiently use the advantages of the information era, NATO has launched a comprehensive structural change, doctrinal and conceptual, in order to ensure information superiority by creating networking feature capabilities (NATO Network Enabled Capability -NNEC).

Nationally, implementation NCW capabilities will not only involve adapting existing elements to this concept, but also establish the legal framework (adapting national security strategy, defining doctrines etc.) that will enable joint forces shift from thinking centered on the platform oriented network.

This process is continuous and without a foreseeable end point now. The teams involved in the transformation and implementation of NCW should take into account that this phenomenon is closely linked coevolution of seven major functional factors of the doctrine, organization, training, technology, leadership and education, personnel and facilities.

Fig.3. Personal radio connection

5. Conclusions

Within combat actions are effective immediately used the results of scientific research:

- -platform: Small UUVs, mini UAVs, UCAVs, terrestrial robots;
- -Weapons: Transportable by air, with increased accuracy and reduced collateral damage;
- -Modern equipment for the future soldier;

Centre of Excellence in the field of land forces for combat simulation is the center of the ground forces (CILFT) from Cincu. of simulation capabilities are global and provide staff training using simulation each category separately, but also their integration in complex simulation federation of LVC (live-virtual-constructive). According vision in the simulation of the head of the Army Staff in 2016 CILFT must be able to conduct exercises distributed brigade level, using federation LVC, where the command of the brigade is where you peace of it, a battalion is Cincu deployed using MILES and VBS2 simulation systems, and other battalions of the brigade are simulated in the simulation system JCATS. Simulation capabilities available for training CILFT force are significant, but there is a major drawback. The command posts of the units trained in general echelon battalion and brigade command and control system is limited to classic maps (paper) and voice communications, although some units have modern C2 systems. There are exceptions, and namely repetition exercises of the mission in which they used American-type systems Blue Force.

Tracking (BFT). A major impediment to the use of C4I systems during simulation exercises it was the lack of an adapter to allow the automatic exchange of data between systems simulation and C4I applications in the endowment land forces. Center Information Systems (CIS) of the General Staff of the Army has developed, a first for the Romanian Army a prototype adapter C4I whose features were demonstrated during the exercise FORTRESS 2013.

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Adaptive fuzzy reference model control for inverted pendulum

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Abstract

We try to solve an inverted pendulum problem, for which we designed several components in a fuzzy system. Also, we performed modelation and simulation via the use of a pseudo code for the fuzzy direct and inverse controllers. An indirect Model Reference Adaptive Fuzzy Control (MRAFC) scheme is simulated for performing an asymptotic tracking of a reference signal for the inverted pendulum, signal with quickly or slowly time-varying parameters. At this point we will improve the performance by adding rules to the rule-base.

Keywords: fuzzy systems, model reference, adaptive fuzzy control, rule-base.

1. Introduction

Inputs and Outputs for Inverted Pendulum.

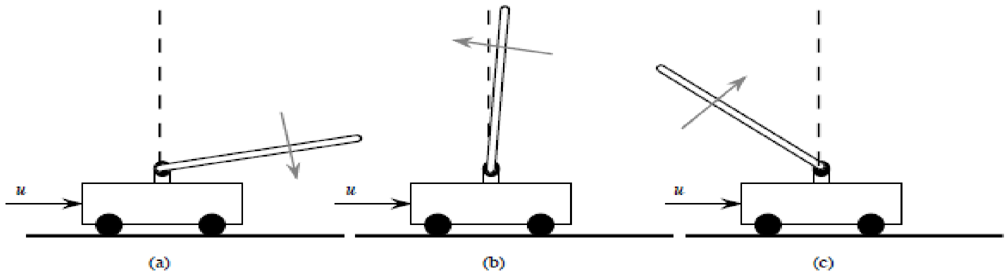

Fig. 1. Inverted pendulum in , 3 base positions.

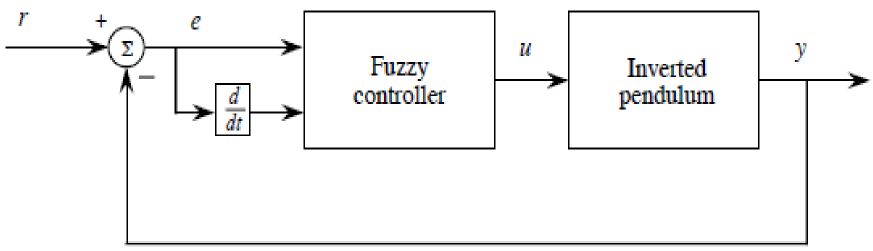

Fig. 2. Fuzzy direct controller with feed back.

The linguistic variables, the inputs mean the error $e(t)$ and the change-in-error *de/dt,* while the output is described by the force $u(t)$- Newtons. $e(t) = r(t) - y(t)$, where $r(t)$ (angle -radians) is the reference input, $y(t)$ means the output angle, made by pendulum with the vertical. “l” is the half of length of the pendulum (meters). See next figure 3.

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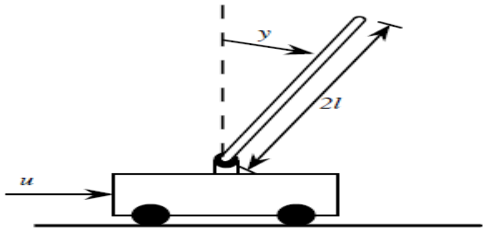

Fig. 3. Force and angle.

Error and change-in-error are framed in domains: “−2” means “neglarge” “−1” means “negsmall”, (right) “0” means “zero”,“1” means “possmall” and “2” means “poslarge” (*left)*. The force has reverse sign, because if $r = 0$, then $e = r - y = -y$ and $de/dt = - dy/dt$.

2. Fuzzy Direct Controller

Table1 Rule Table, heuristic created

“force” u		“change-in-error” $\dot{e}$				
		-2	-1	0	1	2
“error” e	-2	2	2	2	1	0
	-1	2	2	1	0	-1
	0	2	1	0	-1	-2
	1	1	0	-1	-2	-2
	2	0	-1	-2	-2	-2

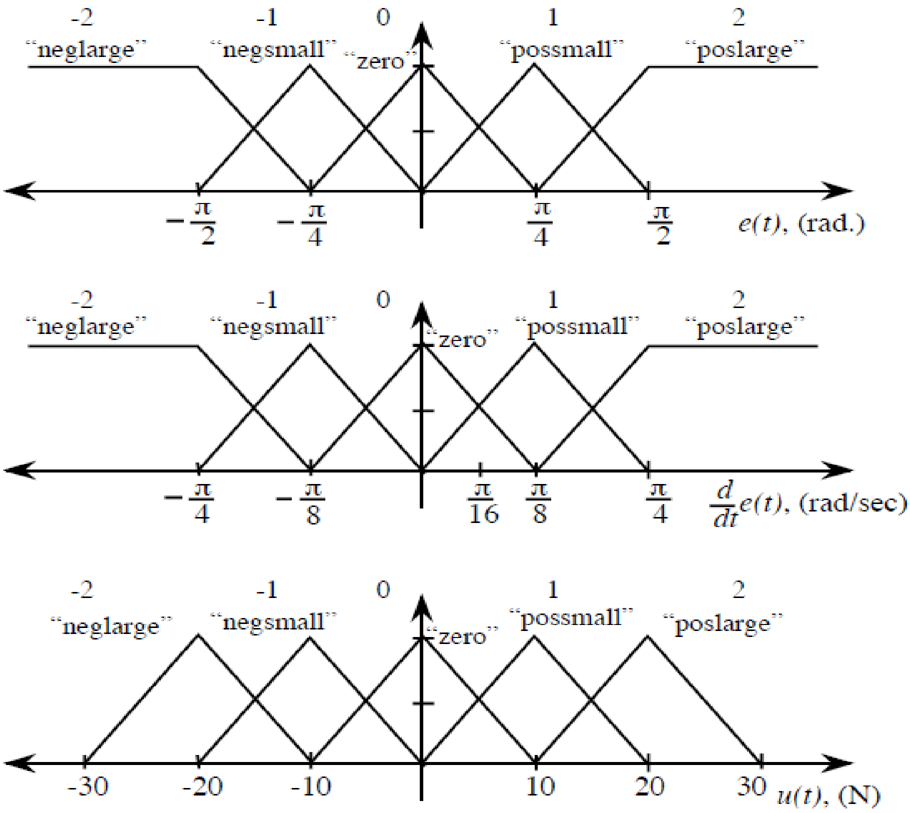

Fig. 4. Membership functions

3. The reference model

Let denote scaling gains with g1, g2, and g0 for error e(kT), change in error c(kT), and output u(kT). The reference model is of the second order, with natural pulsation $\omega_n=3$ rad/sec and damping factor $\zeta=1$. The Laplace transfer function:

$$H_m(S) = \frac{Y_m(S)}{R(S)} = \frac{\omega_n^2}{S^2+2\cdot\zeta\cdot\omega_n\cdot S+\omega_n^2} = \frac{9}{S^2+6\cdot S+9} \qquad (1)$$

The fuzzy inverse also has scaling gains, but now we do not modify them. Knowledge-base modification is performed by shifting center of the membership functions of the Fuzzy Direct Controller, denoted with reg (force) (see FIGURE 6) by scaling it with g0, an output of the The Modifier of the Rules Base. At its turn, this is modified by p, the output of the Fuzzy Inverse Controller.

4. Fuzzy Model Reference Learning Controller (FMRLC)

Matlab Implementation

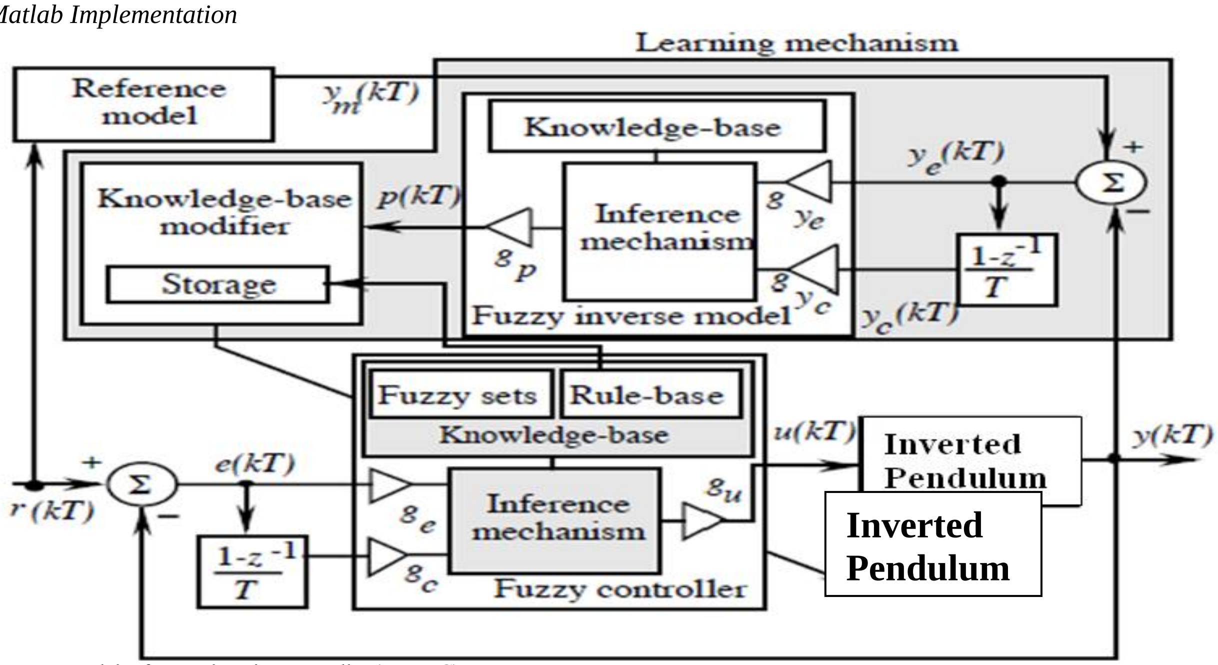

Fig 5. Fuzzy model reference learning controller (FMRLC)

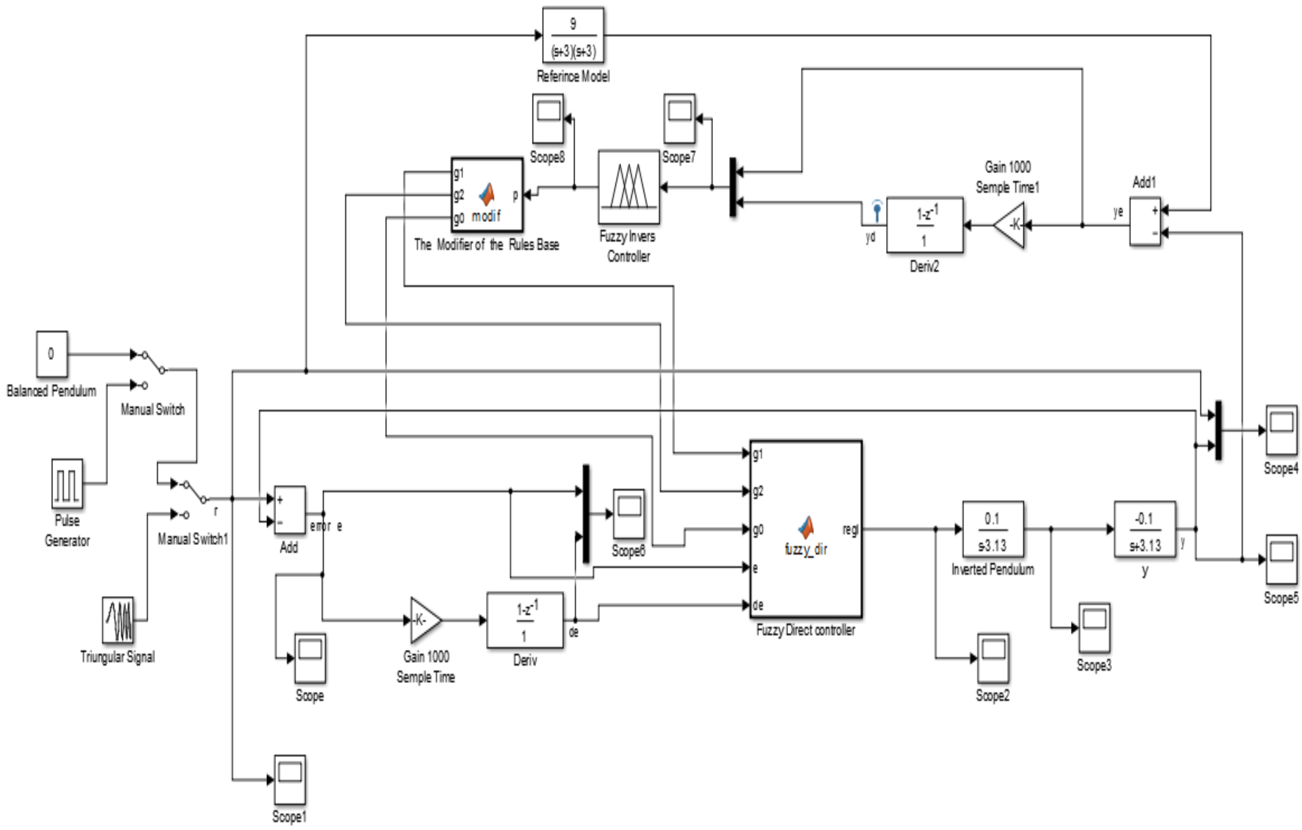

Fig 6. Simulink FMRLC

5. Matlab Functions Code and Fuzzy Inference Systems (FIS)

```
function  regl =fuzzy_dir(g1, g2, g0, e, de)
 %The direct fuzzy controller is defined here
coder.extrinsic('newfis','addvar', 'addmf', 'addrule', 'regl' );
regl=newfis('reg_dir');
%membership function for the controller inputs. error:e=r-y
regl=addvar(regl,'input','error',g1*[-1 1]);
%Add variable to fis. y = addvar(y,'varType','varName',varBounds),where varBounds describs the limiting range
%values for the variable you want to add.
regl=addmf(regl,e,1,'NB','zmf',g1*[-1 -0.5]);
regl=addmf(regl,e,1,'NS','trimf',g1*[-1 -0.5 0]);
regl=addmf(regl,e,1,'Z','trimf',g1*[-0.5 0 0.5]);
regl=addmf(regl,e,1,'PS','trimf',g1*[0 0.5 1]);
regl=addmf(regl,e,1,'PB','smf',g1*[0.5 1]);
% Add a membership function to an FIS:
%y = addmf(y,'varType',varIndex,'mfName','mfType',mfParams), where: 'mfType' is a string representing the type % of the new membership function. 'zmf'and %'smf' are asymmetrical polynomial curve open to the left and to the %right, respectively,change-in-error de/dt.
regl=addvar(regl,de,'change-in-error',g2*[-1 1]);
regl=addmf(regl,de,2,'NB','zmf',g2*[-1 -0.5]);
regl=addmf(regl,de,2,'NS','trimf',g2*[-1 -0.5 0]);
regl=addmf(regl,de,2,'Z','trimf',g2*[-0.5 0 0.5]);
regl=addmf(regl,de,2,'PS','trimf',g2*[0 0.5 1]);
regl=addmf(regl,de,2,'PB','smf',g2*[0.5 1]);
 %The membership functions for the controller output, the force for process command.
regl=addvar(regl,'output','force',g0*[-1 1]);
regl=addmf(regl,'output',1,'NB','trimf',g0*[-1 -2/3 -1/3]);
regl=addmf(regl,'output',1,'NS','trimf',g0*[-2/3 -1/3  0]);
regl=addmf(regl,'output',1,'Z','trimf',g0*[-1/3 0 1/3]);
regl=addmf(regl,'output',1,'PB','trimf',g0*[1/3 2/3 1]);
 %The structure of the rule list is
ruleList=[1 1 5 1 1; 1 2 5 1 1; 1 3 5 1 1; 1 4 4 1 1; 1 5 3 1 1;
        2 1 5 1 1; 2 2 5 1 1; 2 3 4 1 1; 2 4 3 1 1; 2 5 2 1 1;
        3 1 5 1 1; 3 2 4 1 1; 3 3 3 1 1; 3 4 2 1 1; 3 5 1 1 1;
        4 1 4 1 1; 4 2 3 1 1; 4 3 2 1 1; 4 4 1 1 1; 4 5 1 1 1;
        5 1 3 1 1; 5 2 2 1 1; 5 3 1 1 1; 5 4 1 1 1; 5 5 1 1 1];
%The rules are built from statements like this (see rule 1 1 5 1 1):If input1 is MF1 or input2 is MF1, then output1 is %MF5 (weight = 1) .The last column specifies where AND = 1 and OR =2
regl= addrule(regl,ruleList);
%addrule has two arguments. The first argument is the MATLAB workspace variable FIS name. The second %argument for addrule is a matrix of one or more rows, each of which represents a given rule.The Fuzzy Inference %System (FIS) for Fuzzy Inverse Controller follows:
Name='fuzy_back_pendul'
Type='mamdani'
Version=2.0
NumInputs=2
NumOutputs=1
NumRules=25
AndMethod='min'
OrMethod='max'
ImpMethod='min'
AggMethod='max'
DefuzzMethod='centroid'
 [Input1]
Name='error'
Range=[-0.1 0.1]
NumMFs=5
MF1='NB':'trapmf',[-Inf -Inf -0.0981 -0.049]
MF2='Z':'trimf',[-0.049 0 0.049]
MF3='NS':'trimf',[-0.0981 -0.049 0]
MF4='PS':'trimf',[0 0.049 0.0981]
MF5='PB':'trapmf',[0.049 0.0981 Inf Inf]
```

```
 [Input2]
Name='deriv_error'
Range=[-0.4713  0.4713]
NumMFs=5
MF1='NB':'trapmf',[-Inf -Inf -0.3142 -0.1571]
MF2='NS':'trimf',[-0.3142 -0.1571 0]
MF3='Z':'trimf',[-0.1571 0 0.1571]
MF4='PS':'trimf',[0 0.1571 0.3142]
MF5='PB':'trapmf',[0.1571 0.3142 Inf Inf]
 [Output1]
Name='out'
Range=[-170 170]
NumMFs=5
MF1='NB':'trimf',[-150 -100 -50]
MF2='NS':'trimf',[-100 -50 0]
MF3='Z':'trimf',[-50 0 50]
MF4='PS':'trimf',[0 50 100]
MF5='PB':'trimf',[50 100 159]
[Rules]
function [g1,g2,g0] = modif(p)
 g1=pi/32;
 g2=pi/10;
if abs(p)>= 30
        g0=120.-abs(p);
     elseif (abs(p)<30) && (abs(p)>=20)
g0=120.-abs(p/2);
     elseif (abs(p)<20) && (abs(p)>=10)
        g0=120.-abs(p/3);
     elseif (abs(p)<10) && (abs(p)>=5)
        g0=120.-abs(p/3);
     elseif (abs(p)<5) && (abs(p)>1)
        g0=120.-abs(p/3.5);
     elseif (abs(p)<1) && (abs(p)>0.1)
        g0=120.-abs(p/4);
      else
        g0=120.;
 end
```

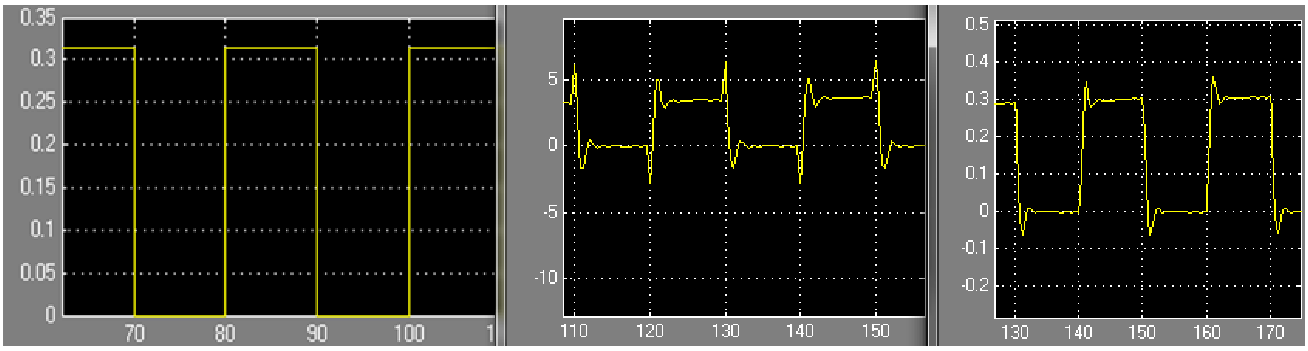

Fig 7. Square wave for input and the response of error and output

6. Conclusions

Wifh fuzzy adaptive controllers arrive equilibrium faster, with reduced oscillations around the setpoint. They Improve the response, since systems spend less time in transient operation. So, power consumption is reduced.

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Application of E-index platform in case of FPSP faculty distance learning system

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Abstract

Distance learning is the integral part of modern educational concepts that utilizes information technology as a basis for knowledge transfer and exchange. In this paper we will discuss the implementation of Electronic Index (e-index) platform for Faculty of Business Studies and Law distance learning purposes. Given platform enables students and teachers to easily communicate, and share knowledge. It also provides basic administrative service functions reducing physical interaction between students and faculty administrative staff. Platform has proven to reduce physical attendance and interaction overhead reducing costs and providing students more time to focus on learning rather than administrative obligations.

Keywords: e-index; distance learning (DL); learning management system (LMS); education in Serbia.

1. Introduction

Concept of distance learning enabled students to obtain knowledge and certification regardless of geographical and language setting. Thanks to expansion of information technologies DL systems revolutionized the way of knowledge adoption and transfer. Distance learning grows at a staggering rate of 7.9% each year and has reached over 51 billion dollars in market value, according to (Docebo report 2016).

Distance learning comes in many forms and so far a lot of concepts and approaches have been developed. Some of them include: Computer Assisted Learning (CAL), proposed by (Lanier, 1966) and modernized by (Zinn, 2000); Learning Management Systems (LMS), proposed by (Becker, 1968) and modernized by (Lee & Lee, 2008); Electronic Learning (e-Learning), proposed by (White, 1983) and modernized by (Piccoli, Ahmad, & Ives, 2001); Mobile Learning (m-Learning) , proposed by (Darazsdi & May, 1989) and modernized by (Rushby, 1998). Timeline of distance learning development is given in Fig 1.

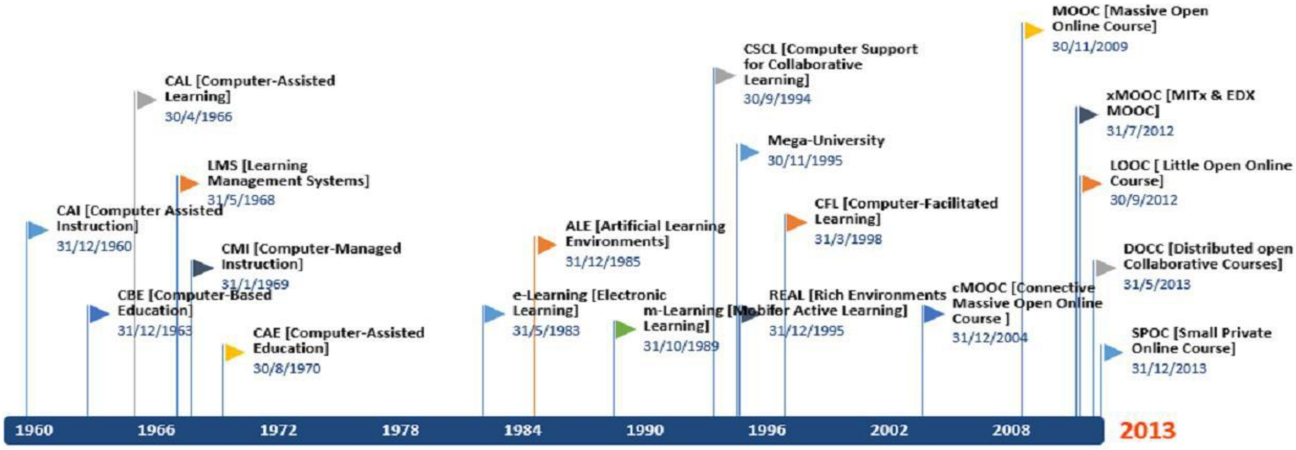

Fig. 1. Timeline of distance learning concepts. Source: (Aparicio, et al. 2014)

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2. Process of creating Distance Learning System

Before we present the implementation of E-index platform it is important to understand the process of creating Dl system. First step is the defining of the content structure which is achieved by planning what type of learning objective needs to be accomplished and what are the outcomes. The learning objectives will serve as the framework for the course, and the element by which all the supporting content is provided. The course outline should be drafted by a Subject Matter Expert or an industry professional who best understands how the training applies in the field.

Second step is writing the content and assessment questions following a model of who, what, when, why, and how. If working directly with a subject matter expert, this person can usually provide the supporting research-based evidence to validate the training program, otherwise it is needed to employ a team of researchers to provide this information. At this point, writers should also be working on putting together a pool of test questions and interactive questions to assess learner knowledge based on the established learning objectives.

Third step is to develop the content interactivity. This means that the existing content need to be translated into audio visual stimuli which can be absorbed by the students in such a way that it invokes the students curiosity and maintains motivation through the course. It is a process of creating textual audio, video and animation material from the written content and combining them into a cohesive program.

Fourth and very important step is the course quality control and deployment. Once a course has completed the development cycle, a blind review is conducted to document any errors, bugs, issues or modifications that may be needed before releasing it live to learners. Deployment can be performed in two ways, either a full course disclosure or a segmented (partial) release of the material.

In Fig 2 is given the graphical overview of the described steps in creating DL system.

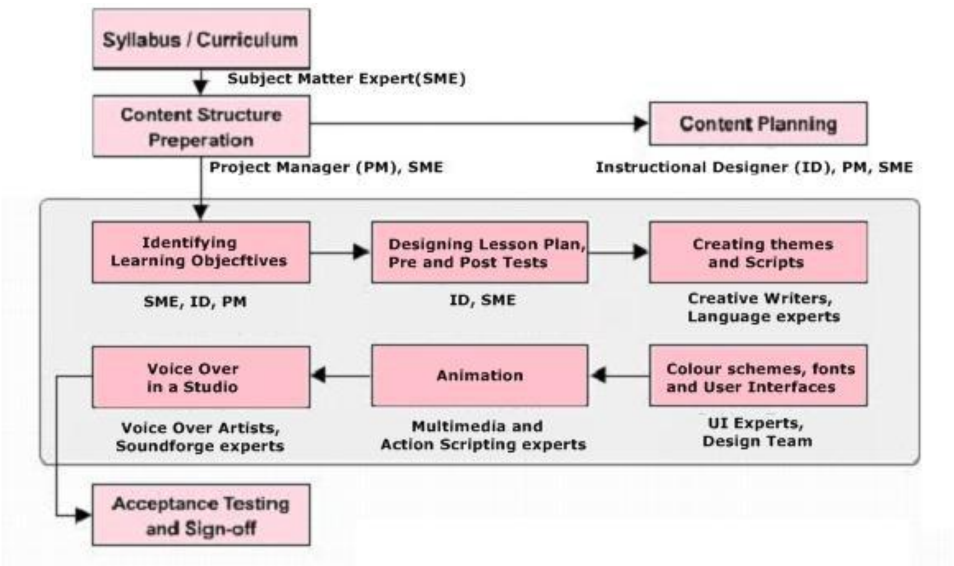

Fig. 2. Process of creating DL system. (Retrieved from: marchinfotech.com/)

3. E-index platform

E-index was developed by Faculty of FPSP (Fakultet za Poslovne Studije i Pravo/Faculty for Business Studies and Law) as a DL system that provides web-based and mobile (android) access with the aim to support students in the process of learning. It provides:

- Delayed lectures following via video (MP4 format). The lecture can be viewed and attend several times.
- Delayed listen to lectures in MP3 audio format. Ideal for learning in the transit and other situations.
- Consultation with teachers and lecturers.
- Monitoring the schedules of lectures, and achieved results
- Electronic exam application.
- Communication with students' service.
- Using the rich content of e-libraries. Textbooks, books, research and graduate papers are available in a special format.
- Manage all other information relevant to the study.
- Manage financial liabilities.

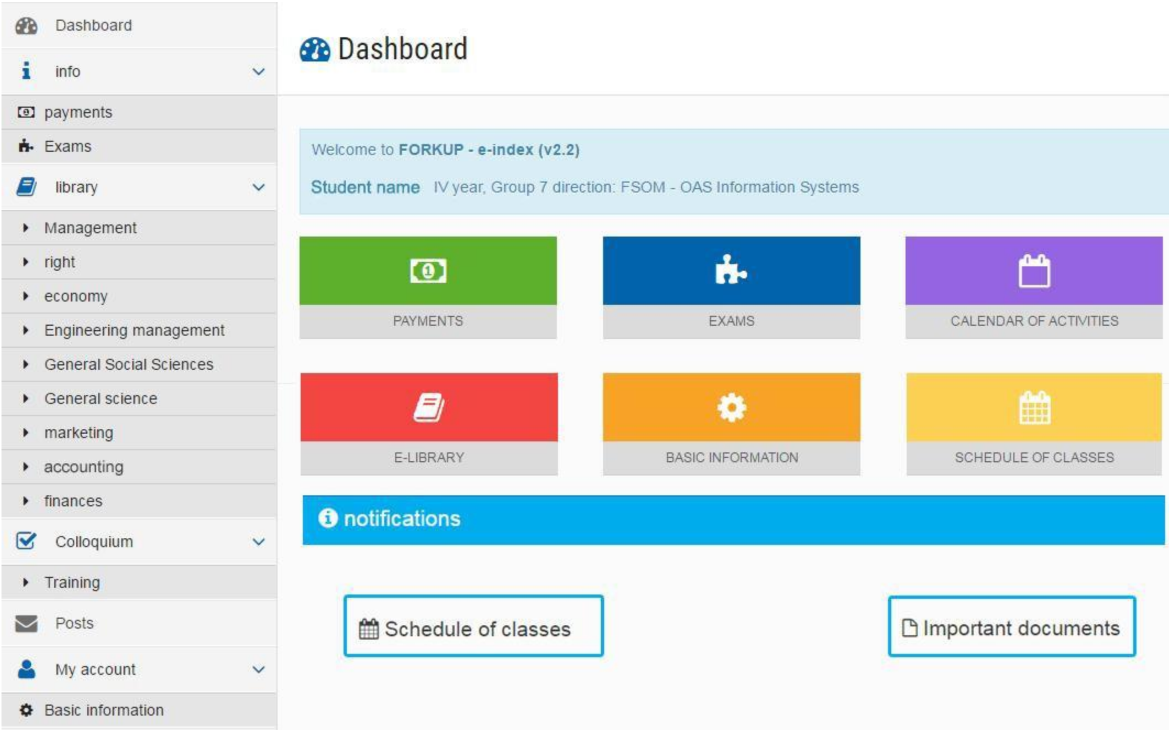

Fig. 3. E-index platform

E-index is locally hosted and access is only enabled to registered students and teachers. Monitoring and maintenance is performed by admins, while contents for courses in maintained by teachers. In Fig. 3 is given the appearance of E-index platform with starting functionalities. On Fig. 4 is given the structure of E-index platform with four distinctive elements and their accompanying features and possibilities. The entire process of the platform is in a feedback loop supported by good interaction between the elements which has proven to perform well in faculty's learning environment. Platform serves over 2000 students from over 10 study programs every day in a year. Future of the E-Index platform is the integration with cloud based learning service which can scale as needed, as well as further improvements in speed and reliability.

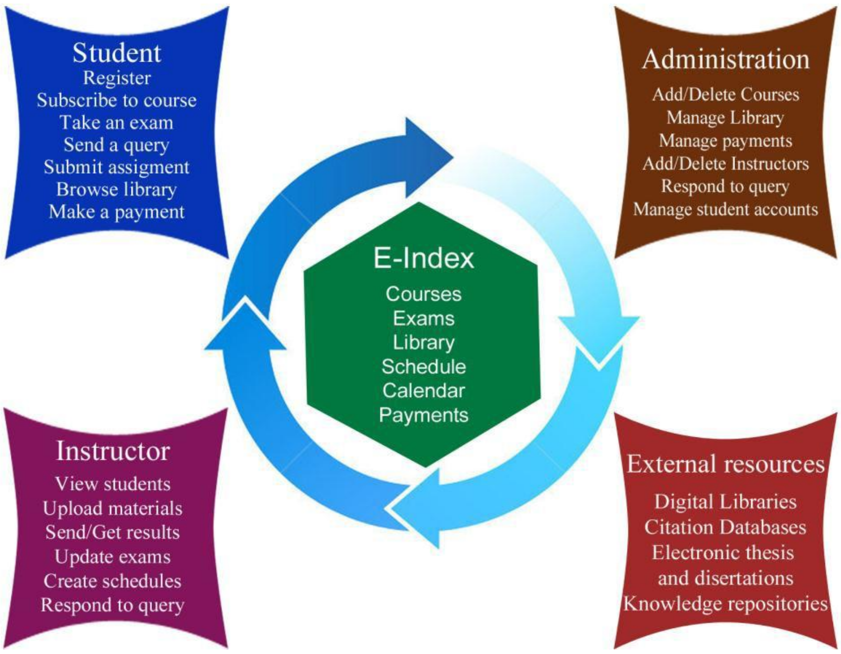

Fig. 4. Structure of E-index platform

E-index platform is based on the use of modern information technology in all elements of the learning process.

Internet and Intranet are used to create conditions for students to interact with the content, instructors and other users. E-index allows complete management of student's study process on the Internet as well as the realization of interactive, two-way communication and data exchange. The developers have to develop DLS using PHP, MySQL and Java Script. Modern learning environment and technologies have been described in papers (Dašić, et al. 2007, 2011; Fedorinov, et. al. 2007). developing learning models (Yang, et al., 2005), applying online learning tools (Sancristobal, et al. 2012), information technologies in the educational process, (Viunenko, et al. 2016), distance learning environment development (Rózewski & Małachowski 2010), comparative study of distance-learning programmes (Cubric, et al. 2011), active monitor system in DLS (Zeng, et al. 2009).

4. Conclusions

Modern learning methods demand the usage of Internet technologies where computer literacy is of utmost importance for both students and teachers. Current and future generations grow and advance with Information technology. In this paper we presented a platform for supporting students in the process of distance learning allowing them to focus more on learning than on administrative tasks. As for future development of the platform, it remains to continue with the updates and planning to migrate to cloud environment for increased scalability.

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Determination of friction coefficient between aluminum semi-finished and plastic deformation tools

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Abstract

Knowing the friction coefficient to plastic deformation is needed because on the basis of it is estimated the necessary deformation forces depending on which is chosen the deformation machine, is determined manner in which deformation occurs and according to this is established the deformation technology. The paper presents theoretical and experimental conditions for determining the friction coefficient between semi-finished deformation tools, in the case of plastic deformation of the aluminium by rings pressing method. Also, are explained, processed and discussed the results of experimental tests.

Keywords: aluminum, friction coefficient, rings method.

1. Introduction

When processing by plastic deformation friction coefficient μ is the characteristic size, which determines the friction conditions between the workpiece and tool.

In most of deformation processes, the value of this coefficient is not known, and needs to be estimated. This estimate, is made with a degree of uncertainty rather large, producing errors in calculating forces and mechanical work deformation. These errors become extremely large at volumetric deformation because the friction mechanical work is in this case a substantial part of the total mechanical work of deformation.

Determining the value of the friction coefficient μ can be done through experiment and calculation, one of the most advantageous methods is the rings pressing [Bejinariu, 2008; Burgdorf 1967].

2. Theoretical considerations

The method consists in testing the cylindrical annular rings under pressure. Rings made of provided material for workpiece, prepared and properly lubricated are subjected to axially press between two planar and parallel surfaces.

Modification of the geometric dimensions can make inferences about the conditions of friction that have existed during rings pressing. Rings pressing sketch is presented in Fig. 1, where:

- h, r_i, r_e - height, inner radius respectively outer radius of the specimen before deformation;
- h_1, r_{i1}, r_{e1} - height, inner radius respectively outer radius of the specimen after deformation;
- r_s - ridge flow radius.

The specimen is divided into two areas:

- (1) - $r \in [r_s, r_e]$ - material flows radially outward;
- (2) - $r \in [r_i, r_s]$ - material flows radially inwards.

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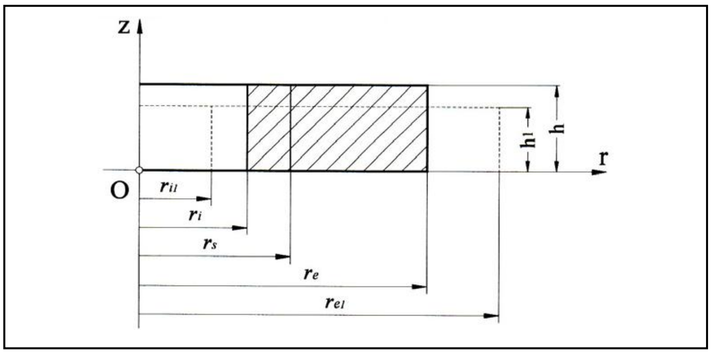

Fig. 1. Rings pressing sketch.

Those two areas are separated by a ridge flow corresponds to the radius r_s.

Are made following simplifying assumptions

- neglect of elastic deflection;
- their own masic and inertial forces are negligible compared to the forces that produce deformation;
- deformation tools behave like rigid bodies;
- neglecting barrel effect is neglected;
- deformation resistance is considered homogenous throughout the mass of the test specimen;
- on the faces of the specimen is considered a Coulomb type friction with a constant friction coefficient μ.

As a basis for theoretical considerations, it is established that determines the velocity field to cinematic rings pressing.

Velocity field satisfies the continuity condition and is concurring with the assumptions stated above.

Friction on the front faces of the specimens is determining the position of ridge flow r_s.

Corroborating these elements, result liaison relationship between the dimensions of the specimen and the friction coefficient.

$$e^{\frac{2\mu}{h}(r_e-r_s)}+\frac{2}{\sqrt{3}}\int_{r_e}^{r_s}\frac{r_s^{\,2}}{r\sqrt{3r^4+r_s^{\,4}}}e^{\frac{2\mu}{h}(r-r_s)}dr-e^{\frac{2\mu}{h}(r_s-r_i)}-\frac{2}{\sqrt{3}}\int_{r_i}^{r_s}\frac{r_s^{\,2}}{r\sqrt{3r^4+r_s^{\,4}}}e^{\frac{2\mu}{h}(r_s-r)}dr=0 \qquad (1)$$

From the dimensions of the specimen, the friction coefficient μ in the relation *(1)* is the only quantity that influences the position of the ridge flow.

Conversely if specimen dimensions are known, is sufficient to know the value of r_s ridge flow position in order to unambiguously determine friction coefficient μ.

At rings pressing method the specimen is axial pressed between two planar and parallel surfaces to a certain amount $\Delta h = h - h_1$. Δh value has to be selected so small that the variation of the radius of ridge flow r_s during deformation can be neglected.

Taking into account the constancy law volumes, ridge flow radius may be calculated based on both the inside and outer diameter variation.

On the basis of the variation of the outer diameter, result:

$$r_s=\sqrt{\frac{r_e^2 h - r_{e1}^{\,2} h_1}{h-h_1}} \qquad (2)$$

Having the radius of the ridge flow r_s, calculated by the equation *(2)*, friction coefficient μ is calculated by numerical solving of the equation *(1)*.

3. Experimental conditions

3.1. Material

Aluminum EN AW-1050A [Al 99,5], conform SR EN 485-X – Aluminum and aluminum alloys. Sheets, strips and thick plates.

As delivered, the laminated sheet form with a thickness of 10 mm and the following chemical composition: %Al = 99,495; %Si = 0,143; %Fe = 0,213; %Cu = 0,021; %Mn = 0,004; %Mg = 0,050; %Cr = 0,003; %Zn = 0,021; %Ni = 0,008; %Ti = 0,006; %Pb = 0,005; %Sn = 0,011; %Ca = 0,003; %Co = 0,002; %V = 0,011; %Na = 0,004.

3.2. Specimen

The shape and dimensions of the specimen used are shown in Fig. 2. For experiments, preparing test specimens included the following: obtaining specimens by fine adjustments and lubrication with zinc stearate.

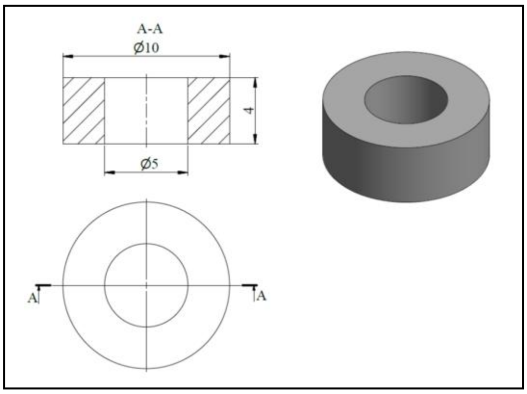

Fig. 2. Shape and dimensions of the specimen.

Specimen Al_00 was made of aluminum sheet Al 99.5 and represents the initial specimen in non-deformed state. Al_01 specimens, Al_02 ..., Al_12 are made of the same material, but severely plastic deformed by Ghosh process [Ghosh, 1988], the values of 01, 02 ... 12 representing the passes to severe plastic deformation

In Fig. 3 (a) represents the rings before pressing, and Fig. 3 (b) rings after pressing.

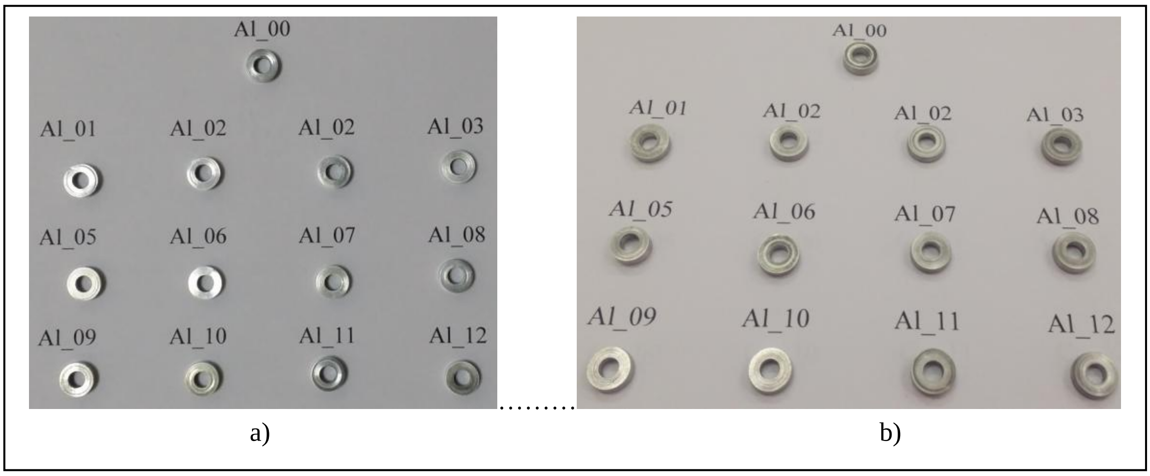

Fig. 3. a) rings before pressing; b) rings after pressing

The specimens are axial pressed between two planar and parallel surfaces to a certain amount $\Delta h = 0{,}5\,mm$ this value has to be selected so small that the variation of the radius of ridge flow r_s during deformation can be neglected. For deformation it was used a laboratory hydraulic press.

4. Experimental results

As a result the experimental tests carried out under the conditions shown were obtained friction coefficient values, shown in Table 1.

Based on the initial dimensions h, r_i, r_e of the specimen, the final measured dimensions h_1, r_{i1}, r_{e1}, was determined ridge flow radius r_s by the relation *(2)*. This value, together with dimensional values enter into transcendental equation *(1)*, and by its numerical solving we have obtained the friction coefficient the corresponds to passes 01, 02, ..., 12 at severe plastic deformation. The evolution of the friction coefficient with the number of passes and hence the degree of cumulative strain is shown in Fig. 4.

Table 1. Friction coefficient values.

Specimen	Dimensions [mm]						Calculated parameters	
	initial			final				
	h	r_i	r_e	h_1	r_{i1}	r_{e1}	r_s [mm]	μ [-]
Al_00	4,00	2,50	5,00	3,50	2,37	5,20	3,27	0,191
Al_01	4,00	2,50	5,00	3,50	2,39	5,21	3,16	0,188
Al_02	4,00	2,50	5,00	3,50	2,42	5,22	3,04	0,186
Al_03	4,00	2,50	5,00	3,50	2,44	5,23	2,92	0,180
Al_04	4,00	2,50	5,00	3,50	2,45	5,24	2,79	0,169
Al_05	4,00	2,50	5,00	3,50	2,46	5,24	2,79	0,152
Al_06	4,00	2,50	5,00	3,50	2,48	5,25	2,66	0,148
Al_07	4,00	2,50	5,00	3,50	2,50	5,26	2,52	0,146
Al_08	4,00	2,50	5,00	3,50	2,50	5,26	2,52	0,146
Al_09	4,00	2,50	5,00	3,50	2,52	5,27	2,36	0,144
Al_10	4,00	2,50	5,00	3,50	2,52	5,27	2,36	0,144
Al_11	4,00	2,50	5,00	3,50	2,54	5,28	2,20	0,140
Al_12	4,00	2,50	5,00	3,50	2,56	5,29	2,03	0,141

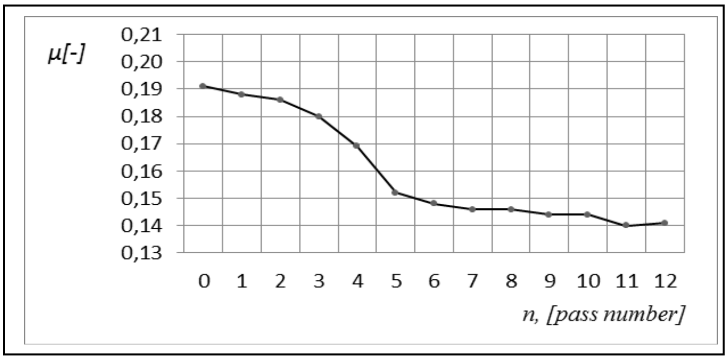

Fig. 4. a) The variation the friction coefficient with the number of passes

5. Conclusions

Knowing the friction coefficient to plastic deformation is needed because on the basis of it is estimated the necessary deformation forces depending on which is chosen the deformation machine, is determined manner in which deformation occurs and according to this is established the deformation technology

Rings pressing method to determine the friction coefficient at plastic deformation presents a clear advantage compared to other methods used, namely that does not require knowing the pressing forces. By this method, friction coefficient is determined on the basis of change in dimensions of the rings after plastic deformation.

Severe plastic deformation of aluminum Al 99.5, with increasing the cumulative degree of deformation on passes the friction coefficient between the material and deformation tools significantly decreases between passes 3 and 6.

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Equipment designing for the Carol shaft rehabilitation from Slănic Prahova Salina

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Abstract

In order to rehabilitate the wooden support of Carol shaft ventilation from Slănic Prahova Salina there have been suggested four variants, from the consolidation of the existing support to its replacing with wood or support or reinforcement with concrete. These mining works can be done only with the help of a special equipment that is encased on the wellhead. The designed equipment for the rehabilitation can be used with minor adjustments for theose four technological variants of shaft recovery. When it comes to recovering the support of the concrete shaft, the equipment is used to support and move the sliding shutterings. The construction of the equipment is simple, easy to transport, handle and fit, having a low cost price.

Key words: ventilation shaft, support, rehabilitation equipment.

1. Introduction

In order to rehabilitate the wooden support of Carol shaft ventilation from Slănic Prahova Salina there have been suggested the following technological variants:

V1 – Replacing the current support with another similar one, made up of oak wood, with strengthening and waterproofing rock around the well by injecting behind the old support a mixture of cement and slag thermal power plant ;

***V2* –** Lining the old sipport with oak wood, strengthening and waterproofing rock around the well by injecting behind the old support a mixture of cement and slag thermal power plant ;

V3 – Replacing the old wooden support with another one, made of concrete;

V4 – Replacing the current support with a similar one made of wood oak, with rock excavation in advance of canopy gaps and filling and sealing with clay.

Making an analysis of the four suggested variants, in terms of technical and economic, here are the conclusions:

- *Variant V1* is close to variant *V2*, economically speaking, (the cost price being higher with approx. 10%), having the advantage compared to the second one that the full support shaft is replaced with oak, raising the support durability. Compared to variant *V4*, that is more expensive, with approx. 20%, variant *V1* has the deficiency that the filling of the holes cannot be completely controlled.

- *Variant V2* has the advantage of being the cheapest, having the disadvantage of the impossibility of the control on filling the holes behind the support and also the disadvantage of keeping the old support.

- *Variant V3* is the most expensive variant, with approx.50% more expensive than the cheapest variant *V2*. This one has the advantage of the durability of the support and complete filling of the holes with concrete.

- *Variant V4* is the second variant, in economical terms, of the execution expenses being with approx. 30% more expensive than the reference variant *V2*. Compared t the other variants of support in wood, it has the advantage of the durability support, that is completely replaced and full filling the holes with clay.

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2. Construction and operation of the installation

In figure 1 is presented the constructive solution of the Carol shaft rehabilitated plant from Slănic Prahova Salina, that is made up of: 1 – supporting metal frame; 2 – work platforms; 3 – cart to transport materials; 4 – 4t manual winch; 5 – bridge work; 6 – roof.

The Carol shaft from Slănic Prahova Salina is used to air the salina, having a rectangular section with two compartments of 2000x1300 mm. The wooden armature shaft is broken and must be remade, and so was suggested the constructive solution of the installation presented in figure 1. This one is made up of a metallic supporting frame, see 1, that is on the wellhead and it rests on a bridge work, see 5. On top of the metal frame beams supporting pulleys are mounted on one end for supporting cables and shift work platforms, see 2.

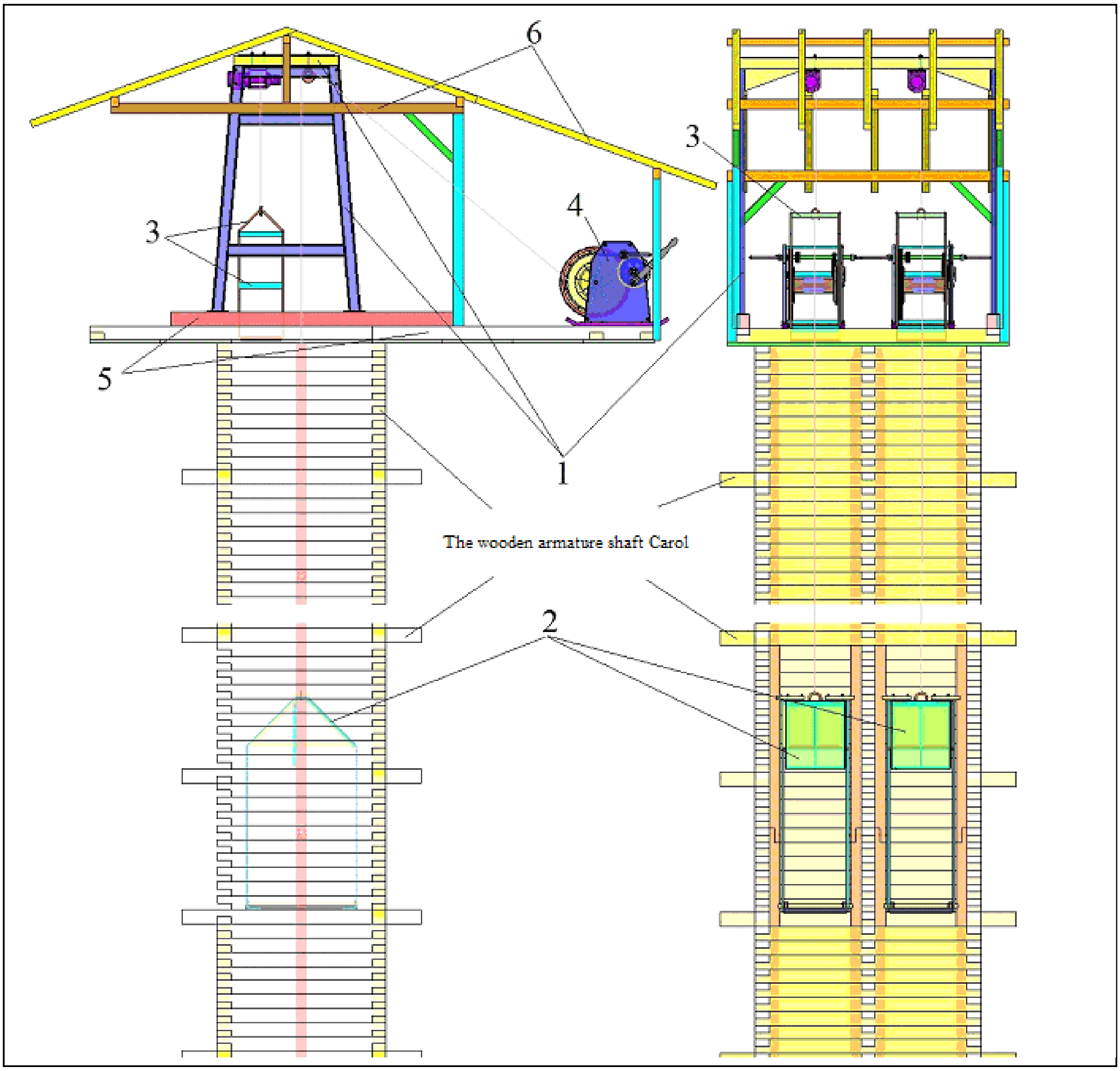

Fig. 1 The equipment for the Carol shaft rehabilitation from the Slănic Prahova Salina

The working platform is moved inside a compartment shaft with a manual winch of 4t, see 4, and it is guided from the superior and inferior part by the wooden rails that glide on the guides compartment shaft. While positioning in the interior of the shaft to operate the armature rehabilitation, this one blocks itself supplementary by those four ear dumps that are caught in nails against the rebuilt shaft armature. The platform roof is with two 45° slopes and one is mobile, fixed in hinges and clasps, in order to allow the transportation of the materials from the surface of the working platform with the help of the cart, see 3. The maximum load that a working platform can meet is 7,50 kN.

It was used in order to handle the platform a 4t manual winch (40 kN) because the maximum load is 10 kN, and the platform moving is done with low speed, below 1 m/min, and with large intervals.

The cart to transport materials is trailed by an electric winch PRO-CP500, made by PROLIFT Constanţa, that can elevate a mass of 500 kg on a height of 58 m and with the speed of 10 or 15 m/min. The winch PRO-CP500 is fixed with the help of a plate on the cross of the superior half of the metal frame, and at the other end, opposite to the pulley for the bridge work, and has a cable of 6 m for the box with control buttons.

Since the length of the operation of rehabilitation of the shaft is long, the entire equipment and the wellhead is protected by a roof, see 6.

The construction of the metallic frame support is presented in figure 2, with the annotations: 1 – standing support; 2 – upper frame; 3 – electric winch PRO-CP500; 4 – pulley Φ200; 5 – screw M16x40; 5 – washer Grower N16; 6 – nut M16.

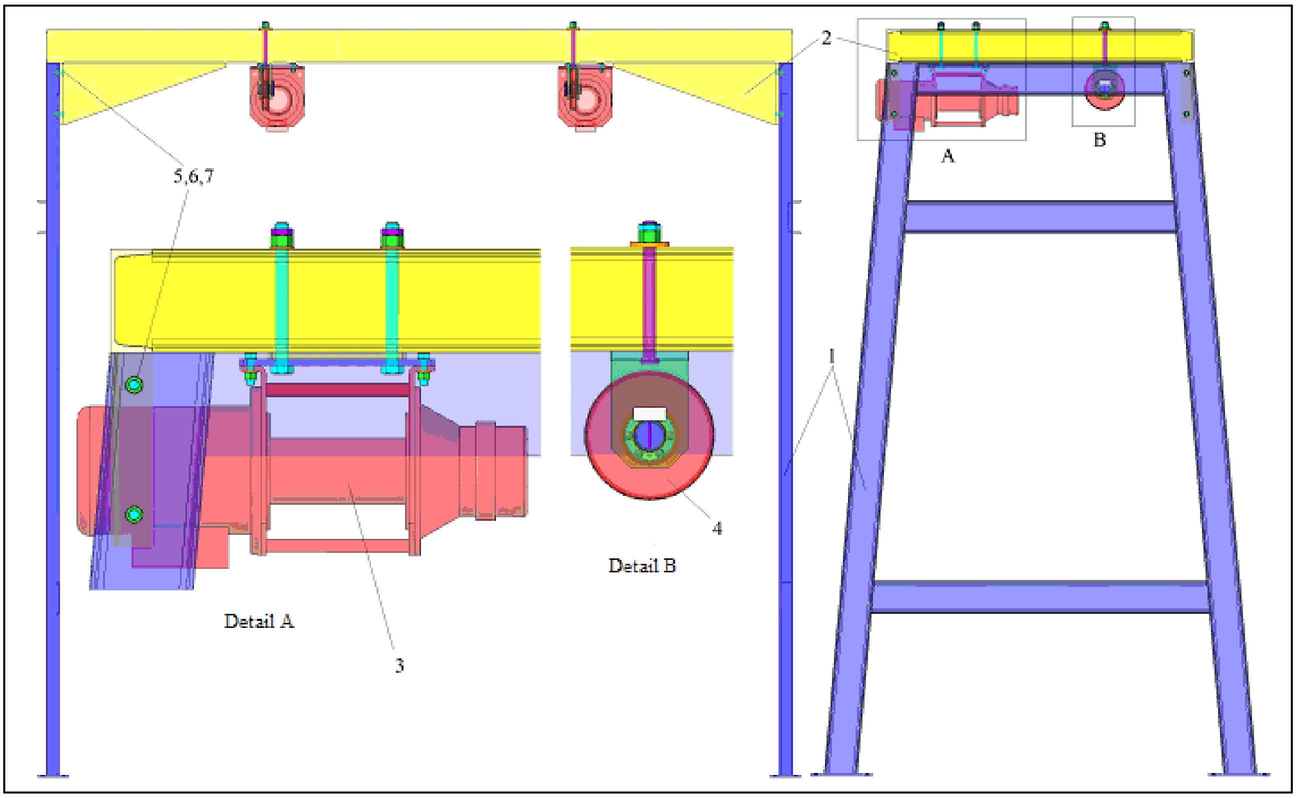

Fig. 2 The constructive solution of the supporting metal frame

The metallic frame is made up of two standing supports, see 1, where a metallic frame is supported and fixed by eight screws M16x40, see 2. This one has two sleepers, on the symmetry planes of the two compartments, at a 1500 mm distance, where there are fixed the winches PRO-CP500, see 3, in order to raise and lower the carts for materials and trolleys transport, see 4, for the towing cables of the work platforms .

The standing support of the metallic frame has a trapezoidal shape, being made up of rolled profiles U16, with two vertical longerons and two horizontal pulleys, and at the lower base of the longerons there are two outsole plates of 10 mm, with a surface of 300x150 mm. They have four holes of Φ11 to fix them with clamps on the wooden beam. At the upper part it has four holes Φ 18 mm, to fix it against the upper frame. Also, under the upper beam there is a U16 beam, sticking with 45mm outside the standing support, to sustain the roof.

The upper frame is made up of two beam of rolled profile U16 with its wings to the inside, with the length of 3630 mm, between them there are fixed four beams of U16. These beams are positioned in twos, back to back, with a distance of 22 mm in order to allow go through them the threaded rod of the shaft and the screws of M20x220 of the winch plate.

At the sides of the upper frame beams the fixing standing supports are mounted by welding, made of sheet of 10 mm, that have a distance from the beam edge of 65 mm and between their interior there must be a distance of 3500 mm. These sheets are stiffened against the frame beam through a gusset plate of 10 mm.

The resistance construction of the supporting metallic frame, standing supports and the upper frame has been made demountable in order to be executed and transported easily.

3. How to use the equipment of the Carol shaft rehabilitation

The way in which the equipment of the Carol shaft rehabilitation is used in order to concrete the reinforcement shaft, stage 1, is presented in figure3a, with the annotations: 1 – salt block; 2 – the wooden armature shaft; 3 – working platform; 4 – reprofiling cylindrical shaft; 5 – concrete platform on the ridge of salt; 6 – concrete reinforcement of the well to the surface; 7 – earth filling; 8 – concrete platform surface; 9 – rehabilitation equipment; 10 – cart to transport materials.

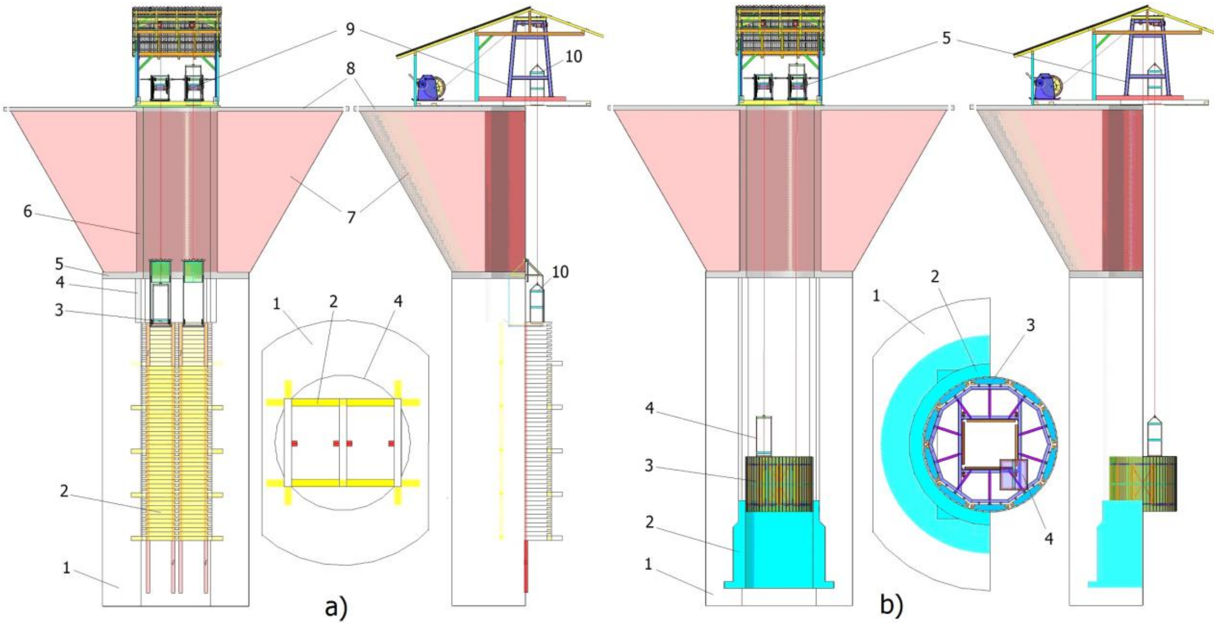

Fig. 3 The usage method of the equipment for the rehabilitation of the shaft by concreting, stage 1 and 2

In figure 3b is presented the usage method of the equipment for the rehabilitation of the shaft by concreting, stage 2, with the annotations: 1 – salt block; 2 – standing support concrete reinforcement of the pit of salt; 3 – interior sliding formwork; 4 – cart to transport materials; 5 – rehabilitation equipment.

After demounting the wooden armature and the reconversion of the salt pit with the help of the standing support of the concrete armature of the pit, follows its casting. The working platforms are removed and instead the sliding metal frame formwork is caught (3). They slide down to the level of the ramp of the cost gallery, where there was arranged a working bridge over the shaft opening and those ten segments of the sheathing are mounted. The interior sliding formwork was presented in subchapter 3.2, the mounting of the formwork segments is done sort of conically, with a difference between diameters of 10 … 20 mm and the large base to the upper side in order to ease the formwork mold release after casting.

Pouring concrete surface is achieved using a flexible hose and its handling for filling the space between the casing and salt is made by a worker being lowered material transport basket **.**

If the transport basket is used to transport workers, the material is mounted by welding two pieces of sheet with dimensions of 690x450 mm 2 mm between the support arms to provide a protective roof.

Lifting the slide inside the mold is 2000 mm, leaving a collar of 500 mm over the previously cast section.

In figure 4a is presented the way of using the equipment for the Carol shaft rehabilitation, by changing the wooden armature with excavation, variant IV, stage 1, with the annotations: 1 – salt block; 2 – the wooden armature shaft; 3 – working platform; 4 –the rectangular profile of the salt pit; 5 – cart to transport materials; 6 – new wooden reinforcement of the well to the surface; 7 – earth filling; 8 – concrete platform surface; 9 – rehabilitation equipment; 10 – ramp pit gallery +400.

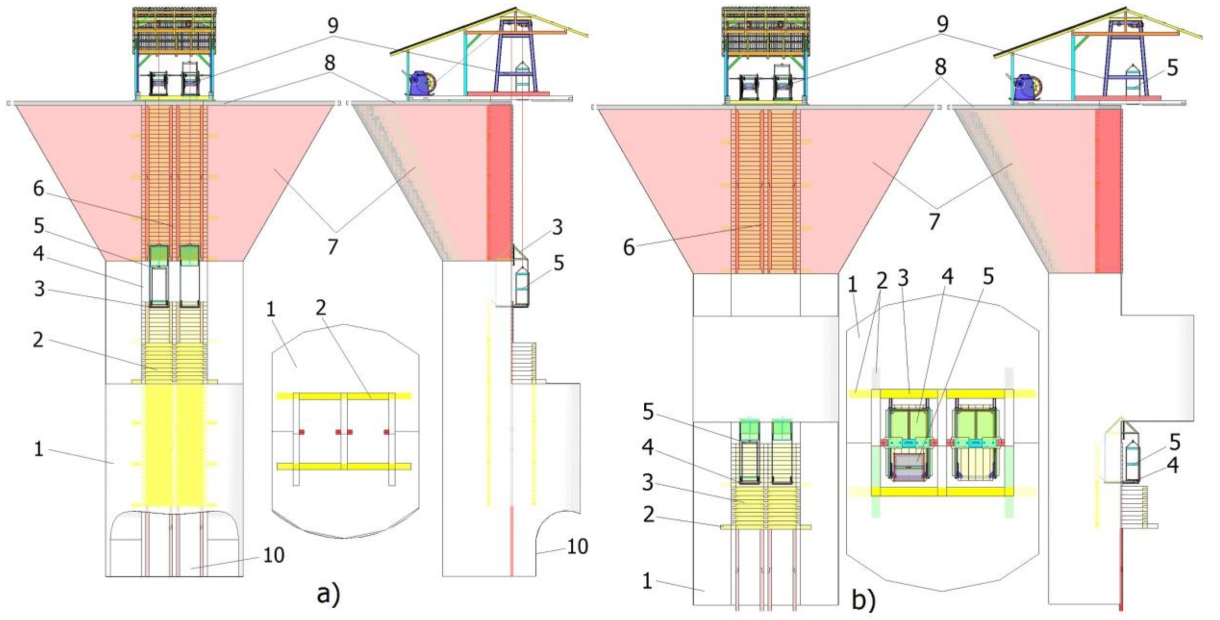

Fig. 4 The way of using the equipment for the Carol shaft rehabilitation, by changing the wooden armature with excavation, variant IV, stage 1 and 2

After conducting excavation in the ground to ridge reinforcement wooden salt and execution of the well to the surface (6), of the earth filling of the excavation cone (7) and of the concrete platform surface (8) there is mounted the equipment for shaft rehabilitation.

The positioning system is such that the plane of symmetry channel pulley wheel to be in the plane of symmetry of the compartment shaft and the plane of symmetry of the wood guides to be tangential to the pulley block.

The working platforms are lowered (3) to the reinforcement of old wood ridge in salt and make removing it and fill with clay and reinforcement block of salt . The demounted armature and the clay are transported to the surface with the two carts to transport materials (5).

In figure 4b is presented the way of using the equipment for the shaft rehabilitation by concreting, stage 2, with the annotations: 1 – salt block; 2 – frame support; 3 – new wooden armature; 4 – working platform; 5 – cart to transport materials; 6 – new wooden reinforcement of the well to the surface; 7 – earth filling; 8 – concrete platform surface; 9 – rehabilitation equipment.

After removing the valve from the timber and cleaning of the salt is carried out, the shaft supporting profiles of the frame support the pockets (2) in the ramp of the shaft we go on to its mounting . The working platforms are lowered (4) until the bridge thing of the ramp pit and then these people and materials are picked up and raised to the support frame. Next, the new armature (3) is carried out, filling the gaps between valve and block salt clay beaten.

The transport of the reinforcement elements and of the clay packed in bags is made from surface with baskets to carry materials (5). If the cart to transport materials is used to transport workers, two pieces of sheet of 2 mm are mounted by welding, with their dimensions of 690x450 mm between the standing supports to make up a protection roof.

For the equipment for the Carol shaft rehabilitation from the Slănic Prahova Salina, there has been done an estimated cost regarding the design of the metallic construction, of the pulley and of the products bought commercially. As well, the estimated cost has been done for the case of the design of only one working platform, one cart to transport materials and one trolley. The total value for the equipment design for the Carol shaft rehabilitation under those two circumstances:

- of working on only one well compartment– 21 318,4 lei;
- of simultaneously working on both well compartments – 30 026,2 lei.

In the cost of the Carol shaft rehabilitation I haven`t included those two 4t manual winches that are found in the Slănic Prahova Salina endowment.

4. Conclusions

The equipment for the Carol shaft rehabilitation from the Slănic Prahova Salina can be used with small adaptations for those four technological variants of shaft support recovery. When it comes to the recovery of the reinforced concrete shaft, the equipment is used for the sustenance and displacement of the sliding shuttering.

The construction of the equipment is easy, easy to transport, maneuver and mount, having a low cost. This cost is low because of the possibility of using those two 40 kN manual winches that exist in the Slănic Prahova Salina endowment.

Moving the working platform is done using the manual winch 40 kN. Also, it can be anchored to the wooden shaft support through four ears dump.

The platform is equipped with two roof slopes at 45 °, of which one is mobile, with fixing hinges and locks, to allow the transport of materials from the area of the working platform using the transportation cart.

The operation of the materials cart moving winch can be manually done from the switchboard or by remote controller from the working platform.

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The synthesis for six bars mechanism of guiding roof supports for the coal mining

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Abstract

The paper brings forward the results of the study with respect to the synthesis of complex mechanism of guiding roof supports for the coal mining. The mechanism of guiding roof supports for the coal must fulfil the following functions: leading the beam shield on a course roughly rectilinear, parallel to the coal face, to gauge how much lower the front-operated space, packaging as well as the support that it can be transported in assembled condition, not to obstruct the free spaces of the roof support it belongs to. The geometric parameters of the complex mechanism shall be determined using the method of vector contours with vectors expressed in their complex form.

Keywords: mechanism of guiding roof supports for the coal, complex mechanism of guiding, method of vector contours

1. Method presentation

The paper brings forward the approximate synthesis of the equidistancing complex mechanism in which the values of geometrical parameters which define it are imposed, in order to result into mechanisms which may be used as equidistancing mechanisms comprised by the mechanised roof supports.

The complex equidistancing mechanism derives from a 4R quadrilateral articulated mechanism obtained through the amplification with a structural group (3R dyad), Figure 1.

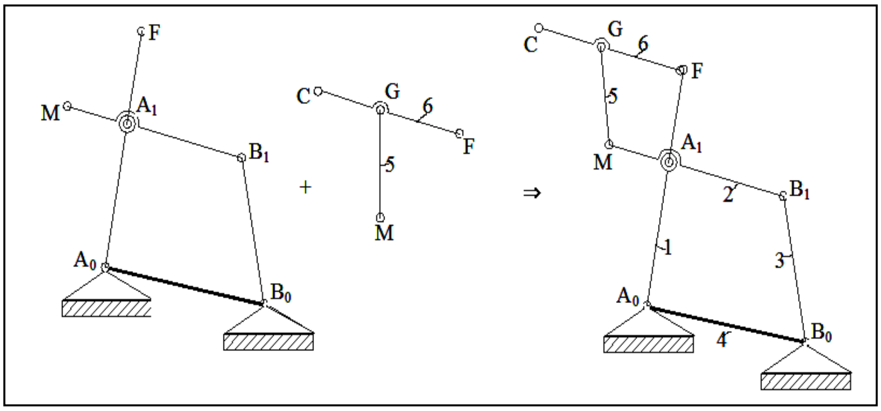

Fig. 1 Attachment the 3R dyad to the 4R four bar linkage

After the amplification using the mentioned dyad the obtained mechanism maintains the mobility degree of the basic mechanism (four bar linkage) but it increases its number of elements (from four to six) and the number of kinematic joints (from four to seven) increasing therefore the use space and the range of possible moves with the new mechanism.

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Figure 1 presents the modality in which the complex mechanism is obtained through the amplification of the 4R quadrilateral mechanism with a 3R dyad. The later one was connected to the rod in point M to the balancing lever A_0A_1 in point F. The quadrilateral mechanism is a complex double balancing mechanism.

It has been taken into consideration the case where the closed contour by adding the 3R dyad is a parallelogram contour with equal sides, to be simplified in the algorithm, without reducing the moving performances of point C.

From the analysis of Figure 2 it may be observed that the elements A_0F and FC are the main central elements of the mechanism, the dimensions and positions of which decisively influence the weight and the form of the complex mechanism.. From the analysis of Figure 2 it may be observed that the elements A_0F and FC are the main central elements of the mechanism, the dimensions and positions of which decisively influence the weight and the form of the complex mechanism.

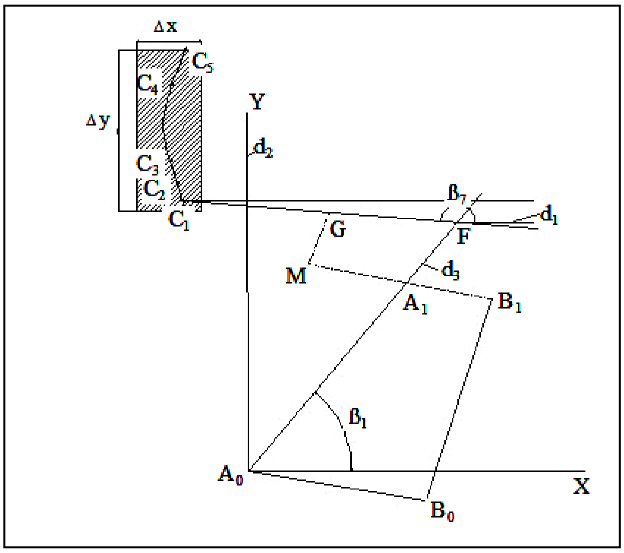

Fig. 2 The complex equidistancing mechanism, calculation diagram

Starting from this observation, in order to appoint the data for the created synthesis algorithm, the following general data were taken into consideration:

- The directions of the axes of the reference system plan xOy are specified;
- The existence domain D and the form of the trajectory of the articulation beam-shield are specified by imposing the system of points C_j, $j=\overline{1,5}$ through which it passes;
- One of the five C_j points is chosen, for instance point C_1 (thinking of the packaged form of the mechanism), though which line (d_1) is drawn with a direction β_7 considering the positive sense of the Ox axis with a value smaller than 180^o;

The direction (d2)$\parallel$Oy is arbitrarily drawn on which, through several trials, the fixed articulation A_0 is chosen, in which the origin O of the reference system $O \equiv A_0$ shall also be considered; from this point the line (d_3), with an angle of slope β_1 the value of which situates it in the first half of quadrant one, is drawn;

The intersection of lines (d_1) and (d_3) is marked F obtaining therefore, according to Figure 2, the lines $A_0F=(z_1+z_5)$ and $FC=(z_6+z_7)$;

It is therefore chosen, by repeating the above mentioned scenarios where the lengths of A_0F and FC_1 are the most corresponding ones;

The kinematic chain $A_0B_0B_1MG$ is also added to the construction, obtaining finally the structure presented in Figure 3 for which the following set of initial data is specified in order to write the synthesis algorithm;

The domain D for framing the trajectory of the point of rod C defined through a set of initial data in order to write the synthesis algorithm:

The length of line A_0F and the angle β_1 of orientation towards the positive direction of the axis Ox in initial position;

The position of the fixed joint $A_0(0,0)$; The closed rhombic contour A_1MGF.

Considering the notes in Figure 3 and the above mentioned data, the following relations may be written:

$$z_6=z_5 \tag{1}$$

$$z_7= FC_1-z_6 \tag{2}$$

$x_F=(z_1+z_5)\cos\beta_1$ *(3)*

$y_F=(z_1+z_5)\sin\beta_1$ *(4)*

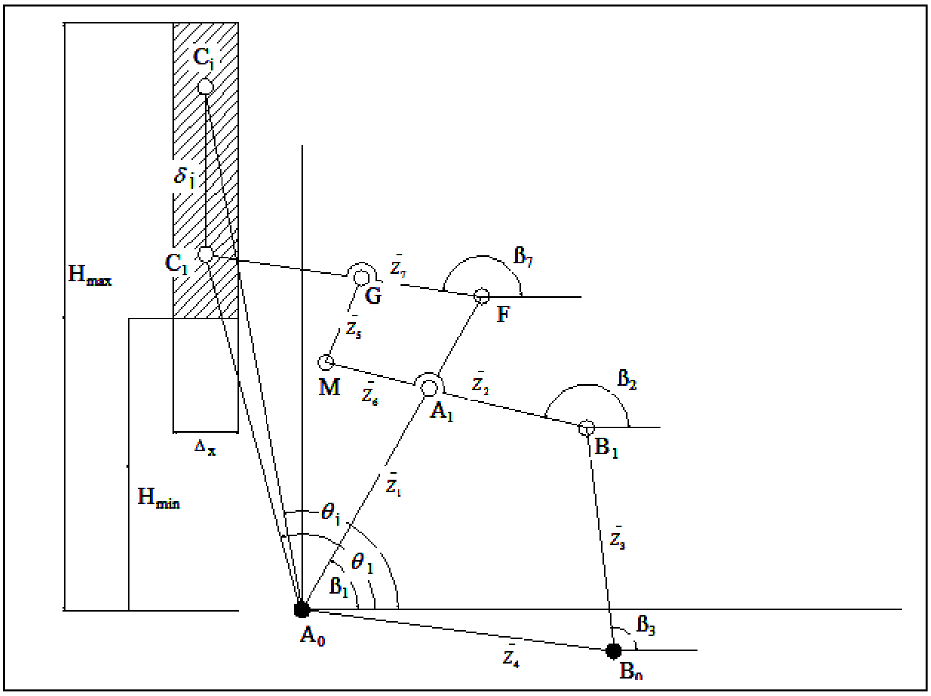

Fig. 3 The layout of the synthesis problem

The known terms are:

$A_0F=z_1+z_5; C_j(x_j,y_j), j=\overline{1,5}$; β_1; $\beta_2=\beta_7$; $\beta_5=\beta_1$; $A_0(x_{A0},y_{A0})$, namely 16 data.

The other geometrical parameters which define the complex mechanism are unknown: z_2; z_3; z_5; β_3; φ_j; ψ_j; $\gamma_j=\varepsilon_j$, $j=\overline{2,5}$, namely 16 unknowns.

The definitive geometrical elements of the mechanism are expressed as follows, Figure 3:

The sides of the mechanism,

$z_k=z_k\, e^{i\varphi k}$; $k=1,7$ *(5)*

The operators of the revolutions of the elements,

$\lambda_j=e^{i\varphi j}$, $\nu_j=e^{i\gamma j}$, $\mu_j=e^{i\psi j}$, $\chi_j=\nu_j$; $j=2,7$ *(6)*

The movement of the rod point C_1 in positions C_j, where $j=\overline{2,5}$

$\delta_j=r_j-r_1$, $j=2,5$ *(7)*

The vector radiuses of points C_j, $j=\overline{1,5}$ close each two vectorial contours, the first in initial position and the second one in position j.

$r_1=(z_1+z_5)+(z_6+z_7)=z_3+z_4+(z_2+z_6)+z_5+z_7$ *(8)*

$r_j=(z_1+z_5)\,\lambda_j+(z_6+z_7)\,\chi_j=z_4+z_3\cdot\mu_j+(z_2+z_6)\cdot\nu_j+z_5\cdot\lambda_j+z_7\cdot\chi_j$ *(9)*

Considering relations (8) and (9), relations (7) receive the following form:

$$(z_1 + z_5)(\lambda_j - 1) + (z_6 + z_7)(\chi_j - 1) = \delta_j \qquad (10)$$

$$z_3(\mu_j - 1) + (z_2 + z_6)(\nu_j - 1) + z_5 \cdot (\lambda_j - 1) + z_7(\chi_j - 1) = \delta_j \qquad (11)$$

Separating the terms of the real and imaginary part, relation (10) receives the following form:

$$\left(\overline{z_1} + \overline{z_5}\right)\cdot\left[\cos(\phi_j + \beta_1) - \cos\beta_1\right] + \left(\overline{z_6} + \overline{z_7}\right)\cdot\left[\cos(\gamma_j + \beta_2) - \cos\beta_2\right] = r_j\cos\theta_j - r_1\cos\theta_1 \qquad (12)$$

Some of the geometric parameters of the mechanism may be determined with the additional relations:

$$FC_1 \equiv z_6 + z_7 \qquad (13)$$

in its initial position.

$$FC_1 = \sqrt{A^2 + B^2} \qquad (14)$$

$$\beta_7 = arctg\frac{B}{A} = \beta_2 \qquad (15)$$

Where:

$$A = (z_1 + z_5)\cos\beta_1 - \chi_{c1} \qquad (16)$$

$$B = (z_1 + z_5)\sin\beta_1 - \gamma_{c1} \qquad (17)$$

The position vectors $\overline{r_j}$ of points C_j, $j = \overline{1,5}$ on the trajectory imposed to the beam-shield joint are defined using the following relations:

$$\left|r_j\right| = \sqrt{x_{C_j}^2 + y_{C_j}^2} \qquad (18)$$

$$\theta_j = arctg\left|\frac{y_{C_j}}{x_{C_j}}\right| \qquad (19)$$

2. Aplication

The following input data in mm were taken into consideration for exemplification: $ß_1$=22.89^o; $ß_2$=171.84^o; x_{A0}=0; y_{A0}=0; x_{C1}=-630.011; y_{C1}=1189.594; x_{C2}=653.108 y_{C2}=1533.051; x_{C3}=-676.48y_{C3}=1841.58; x_{C4}=-701.803; y_{C4}=2125.657; x_{C5}=-729.043 y_{C5}=2391.492

The following data are determined while running the synthesis algorithm: A_0F=2110 mm FC_1=1346.12 mm $ß_2$= $ß_7$=171.84^o.

$$r_j = \begin{bmatrix} 1346{,}123 \\ 1666{,}372 \\ 1961{,}904 \\ 2238{,}514 \\ 2500{,}148 \end{bmatrix} \quad \theta_j = \begin{bmatrix} 117{,}905 \\ 113{,}074 \\ 110{,}170 \\ 108{,}271 \\ 106{,}953 \end{bmatrix}; \qquad j = \overline{1,5}$$

The mechanism presented in Figure 4 was obtained when the presented algorithm was run, mechanism the form of which is acceptable for a guiding mechanism of a mechanised roof support.

Having solved the two nonlinear systems with the use of the MATHCAD software the following unknowns have resulted:

$\varphi_2=4^o$; $\varphi_3=8^o$; $\varphi_4=12^o$ $\varphi_5=16^o$;$\gamma_2 = -4{,}7^o$; $\gamma_3= -8{,}8^o$; $\gamma_4= -12{,}53^o$; $\gamma_5= -16{,}067^o$

$z_3=1414{,}24$; $z_2=413{,}009$;$\psi_2 =3{,}43^o$; $\psi_3=7{,}12^o$; $\psi_4=11{,}004^o$; $\psi_5=15{,}03^o$;$\beta_3 =36{,}58^o$

After having determined all the geometric elements the positional kinematic analysis of the synthesised mechanism is then carried out, obtaining the real trajectory of the beam-shield joint C verifying that it is comprised within the domain D and meeting the deviation Δx.

3. Conclusions

The method brought forward in the paper represents for the designers of mechanised roof supports the means for the synthesis of complex equidistancing mechanisms.

The obtained mechanism amplifies the possibilities of covering large face wall heights not letting the lengths of the interlaid kinematic chain between the sole and the beam to reach unacceptable values.

The use effects of complex equidistancing mechanisms are great:

A reduced weight mechanism is obtained on the direction of the front-mined space;

The mechanism has a good packaging;

The stability of the mechanism on the direction of the front-mined space is very good.

The attached dyad considering the above mentioned conditions does not complicate the algorithm which corresponds to the synthesis of the 4R quadrilateral basic mechanism.

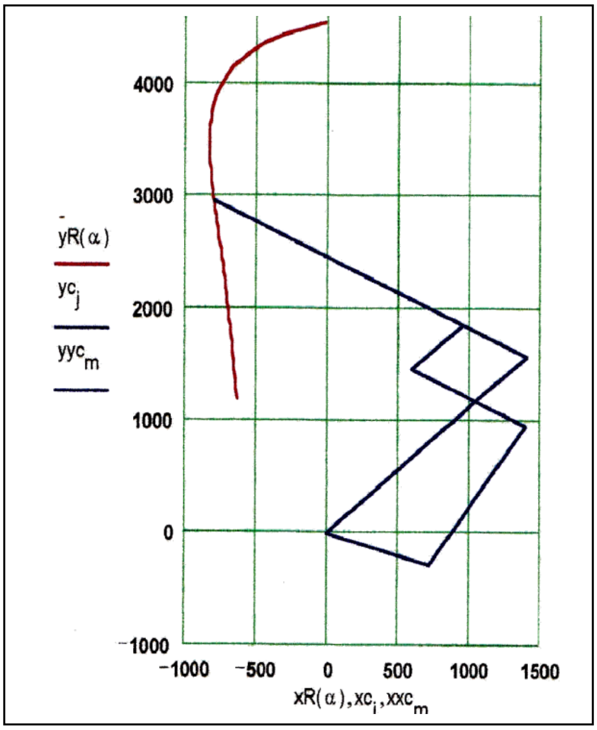

Fig. 4 The complex equidistancing synthesised mechanism

Acknowledgement.

The authors gratefully acknowledge the scientific merits of the late Professor Zamfir Vasile for carrying out this work.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Research on using images to monitoring conveyor belt

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Abstract:

This paper addresses the study possibility of monitoring conveyor belts using images taken by inspection cameras and analysis of the information accuracy collected by this way reported the real situation.

Keywords: conveyor belt, images, monitoring, visual inspection.

1. General Considerations

Overall demand for natural resources is increasing, so the need for increased production resources grows similarly.

Coal is an energy source highly competitive given that most European countries are forced to resort to imports to meet energy needs. Getting a competitive price of energy produced by coal is dependent on the performance of the technology adopted. Cost pressure and willingness to change is the engine of introducing modern techniques. They depend on the speed with which collect the information needed to make informed decisions to increase productivity and reduce costs.

A lot of elements, characterized by some attributes with relations between parts of them, forming an organized whole, which makes a practical activity to operate intended purpose, define the concept of operating system.

Mining mass transport results in the excavation process is the main task to transport coal from open pit mines energy movement sterile or tailings from lignite delivery to consumers on conveyor belts or rail through the point of loading in wagons.

An operating system is characterized by:

- Type of equipment components: extraction, transport and deposition;
- Type of operation: cyclic / discontinuously or noncyclic / continuous;
- The organization of work: technological flows, which represent different combinations of excavating machinery, with a means to transportation and storage;
- Practical work carried out to consists of open pit mining excavation, transport and storage of mining mass;
- The aim is extraction of useful minerals.

Equipment's components features technology flows from open pit mining in relation to their operational continuity make up a system of exploitation: continuous, discontinuously or combined.

Continuous operating systems are most prevalent in lignite quarries, process steps being carried on in a normal sequence, machinery components being correlated in point of view of capacity excavation - transport - dump - storage. Within these operating systems continuous action can be found buckets wheel excavators, high capacity conveyor belts machines and equipment deposited in damp and deposit equipment's. Main equipment arrangement of within the process flow of careers is based on technical studies, which according to geological and mining parameters of each perimeter determines the type, place and the working mode. Process steps are carried out in a normal sequence, and the equipment is correlated in point of view of excavation capacity and appropriate to the ore deposit.

Conveyors belt are part of the chain that allows transport of excavated material to the coal depot or the place of the tailings deposit.

An essential problem which has been resolved is to optimize transport capacity by varying the speed of the conveyor belt.

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Such a solution is placing the inspection camera above the belt determines in real time the section conveyed material, figure 1. This profile represents one of the input data of the mathematical model. With this mathematical model to determine the optimal speed of the conveyors belt.

Fig. 1.Determination of the real-time section of the conveyed material using inspection camera

Important is the implementation of the adjustment functions of centering the band and oversight flaws that may occur in the rubber carpet.

Each conveyor belt must have its own control system. Their individual control systems are connected to central dispatch.

The control system performs the following functions:

- Submit to central dispatch all necessary data such as:
• Images from surveillance cameras;
• Current operating parameters;
• Parameters related to the transported material:
- Information for system diagnosis and monitoring.
- Control and monitoring functions that ensures automatic operation of the belt.

Belt conveyorsin addition to the transport function of the material, can also be used in the management of the quantities conveyed. Mounting on the scales allows real-time transmission of data on quantity transported, which can be integrated into a management system quantities of materials conveyed.

2. The inspection process

The inspection process is based on using a special sensor (usually a video camera) whose output signal is picked up by a digital processing system. What distinguishes fundamentally this system of a simple video surveillance camera is its ability to make decisions.

Basically we can define the system as an automated system that is able to make decisions based on the analysis of various geometric and topographical characteristics of the "stage" analyzed. Overall "stage" system presented is a physical object that can be simple or complex, a banal object or a complex mechanical assembly, but can also relate to other situations in which the analyzed "stage" represent is another nature image.

The set of software tools used to verify and measure differences in contrast and in what sense are evaluated. Digital cameras then collect this information and evaluate them based on programmed rules. Because measurements are directly dependent of contrast (the difference in intensity between pixels) is very important that the lighting is constant and uniform.

2.1. Description of functioning

Inspection Cameras acquires images then analyzed based on rules set by the programmer, if they satisfy the criteria. It further describes the functionality internal inspection cameras. In Figure 2 the decision making levels determined by the internal components.

On the upper level are system parameters. These parameters are common for each inspection that cameras are executed, parameters affect the overall behavior of the cameras, at least of a certain checks.

Then the inspection programs can make changes to the parameters that relate to a single inspection program (such as lighting), essentially parameters are at the program works only on a particular program, the rest remain uninfluenced.

Finally, the parameters of the instruments can only change those parameters inspection tools.

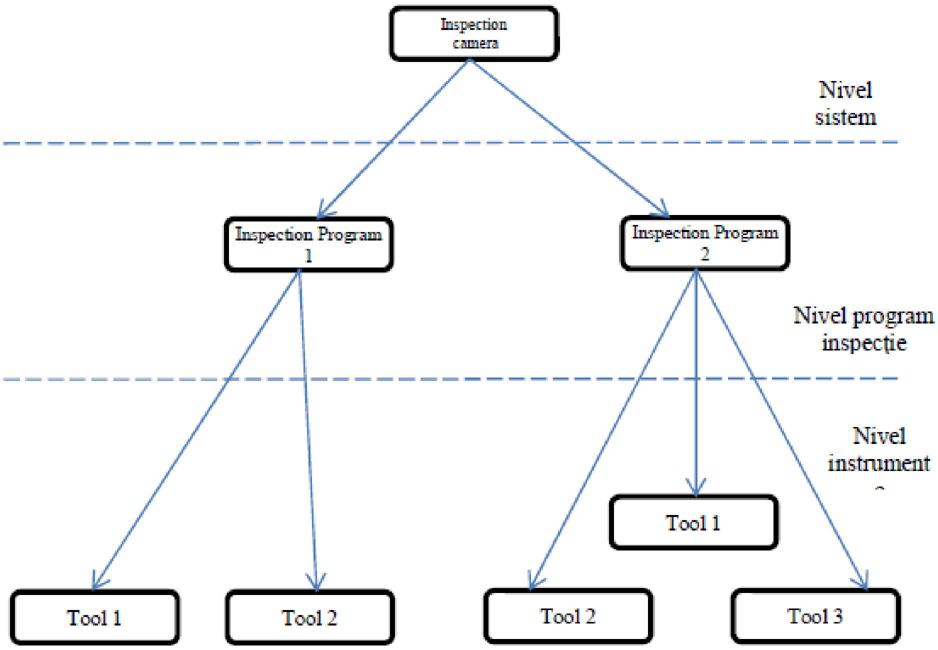

Fig. 2.Hierarchical organization of inspection cameras

Achieving and innovative design an inspection system using digital cameras is easy due to the properties hardware, software and variety of communication protocols. Logic diagram inspection system is relatively simple and is shown in Figure 3.

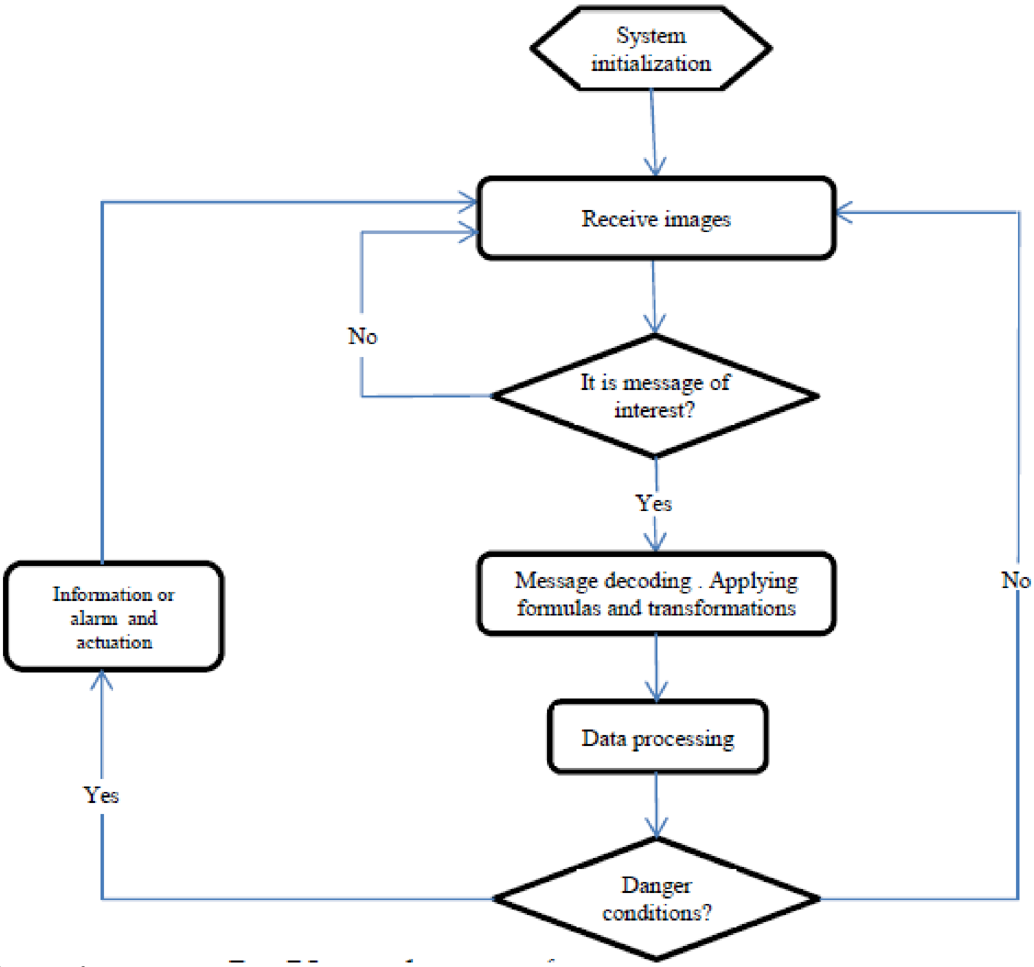

Fig. 3.Logic diagram of inspection system

2.2. Parameters basic characteristics of belt conveyors

Productivity is an important technical feature of the conveyor, which is expressed in t/h and is calculated using the relation:

$$Q_m = 3600 * A_0 * v * \rho \ ; \quad [t/h] \tag{1}$$

Where:

A_0 – real cross sectional area by material [m^2];

v - the transport speed [m/s];

ρ – density of the material [t/m^3];

Due to shocks and vibrations during belt movement, sectional area of the material layer changes. To determine the real section will take account of the degree of filling of the conveyor expressed by the filling factor ψ. If trough conveyor belt filling factor depends on the type of material and the working conditions, ψ =0,4÷0,6.

For the conveyor belt in Figure 4, the size of the section after which are placed the material is determined by the width of the belt B.

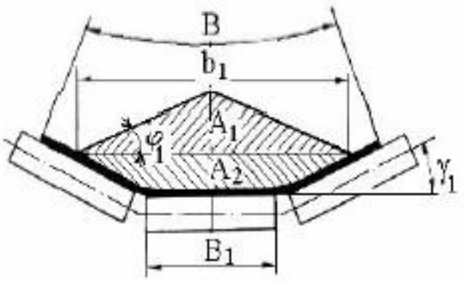

Fig.4. The size of the section after which are placed the material

$$b = 0.9 * B - 0.05; [m] \tag{2}$$

$$h = \frac{1}{12} * b \tag{3}$$

Such the material section area will be:

$$A = \frac{2}{3} * h \ \cong \frac{1}{18} * (0.9 * B - 0.05)^2 \tag{4}$$

Taking into account the unevenness coefficient ψ, relations for calculating the real cross-sectional area becomes:

$$A_0 = \frac{1}{18}(0.9B - 0.5)^2 * \psi \tag{5}$$

$$A_0 = 0.075 * B * \psi \tag{6}$$

Substituting the expression of the relation (2), A_0 result:

$$Q_m = 270 * B^2 * v * \rho \ ; \quad [t/h] \tag{7}$$

Or:

$$Q_m = 3.6 * \frac{G}{d} * v \ ; \quad [t/h] \tag{8}$$

Where:

G - Load weight transported [kg];

d – Distance between two consecutive tasks [m].

Transport speed is another characteristic parameter. Belt speed is chosen depending on the type of product transported and depending the productivity.

To study the possibility of using images to calculate the flow rate of the unit we chose a mining conveyor EM Lonea, conveyor that makes the C.F.R wagons loading. The total flow is 120 tons and made at certain times time, from 10 to 10 tones.

The data used for comparison were obtained by weighing and provided courtesy of the staff that served this work point.

Such is synthetically in tabular Table 1 and graphic Figure 5, Figure 6, the results obtained using and processing the recorded images and comparing the data obtained with the data provided.

Table 1.The data used for comparison

Nr.crt	Time	Data provided using weighing	Data obtained using images
1	0	0	0
2	t1	10	9.9523
3	t2	20	20.1592
4	t3	30	29.8712
5	t4	40	40.0298
6	t5	50	49.9531
7	t6	60	58.9821
8	t7	70	71.0098
9	t8	80	80.4678
10	t9	90	90.2512
11	t10	100	99.3542
12	t11	110	108.8798
13	t12	120	120.2687

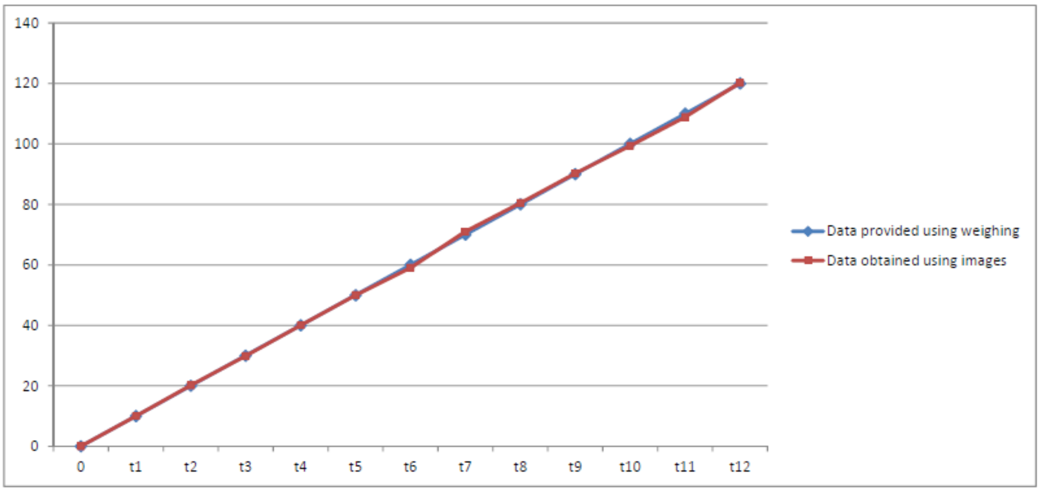

Fig.5. The data used for comparison

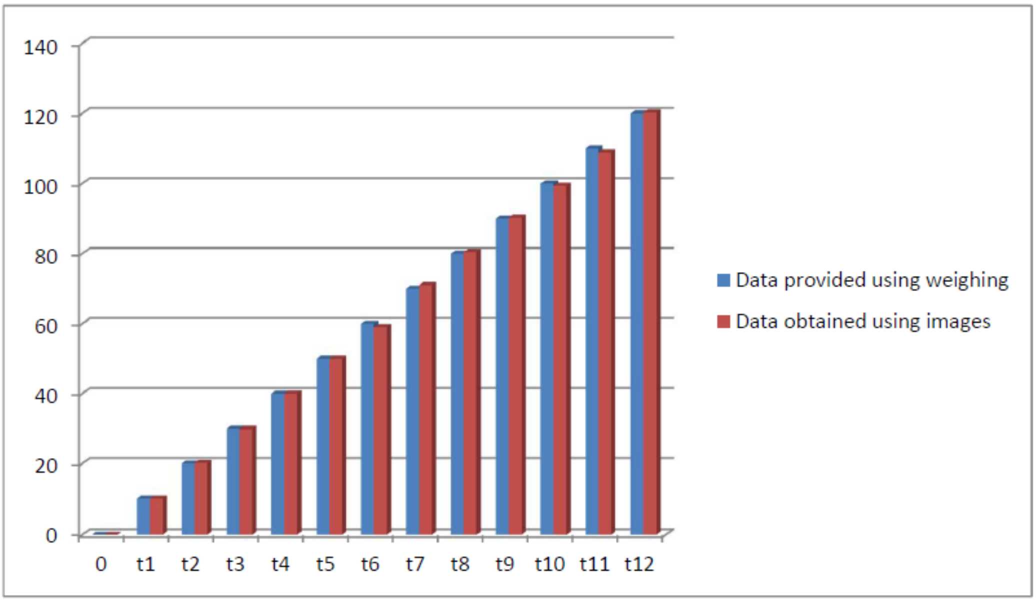

Fig.6. The data used for comparison

3. Conclusions

Using networked equipment enables remote diagnostics of machines. This can shorten the minimum response time in case of a fault. Furthermore, it can also provide a system for monitoring and programming equipment conducting routine maintenance work so that unplanned downtime is minimized.

Integration of all equipment, command and control from the central dispatcher can secure controlled coal qualities through effective use of data from geological model of the reservoir. All this to fulfill current major desideratum: obtaining a controlled coal quality with maximum productivity under conditions of minimal costs.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Analysis of flat cable connecting devices for winding installation vessels

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Abstract

Winding installations have the role of transporting, between underground and surface, useful minerals, materials, equipment, and people, with extraction vessels. Cable connecting devices connect winding installation cables to extraction vessels. Depending on their design, connecting cables can be: with loop and core, self-tightening with wedged core on one or both sides; with hinged jaw; with cone-shaped friction wedges; with wedges and bridles.
The paper presents an analysis of flat metal cable connecting devices.

Keiwords: Cable connection device;

1. Introduction

Flat cable connection devices for equilibrium provides connection between extraction vessel and flat cable to compensate for hoisted materials.

Table 1 shows the constructive-functional characteristics of flat cable devices for equilibrium.

Table 1. characteristics of flat cable connection devices for equilibrium

No	Characteristic		UM	Value of characteristic		
				DLCLE-118	DLCLE-129	DLCLE-135
1	Maximum static load		tone/k N	2/20	3,5/35	5,5/55
2	Flat cable section		mm	106×15,5 118×17	124×18 129×19	135×20
3	Specific cable mass		kg/m	5,447/6,726	7,558/8,128	8,865
4	Cable fixing		-	With loop and eccentric core		
5	Bolt diameter		mm	60	70	70
6	Cover plate width for attaching to the skip		mm	40	48	40
7	Number of fixing clamps of flat cable		pc	6	6	6
8	Space btw. clamps		mm	120	120	120
9	Size	Length (height)	mm	1327	1577	1706
		Width	mm	380	460	500
		Thickness	mm	238	250	258
10	Weight		kg	190	248	290

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2. Device construction and functioning

Main constructional-functional parts of flat cable connection

The main constructive-functional parts of flat cable connecting devices for equilibrium DLCLE-118, DLCLE-129 and DLCLE-135 are shown in Fig. 1 and 2.

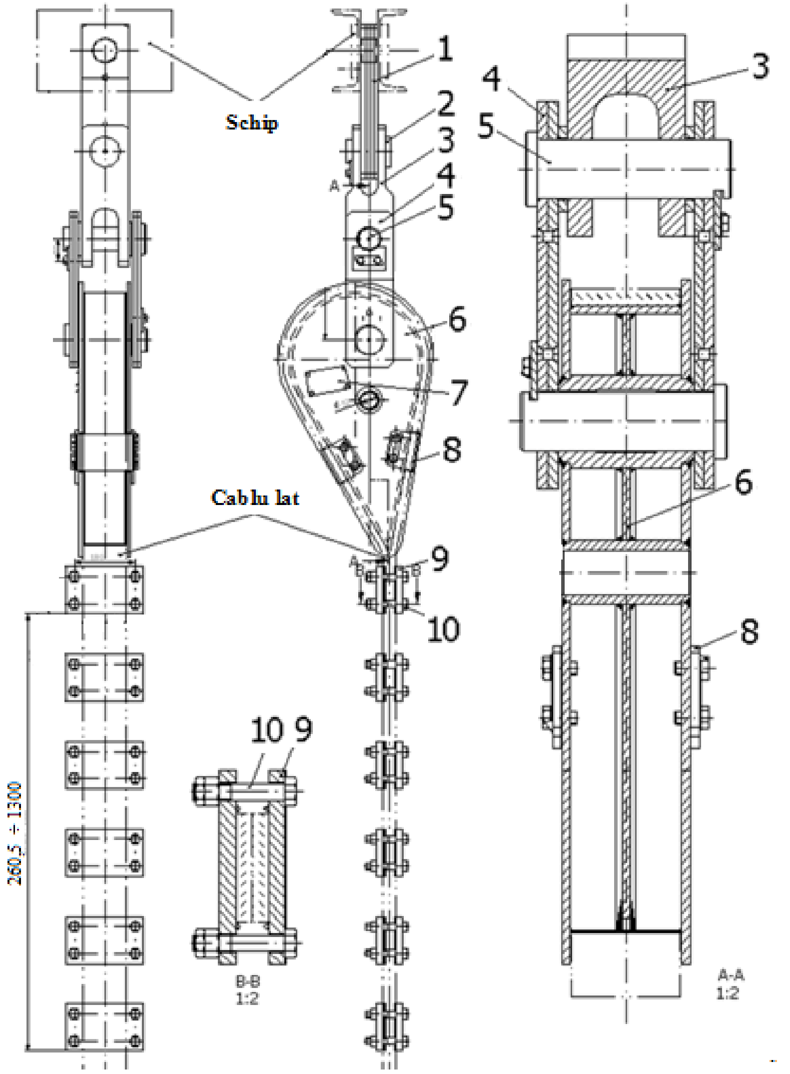


Fig. 1. Flat cable connecting device DLCLE 118, 129, 135

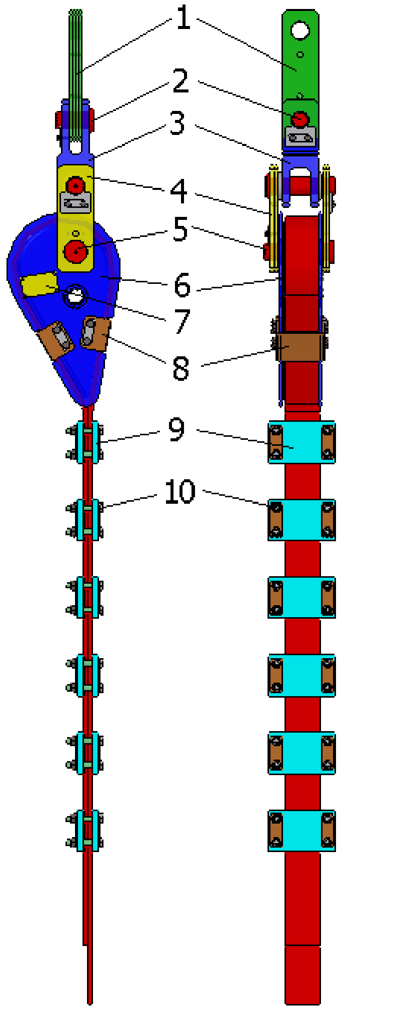


Fig. 2.flat cable connecting device for equilibrium DLCLE 118

The three typo-dimensions of flat cable connecting devices have the same constructive shape, the difference lying in the dimensions of the component elements, which are subject to different trials depending on the characteristics of the compensation cable.

According to Fig. 1, such a device is made up of a series of elements of resistance making the connection between the bottom of the extraction vessel and the eccentric core, its functional width being determined by the width of the flat cable and a series of clamps for fixing the end of the cable wound around the core.

The whole of the device is fixed to the extraction vessel by means of cover plate 1, which is a structure of resistance made up of four steel plates riveted between them and processed by cutting to nominal size. The connection to the eccentric core 6 is done by means of a fork 3 and two cover plates 4, made up od two steel plated riveted between them, and the connection between the three elements being made by bolts 2 and 5, made of allied steel and thermally treated.

The eccentric core is a welded metal structure, Fig. 3, with a central plate giving the shape and position of the two sleeves, and the winding plate and the exterior plates make up the canal around which the end of the flat cable is wound for compensation. The core, besides the bolt 5 sleeve also has a hole used to support the device in view of mounting the cable. The label 7 is fixed tot the core, to identify the device and the two flanges 8, having the role of fixing the flat cable to the canal of the metal core.

The loose end of the cable is passed along 1500 mm over the cable entering the core, the two branches being seized in six double clamps 9, each having four tightening screws 10, with nuts and counter-nuts.

The material of the important parts, the plates of the cover plate seizing the extraction vessel, all the connection bolts, the connection fork, the plates of the intermediary cover plate, the lower and the upper plate of the eccentric core respectively, should be monitored for defects, non-destructively, before the material flow, and should meet the prescriptions specified in the technical documentation.

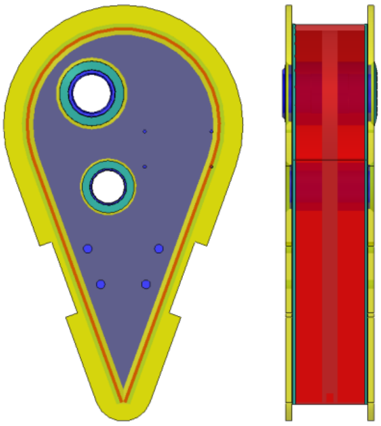


Fig. 3. Eccentric core

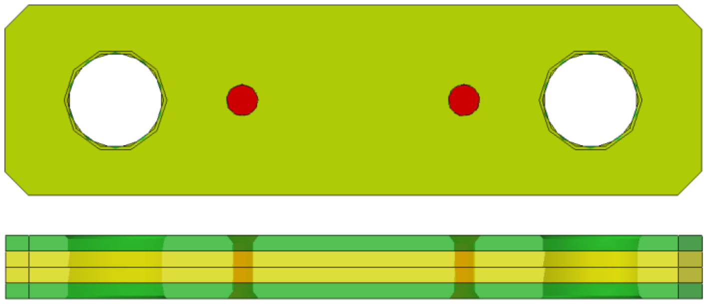


Fig. 4. Cover plate for attaching the skip

In the execution of the skip that seizes the cover plate, Fig. 4, of the intermediary cover plate and the lower and upper plates of the eccentric core, the following conditions should be met:

- heat straightening of the sheets of which the before mentioned subassemblies are made, is not allowed;
- the piece will be cut out from the sheet along the outline by chipping or thermal cutting, in which case a processing addition of minimum 10 mm is left, which will be removed by chipping;
- the piece will be cut out so that the direction of lamination of the sheet would coincide with the strain direction of the piece, along it.

In the execution of the subassemblies made up of plates, the exterior and interior plates are gripped in a package and the boring for riveting is done, after which they are riveted together, and the other boring operations will be done. After assembling the plate packages by riveting, the end of the rivet is processed, so that the outside of the of the plate surface would not be extended in the exterior

In order to execute the connecting bolts and forks, the forging of the material is not allowed, only its mechanical processing.

Before its installation at the place of use, all the component pieces of the device are verified. The component elements showing defects or damages, which might adversely influence the functioning of the device will not be allowed.

The extraction vessel to which the equilibrium device is attached is found on pegs of a safety bridge.

At the upper part, the device is mounted by means of bolts to the extraction vessel, and at the lower part the flat cable is mounted by winding around the eccentric core and fixing by clamps.

The daily verification of the devices is done by careful visual examination and tapping, watching whether the component parts show fissures or deformations.

3. Size verification of devices.

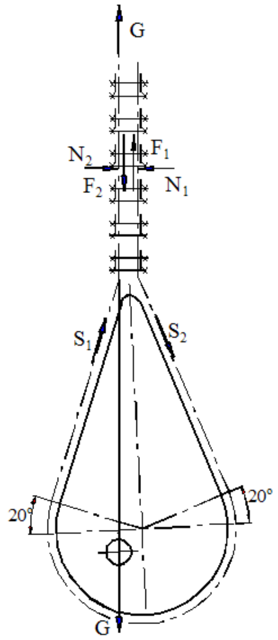
Starting from the mathematical equilibrium model of the cable and metal core, shown in Fig. 5, and the non-slip condition of the end of the cable blocked between clamps and cable, the relations of determination of clamps tightening force is given below:

$$N_1 = \frac{G \cdot e^{-\mu\theta}}{\mu_1 \cdot \left(1 + e^{-\mu\theta}\right)}, [N] \qquad (1)$$

where: G is the maximum weight of the equilibrium cable, G = 20000 N; μ – friction coefficient between the cable and the metal core, μ = 0,1; θ – winding angle of the cable on the metal core, θ = 220º; μ_1 – friction coefficient between cables, μ_1=0,1.

For a dynamic coefficient of the winding installation of 1,6 ... 2 and a safety coefficient higher than 10, a number of twenty one M20 screw result executed in OLC 35q, with a flow limit of 370 MPa. Due to the use of clamps with four tightening screws, six clamps for safe fixing of the end of the cable are required.

The cover plates and fork have been tried for tear and shear in the bolt area and for contact pressure between their boring surfaces and bolts.



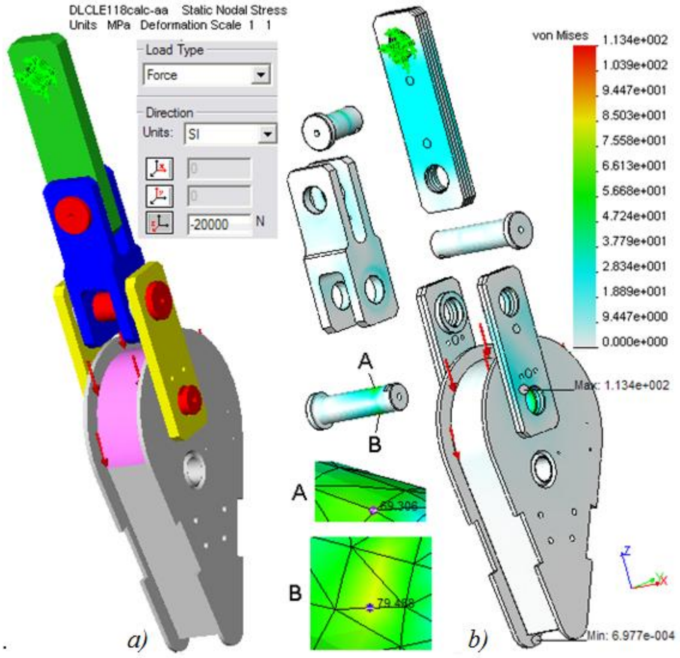


Fig. 5. Mathematical model of fixing forces of cable

Fig. 6. Numerical analysis with finite elements of device DLCLE 118

Bolts have been tried for strains at bending and shear, for a safety coefficient higher than 10, the use of one 42MoCr11, 31MoCr11, 31MnCrSi11 or 25MnCrSi11.alloyed steels of improvement resulting.

Fig.6 shows the numerical analysis with finite elements of the device DLCLE 118, in Fig. 6,a showing the way of loading, fixing with of the boring of the bolt of attachment to the skip, and application to the surface of the metal heart of a force equal to the maximum weight of the cable, 20000 N. Fig. 6,b shows that the maximum strain of the bolts occurs in the area of separation between the cover plate an the sleeve of the metal heart due to the shear strain, this is highlighted by the detail A and B, where tensions equivalent to 69,306 MPa and 79.468 MPa come up, confirming the necessity of using alloyed steels of improvement.

4. Conclusions

In drawing up the documentation of execution for connecting devices of flat cables for equilibrium in contract No. 193/ASL/2006, concluded with CNH Petrosani, the following technical economic aspects had been in view:

- simplification of constructive solutions from technological point of view (eccentric core and clamps in welded construction compared to their cast construction);
- equalization, as far as possible, of constructive solutions for flat cable connecting device, which equips multi-cable winding installations in the Jiu Valley. This was particularly difficult, since it was necessary to maintain the inter changeability with the present constructions;
- use of constructive solutions that had been verified in practice for similar devices;
- maintaining the present safety coefficient , and in some cases, its increase;
- decrease of costs by reducing manoeuvre.

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7th International Multidisciplinary Symposium

„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH"

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Optimization of geometric and strength parameters of teeth for bucket wheel excavator in view to increasing the cutting efficiency

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Abstract

The paper deals with the multi-criterion optimization of teeth used on buckets of bucket wheel excavator. It is known that the geometry of tooth influences the cutting parameters and also the endurance and strength of the tooth itself. The dependencies between the cutting and penetrating forces, the specific energy on the rake angle and the relation between this last one and the robustness of the tooth are somewhat contradictory, so in the design of shape and dimensions of tooth a multi-criterion optimization is necessary, in order to obtain the most lightweight one with maximal rigidity and best energy and force characteristics for a given excavated rock. The method presented in the paper uses Mathcad for fulfill this task, and as result three versions of teeth were devised for excavating overburden rock and/or lignite, suitable for bucket wheel excavators used in Romanian lignite open pit mines.

Keywords : bucket wheel excavator; optimization; multi-criterion; teeth;

1. Problem setting

Previous experimental and theoretical research regarding the cutting forces of the lignite and surrounding rocks from the Oltenia coalfield open pits and field observations lead to the conclusion that on the entire open pit coalfield is recommended to use two types of teeth for excavating the covering rocks and one for lignite, to balance reliability, efficiency and cost requirements.

The establishing of teeth types is a complex and difficult problem, involving compromising between the numerous and contradictory influence factors on the geometric parameters of the teeth.

Comparative studies of mechanical charge of teeth in case of the lignite vs. rock excavation shows that they are comparable in size, in some cases the sterile is easier to be excavated, but in the case of rocks the wear is the main quality parameter of teeth.

Starting from here, it results that two types of teeth seems to be sufficient to fulfill the cutting force requirements for covering rocks in the entire coalfield, considering geometric parameters. These geometric parameters are explicated in table 1 and the geometric shape of the tooth mounted on the bucket is shown in figure 1. For cutting the covering rocks and lignite, we concluded that it is sufficient to have in total three types of teeth.

Taking into account the mounting scheme in fig. 1, the main geometric parameters of teeth used for excavating both covering rocks and coal are shown in fig. 2.

To both teeth a lateral longitudinal angle of 5^o and a lateral transversal angle of 3^o were considered in order to avoid the lateral friction between the teeth and the rock.

The teeth has the same shape, but they are different values of the active part's geometric characteristics. The type I is a more robust one, with a larger rake angle and a smaller edge angle, and is devoted to the excavation of rocks having a smaller specific cutting resistance (A = 200 ... 450 N/cm) encountered in Husnicioara, Roşia and Roşiuţa pits namely different type of clays.

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The type II is a more heavy version, with smaller rake and larger edge angles, recommended for cutting more resistant rocks from Lupoaia, Roşiuţa, Jilţ, Roşia and Husnicioara pits with specific cutting resistance A = 450 ... 800 N/cm.

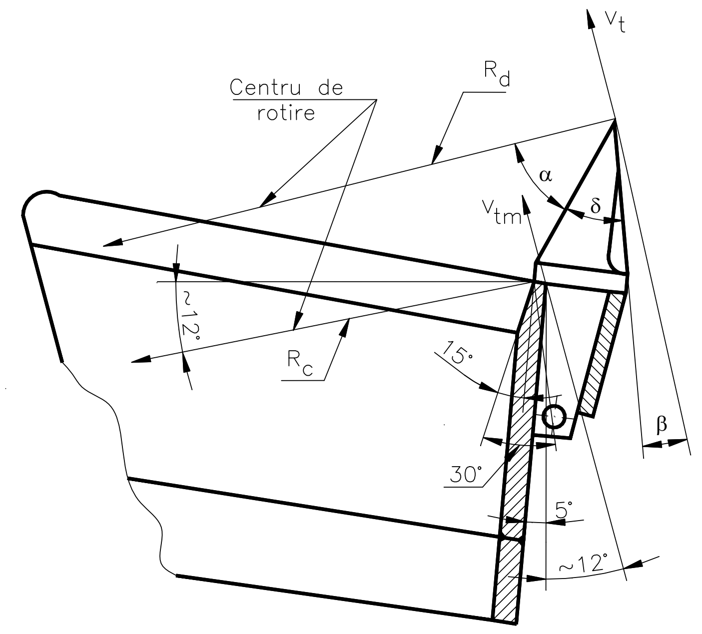


Fig. 1. The mounting scheme of tooth on the bucket

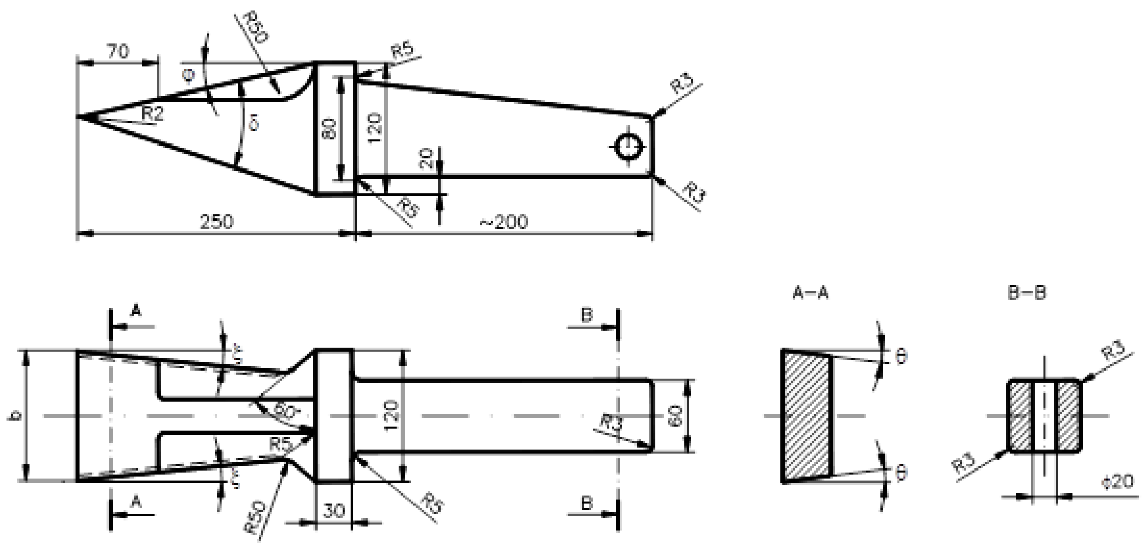


Fig. 2. The general shape of a teeth

2. Theoretical issues

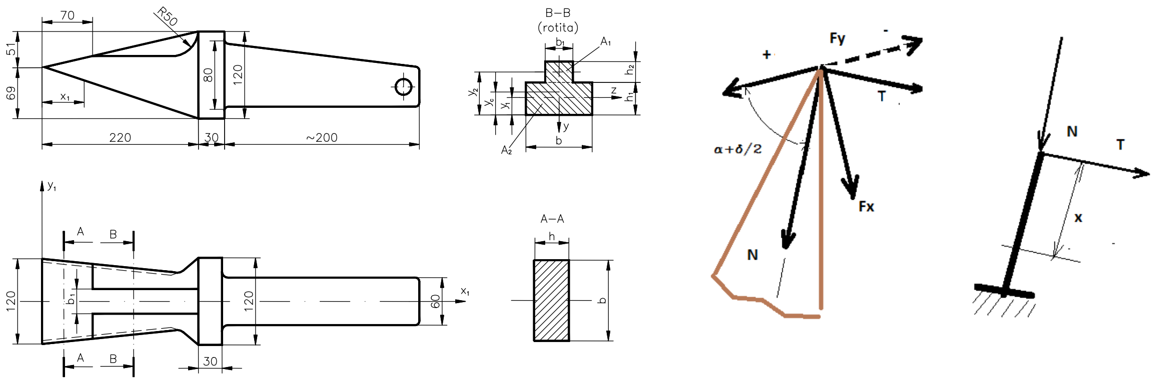
In order to justify the optimality of the three devised teeth able to be used in lignite, soft overburden rock and mix (lignite and rock) in Oltenia coalfield, a theoretical multi-criterion optimization has been performed , presented below.

Considering the loading scheme presented in fig. , we can consider the tooth as a bar (beam) fixed in one side and loaded with two concentrated forces on other side, The first force (T) act on perpendiculary direction on tooth axis, and the other denoted with (N) is acting along the axis. The force denoted with N on each cross section produces compression / tensile stress , and the force denoted with T produces flexional moment M= Tx on each cross section, at distance x from the tip. We can write for each cross section the maximal value of the stress as:

$$\sigma = \sigma_N + \sigma_T = \frac{N}{A} + \frac{M}{W} \quad (1)$$

Where :

N- normal force ;
T- tangential force ;
M –bending moment produced by the force T, M=T.x ;
x – distance from tip of tooth to the considered cross section ;
A- Area of the cross section ;
W- the modulus of resistance .



a) b)

Fig. 3 . The general shape of a teeth with cross section parameters (a) and the loading scheme(b)

Based on figs. 3 a, and b, the forces N and T as a function of the cutting force F_x and the penetration force F_y acting ont he tip of the tooth, and taking into account the geometric parameters , can be expressed as:

$$N = Fx \sin(\alpha+\delta/2) \pm Fy \cos(\alpha+\delta/2) \quad (2)$$

$$T = Fy \sin(\alpha+\delta/2) \pm Fx \cos(\alpha+\delta/2) \quad (3)$$

Taking into account the relation between the cutting force Fx and the penetrating force Fy as:

$$F_y = k_y F_x \quad (4)$$

The equations (2) and (3) can be written as :

$$N = Fx\,(\sin(\alpha+\delta/2) \pm ky \cos(\alpha+\delta/2)) \quad (5)$$

$$T = Fx\,(\cos(\alpha+\delta/2) \pm ky \sin(\alpha+\delta/2)) \quad (6)$$

Both the Fx and Fy forces, as well as the parameter ky , are dependent ont he rake angle α and the depth of cut , h .

So, the equation (1) become :

$$\sigma(\alpha,h) = \sigma_N(\alpha,h) + \sigma_T(\alpha,h) = \frac{N(\alpha,h)}{A(x)} \pm \frac{T(\alpha,h).x}{W(x)} \quad (7)$$

The optimization task is on one hand that the shape of the tooth be as close as possible to a equal resistance one, and ont he other hand to have the maximal stress less than the allowable one, so:

σ = const. , $0 < x < l$,
$\sigma(l) < \sigma_a$

Because the shape of the cross section is variable along the axis of the tooth, and taking into account the complicated shape, in order to calculate the variable area and modulus of resistance A(x) and W(x) we used the MATHCAD program. In fig 4 , the analytically described shape on axial plane and in figs. 5 and 6 the variation of the area and modulus of resistance, calculated for all cross sections at distance x .

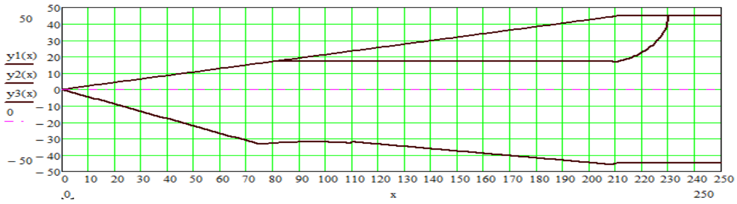


Fig.4 Longitudinal shape of teeth constructed analytically

In fig. 7 the diagrams of tensile and compression stresses are presented. It can be seen that except a cca. 40 mm distance from the tip, the stress is almost constant, which is a proof of the fulfilling of optimality criteria. In fig.8 we presented the diagram of W(x)/A(x) ratio . It can be demonstrated , using more complicated calculi, that the condition for a bar loaded axially and tangentially on the tip, is close to an equal stress beam if the ratio W(x)/A(x) is linearly dependent (increases) with x. This assumption is also proved by the mentioned diagram.

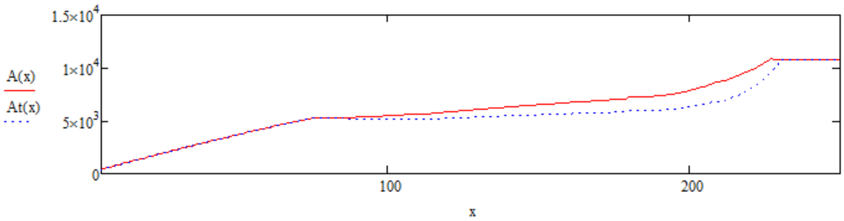


Fig. 5 The variation of the cross section area

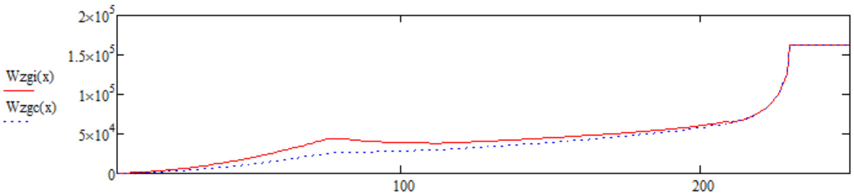


Fig. 6 The variation of the modulus of resistance

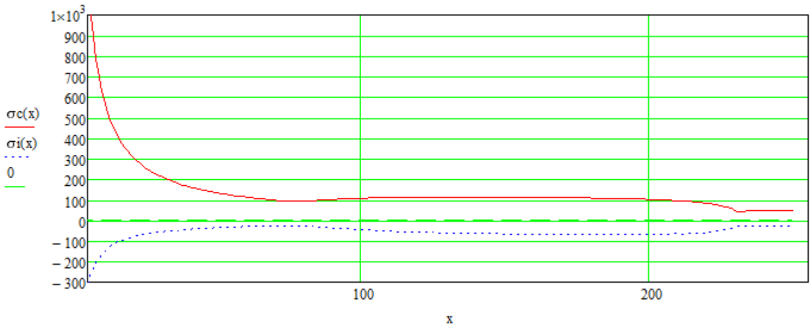


Fig. 7 The variation of tensile and compressive stress

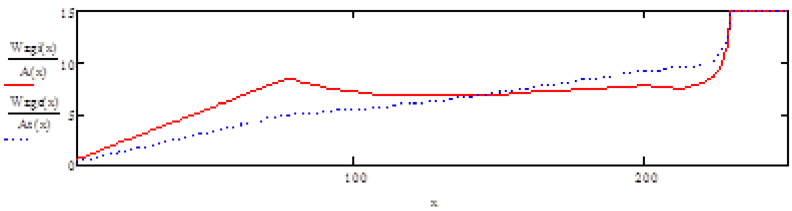


Fig. 8 The variation of the ratio   W(x)/A(x)

3. Practical solutions

On the basis of performed research, 3 types of teeth were devised, designed and developed a presented in figures 9,10 and 11.

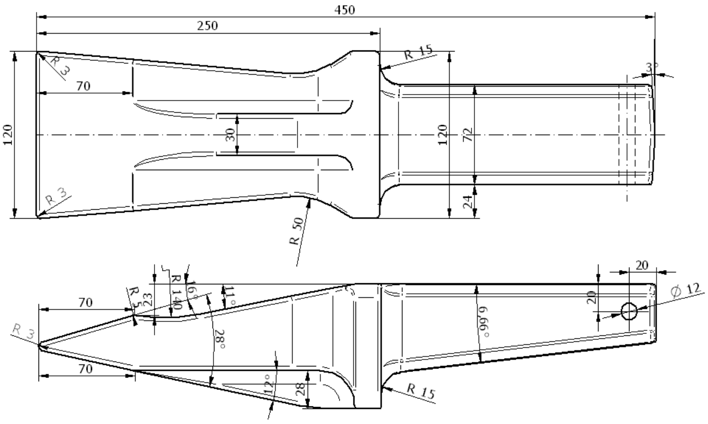


Fig. 9 Proposed tooth I[st] . version

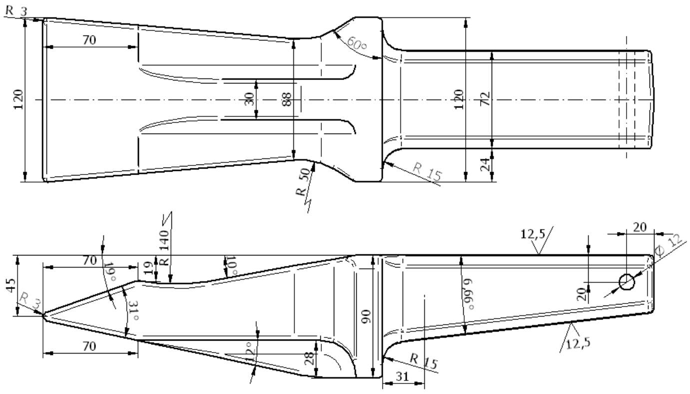


Fig. 10 Proposed tooth II[nd] . version

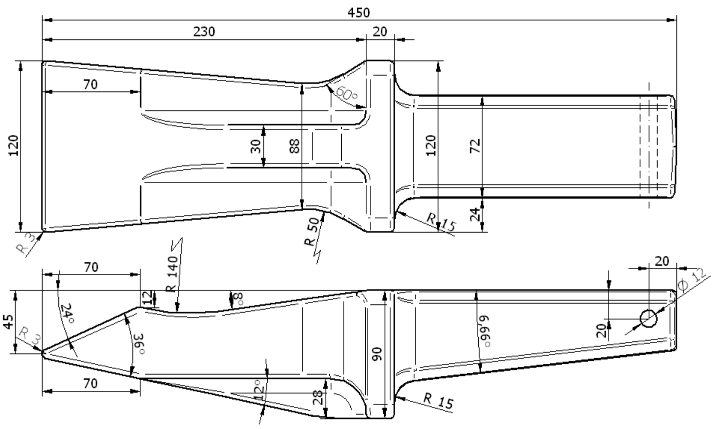


Fig. 11 Proposed tooth III[d] . version

The main dimensions are the same for all the three teeth, except the rake angle, which is different and established on the basis of above presented optimization study. All the tethh have a zone of 70 mm which is subject of wear, presenting a self sharpening property.

Conclusion

The research performed before led to the conclusion that in Oltenia coalfield three type of teeth can be used for the bucket wheel excavators, one for overburden rocks, other for lignite excavation and third for mix excavation.

On this basis, the appropriate teeth were developed, and prepared for field tests in real conditions.

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Noise emission of conveyor idler rollers

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Abstract

The paper intends to introduce research results in area the noise of belt conveyor rollers. Measurements were carried out in laboratory by the author. At the end of the paper, used the results of measurements also gives examples to calculate noise power level of belt conveyor.

Keywords: noise; conveyor belt; roller; measurement; noise power level

Introduction

Noise had an insignificant impact earlier among the harmful effects of the environment affecting people. The increase of the areas settled by various industrial plants has meant at the same time that populated areas and those accommodating industrial plants have moved closer and closer to each other. This resulted in the reduction in the size of protective belts which had reduced by their effect the noise level affecting areas used for habitation and recreation to an acceptable value earlier. The situation is further augmented by a significant rise in the performance of the machines employed as caused by ever enhanced mechanization in all the fields of industry and agriculture – entailing evidently an increase in the energy of noise emitted by them. This is accompanied by an increase in the loading effect of noise originating in traffic.

1. Noise problems in the vicinity of conveyor belts

Our narrower field – namely mining – is also concerned in the environmental problems associated with noise. Due to the nature of the subject the surroundings of mines operating on the surface for producing construction materials and fuels (brown coal, lignite) are affected mainly by this issue. Compared to the production machinery operating with considerable noise output the noise generated by conveying equipment and its effect is not negligible at all. It may appear at first approximation that the effect of the noise generated by the rubber-belted conveyors widely used for transporting bulk materials is much less than that of the machines used for production. Cautiousness is called for, however, by the increased number of complaints submitted by people because of high performance conveyor belts operated close to habituated areas. The disturbing effect is retraceable basically to two causes. One of these is the continuous mode of transportation. After all the conveyor belts positioned along the transport route of producing mines are operated generally overnight as well. However, the noise level (L_{AM} = 40 dB in small-townish & rural areas) permitted for the night period from 22:00 to 6:00 hours is low enough for an insufficiently wide protective belt or an improperly maintained conveyor belt to cause this limit value to be exceeded. The situation is further augmented by the fact that the night-time period investigated is only T = 1/2 hour. In the daytime it is more advantageous in respect of the noise load generator that the time period of evaluation is T = 8 hours. The other cause is the nature of the source. The belt conveyor as a noise source behaves as a linear source. The noise generated by such a source is attenuated to a lesser extent as the function of distance then if it were originating from a point source.

Outside the borders of Hungary – mainly in the countries where the quantity of fuels produced in mining by open-cast method is significant (such as Australia, Canada, the United States) – the noise generated by conveyor belt approaching the living-space of people had enforced already earlier this issue to be dealt with. According to the

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measurements concluded a 100 m long section of a conveyor belt transporting coal of common design – running at 5 m/sec velocity and 10,000 t/h capacity – generates 113-119 dB noise output levels. [Brown et al,2004] In the case of designs aimed explicitly at reducing the noise output even somewhat lower – around 107 dB - noise output levels can be achieved (referred also to a 100 m long section). We hasten, however, call attention to the fact that well maintained, not worn-out conveyor belts were involved in the above-mentioned cases. It is a completely different case to be faced, however, when the track contains components deteriorated during operation – such as worn rollers, strings and others as well, with their numbers being important as well, naturally. In such a case the increase in the noise output level may reach such an extent which may mean the multiplication of the noise output level.

It is very important to decide at what level we attempt to intervene in order to reduce the noise level. Also, it may be useful in the case of operating production plants if we can estimate in advance what noise load is expectable at the inhabited object close to a conveyor belt intended to be operated along a planned route during its operation. Considerable costs could be saved for the plant if it could be determined already in the phase of designing a mine – or its revamp – whether the noise generated by the conveyor belt intended to be installed along the planned transport route would cause the limit value to be exceeded or not. Or – even if it would not in its newly installed condition - with the expected rate of attrition taken into consideration an estimate can be made of when the noise energy would rise to a level where the limit value may already be expected to be reached. The correlations describing noise propagation – usable for such an investigation – have been known for a long time.
It is indispensable, however, to know the intensity of the source itself – or more technically its calculated noise output level.

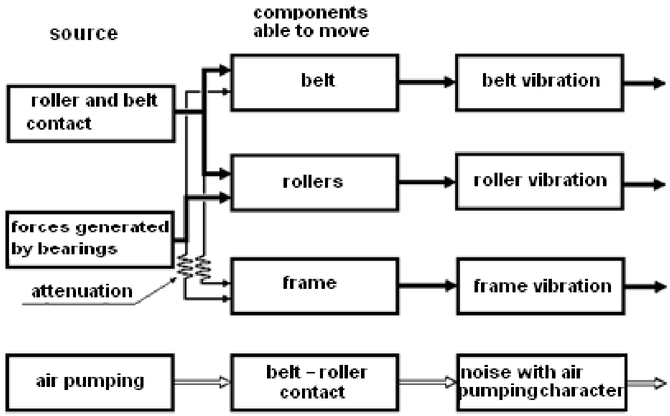

Fig. 1.

The noise output by conveyor belts is a complex one, in respect of its formation it is the consequence of the combined operation of several noise generating mechanisms. In summary these mechanisms are as listed below:

- Noise originating in roller bearings and their vicinity
- Noise generated by the contact of the roller and the belt
- Noise generated by the vibration of the roller skirt
- Noise generated by air pumping due to the movement of the belt
- Noise generated by the vibrations of the conveyor frame

In the case of a track built from new components the interaction between the belt and the rollers is dominant with regard to noise generation. The observations to date have shown that the shape of the roller skirt – the skirt profile – and its defects, respectively, is the most important factor in the excitation of the vibrations the sounds generated by which are then radiated to the surroundings as noise. [Brown et al,2004]. Thus, the important conclusion – that the skirt profile defect taken into consideration for the qualification of rollers is not only a parameter classifying a roller in mechanical aspect but is significant also with regard to the noise generated by the track – can be drawn already here. The specialists dealing with this subject propose therefore to use the **m**aximum **i**nstantaneous **s**lope (MIS), the parameter qualifying the quality of the skirt as the noise generation potential due to the inaccuracy of the rollers. [Brown et al,2004] The question arises immediately, of course, whether the energy of the noise generated is influenced not only by the deviation of the roller profile from the ideal but also by the surface and condition, respectively, of the belt if the interaction between the belt and the rollers plays a primary role in the generation of vibrations and thereby of noise. Reference to this can also be found in the international literature but much less publications deal with this subject.

The experiences in Hungary show, unfortunately, that the rollers and roller strings installed in the belt tracks operated in the field of mining are replaced in general only in their severely deteriorated condition. The reason for this is to be found, naturally, in the intent to reduce operating expenses. The evaluation of whether this track maintenance concept results in the realization of actual cost saving and, if yes, whether it would entail extra cost in another area at the same time, is not a subject of this paper. It is a fact, however, that in the case of deteriorated or severely worn rollers the first element of the mechanisms shown in Figure 1 above becomes the primary factor in respect of noise generation. Thus, a large portion of energy of the noise generated originates in the roller bearings and their vicinity. At the same time the intensity of the noise increases significantly along with the noise output level of the roller as noise source as well. A conveyor belt operating with worn-out rollers becoming noisy may subject the surroundings in comparison to its original newly installed condition to such a high noise load which may cause the limit value to be exceeded at the objects to be protected in its vicinity. Experiences indicate that in the case of high performance conveyor belts not only the track itself but also the drive system moving the belt constitutes a noise source. The motors of several hundred kilowatt power consumption, clutches and drive gears radiate a substantial acoustic energy to the surroundings. This energy is frequently higher than the noise output of the track. In spite of this the disturbing effect of the noise radiated from these components exerts itself in general to a less extent than that originating in the belt track since the drive system behaves as a point source and the noise generated by it is attenuated faster as the function of distance than that generated by the belt track. And, should the protective belt be insufficient, then the shielding of the sources – motors, drive gears – can be considered. It is reassuring that muffler enclosures can be installed also afterwards although this solution involves considerable expenses.

Naturally, conveyor belts can also be enclosed. If, however, the objective of enclosing is noise attenuation, then the installation of movable noise barriers directly along the track is a less expensive solution.

The limit values of noise load are checked by taking measurements at the object to be protected. (Sound pressure level measurement [L_p]=dB) Table 1 contains the limit values stipulated in joint Ministries of Environment Protection & Rural Development and Public Health Decree No. 27/2008 (XII.3.) KvVM-EüM and taken into account by the authorities in the case of inspections.

Table 1

Area to be protected	Noise Limit (LTH)	
	Day: 6-22 h (T=8 h)	Night: 22-6 h (T=1/2 h)
Health Resort, health area	45	35
Living area (small town, suburb, village)	50	40
Living area (city)	55	45
Economic area	60	50

In cases where the limit value is exceeded some kind of protective measures is required. The implementation of this after the installation of the conveyor always entails higher costs as if attempts were made to intervene already in the design phase. In order to intervene in the design phase, however, the quantity characterizing the “noise generation capability” of the machine or package – in our case that of the conveyor belt, that is the [L_w]=dB noise output level must be known. If this value is known then a good estimate can be developed for the sound pressure level present at a given distance from the source by using the equations describing sound propagation. This will be only an estimate because the attenuating ability of the propagation path cannot be known accurately due to the variability of the features of the ground and the vegetation. The estimate is actually a calculation but it results only in a range of the expectable sound pressure levels according to the variation of attenuation.

2. Determination of the noise level of rollers

Few data are available in the literature about the noise output level of the rollers used in conveyors. Estimator formulas exist for some common machinery types (e.g. drive gears, transformers) which provide estimated noise output values as the function of size and performance. No such correlations are available, however, for the rollers of conveyor belts. (As yet.) For this reason measurements were conducted at the Technical Earth Science Department, Faculty of Geotechnical Equipment of Miskolc University – in the scope of the Scientific Fraternity work of our student, Norbert Matisz, among others – with the objective of determining the noise output levels of new and used rollers.

The strength of a source, the numerical value of the noise output level can be determined by measurement. This requires basically a decision regarding what measurement accuracy should be employed. In this respect the applicable standards and the recommendations given in them classify the measurement possibilities into three groups. These are: informative, technical and accurate. The Hungarian standard used by us (MSZ EN 3744) recommends the performance of technical accuracy measurements. The test arrangement for this can be used in the case of measurements conducted in an enclosed space above a reflective surface. In the course of this the object to be measured is surrounded by an imaginary enclosed surface and the sound pressure levels are measured simultaneously at each surface portion. (See Figure 2.) Then the energy and noise output level of the source can be calculated from these measured values with the use of the equations given in the standard.

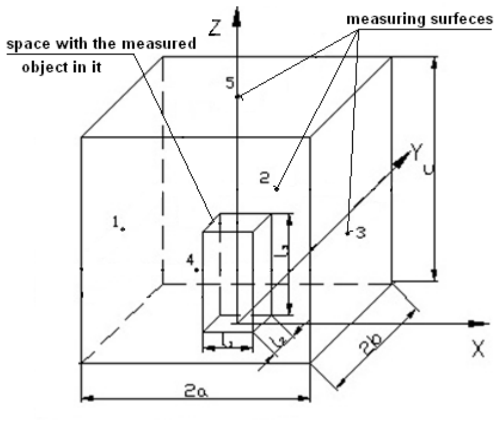

Fig. 2

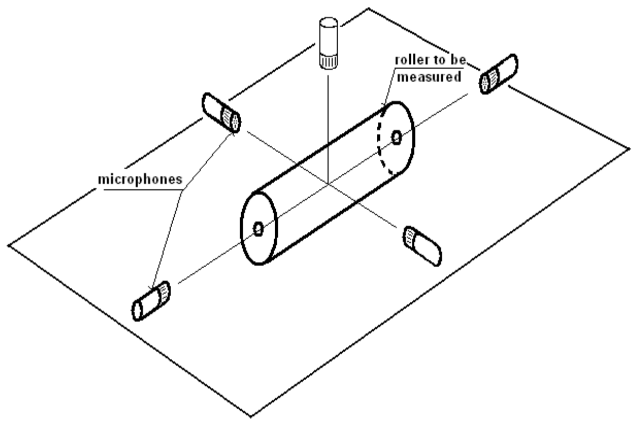

Fig. 3

The measurement accuracy can be improved by increasing the number of test points at each surface portion. In this case several pick-ups are used at one (or more) boundary surface for detecting the sound energy passing through the surface. The use of several pick-ups is intended actually to track the directivity of the sound. Unfortunately, this results in increased measurement costs at the same time since the price of the pick-ups forms a significant item in the test arrangement. In our case we performed the measurements with one pick-up positioned at the centre of each boundary plane surface. The schematics arrangement is shown in Figure 3.

3. The execution of the measurements

We selected 89x315 mm size rollers mainly because the rollers of this size are widely used in our country. Even so the authors are aware of the fact that conveyor belts using larger rollers are also operated at several locations. Among the twelve rollers included in the investigation two were new and ten used. Unfortunately no information was available about the usage of the latter ones. Afterwards, subsequent to the completion of the tests we formed the opinion that there were considerable differences in respect of the usage (the number of revolutions completed until removal) of each used roller.

The tests were conducted at speeds conforming to three different belt velocities. These were: 1.56, 3.94 and 6.34 m/sec.

Based on the experiences of a few preliminary runs we found that there are major differences between the noisiness of the rollers but at constants speed (the way the test were conducted) the noise had a constant nature and thus there was no need for long observation periods in order to determine the average values of the sound pressure generated. Therefore a test period of about 10 seconds was chosen for each roller. The devices of the company National Instruments (NI) were used as the test data collection & evaluation system for accomplishing the task. The mark NI9234 modules receiving the signals of the (Brüel & Kjaer make) pick-ups were processed by the measurement software written under the LabView application framework running on the laboratory computer.

The software was compiled for performing the following functions: initialize the elements of the measurement system prior to the tests, control the tests, collect the measurement data, produce the statistics expected as the test result along with the completion of the calculations needed for this and display the test results graphically. Figure 4 shows a LabView window corresponding to the status after a 10 seconds observation cycle with the mean sound pressure values belonging to each channel (pick-up). (The display of channel 1 is seen with blue background.) The spectra of the signals from the five pick-ups resolved by octave bands are shown above this.

The results of the tests completed on the twelve rollers and the noise output level characteristic of each roller are contained in Table 2. Figures 5 & 6 show the data of Table 2 in the form of bar charts. The three charts in Figure 5 show the noise output levels measured in the case of the individual rollers with the belt velocities associated with each speed indicated alongside. Figure 6 shows the same test results combined into a single chart. Figure 5 identifies also which data apply to the new (No. 1 & 2) and to the used (No. 3 thru 12) rollers.

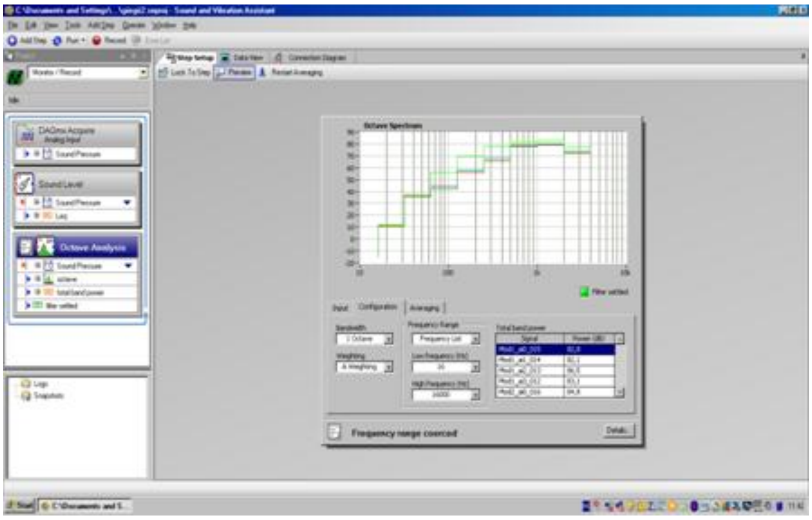

Fig. 4

Table 2

	L_W [dB]													
Idler	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	mean (worn roller)	incrase
v_1=1,56m/s	49	50	-	51	56	57	55	59	72	60	79	88	79,1	
v_2=3,94m/s	52	52	59	55	60	64	79	62	83	67	79	92	82,7	3,6
v_2=6,34m/s	54	54	70	59	64	69	64	63	88	71	80	94	85,2	2,5

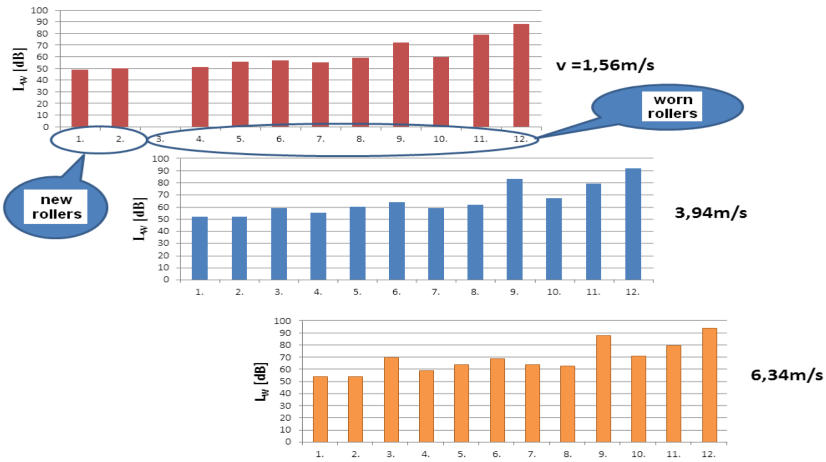

Fig 5

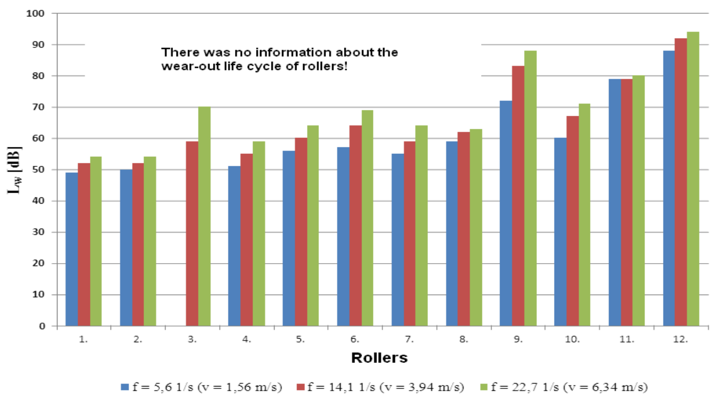

Fig. 6

4. Conclusions

As it could be expected, the noise level increases in proportion to the speed in the case of all rollers. Roller No. 11 behaved differently as an exception. Some increase could be observed also in its case but – although it was a used component – the rate of increase was smaller (1 dB) than in the case of the new rollers (2 dB). We have to emphasise also here that no information was available about "the wear-out life cycle" and the number of revolutions completed until removal for the used rollers.

All the same we wish to express our thanks to the colleagues working at the EURO GUMI Marketing Ltd and the Márkushegy Mining Plant of Vértes Power Station for putting the new and used rollers at our disposal for the purpose of our tests.

The two new rollers behaved similarly. At the speeds employed by ~2 dB rise was observed in proportion to the increase of velocity, naturally. The used rollers produced a higher increase than this. ΔL_1 = 3.6 dB (about 2.3 times) and ΔL_2 = 2.5 dB (about 1.8 times) could be observed in the mean values at the two velocities employed for both rollers. See the last row in Table 2. At the same time the ratios of velocity increase ν_2/ν_1 = 2.53 and ν_3/ν_2 = 1.61 were not the same. (We call the attention of the esteemed reader that the averages shown in the last but one row are mean energy values generated from the values given in dB and not the averages of the numerical dB values!) On the basis of the results it can be stated that the fundamental cause of noise increase in the wear-out of the rollers and the increase of the belt velocity has a less effect on noise increase.

Maybe more warning is given if we observe the change of values taking place in the course of wear-out and characterizing the noise increase of the rollers at one given velocity. Table 3 contains these values for the rollers investigated by us. Choosing v = 3.94 m/sec velocity we can see that the difference between the average levels represented by the new rollers (52 dB) and that of the used rollers (82.7 dB) was 30.7 dB! This corresponds to a ratio of 1:1174!

Table 3

speed [m/s]	1,56	3,94	6,34
new [dB]	50	52	54
worn mean [dB]	79,1	82,7	85,2
increasing [dB]	29,1	30,7	31,2
multipe	813	1174	1318

The appropriate column of Table 3 also shows that the multiplication of the noise energy between new and used rollers is significant even at relatively low 1.56 m/sec belt velocity: 813 times.

The spectral distribution of noise indicates that the largest part of the energy falls into the two octave frequency range between 500 Hz and 2 kHz. This statement applies to all used rollers. (See the spectra resolved by octave bands shown in Figure 4.) The disturbing effect on speech of noise distributed in this way is, unfortunately, considerable since the vibration components of human speech can also be found mainly in these two octave bands. It is reassuring, however, that the components falling into the higher (1-2 kHz) octave band are considerably attenuated basically due to the ground features and obstacles (trees, bushes, if any) along the propagation path.

Acknowledgement

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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The main aspects of the durability increase of hydro-transportation pipeline systems providing exploitation reliability and efficiency

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Abstract

Starting from the second half of the last century pressure pipeline hydrotransportsystems saw wide scale development throughout the world. Nowadays their total length counts a few dozens of thousands of kilometers. These systems are effectively used in mining and construction fields, agriculture, hydraulic engineering construction, household sector, for long distance shipment of various solid minerals and construction material. This is mostly to be accounted for their economic effectiveness and ecological safety. This system significantly outranks the traditional types of transportation in all rates. It is very important that the system is easily implementable in any geographical and climatic conditions. In order to achieve high technical and economic indexes and for further widening of the sphere of utilization, this type of transportation requires timely and thorough study of certain issues.
There are large-scale studies ongoing in the Mining Institute of Georgia dedicated to the above objectives. The results of the studies so far achieved have gained to them the highest evaluations by the international scientific society. Despite the mentioned, hydrotransport systems need that certain works be performed for increasing their life time, reliability of operation and effectiveness. This is directly linked to the main factors: hydro abrasive wearing and dynamic processes of pipelines that appear to be totally different in hydrotransportsystems. As it is of common knowledge, the carrying fluid mass contains a large amount of solid bulk material as well as the highly abrasive materials having different granulometric composition.

Keywords: hydrotransport systems; abrasive materials; hydro abrasive wearing; dynamic processes in pipelines.

1. Introduction

There have been fundamental theoretical and experimental studies performed in the above mentioned institute toward hydro abrasive wear and dynamic processes, having used laboratory stands and main pipelines of large industrial hydrotranspor tsystems with diameters 250-1400 mm (Makharadze *et al*., 2006; Makharadze and Kirmelashvili, 1986; Makharadze *et al*., 1984) used for transportation of different type, greatly varying from each other, highly abrasive solid bulk materials.

2. Results and discussion

The results of these studies are provided on figures 1 and 2 in the form of distribution diagrams for both the straight and curved portions (of turns) of the main pipeline. The analysis of these results enables us come to the following conclusions:

- Hydroabrasive wear of main pipelinwallinternal surfaces holds importance in any and all cases, therefore, it is unallowable to not give consideration to this factor in the methodology of calculating strength of pressure hydrotransportsystem main pipelines;
- Distribution diagram of hydroabrasive wear of main pipeline varies in each case (is of different types), this meaning that thickness of main pipeline walls changes (decreases) following various regularities, this being

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ensued by the fact that it is practically impossible to maintain the established mode with the same indexes of parameters during the experimental studies even for short-time intervals. This is due to the fact that in the case reviewedconcentration of the most important parameter – solid abrasive bulk material undergoes constant changes in carrying fluid material (water). Granulometriccompositionof the material, the shape of the solid bulk material particles and accordingly, abrasiveness and the level of abrasive impact on the main pipeline wall internal surface change constantly as well;

- In uniform conditions hydroabrasive wear of curvy (turn) portions of the main pipeline in more intensive than that of the straight portions (Figures 1 and 2).

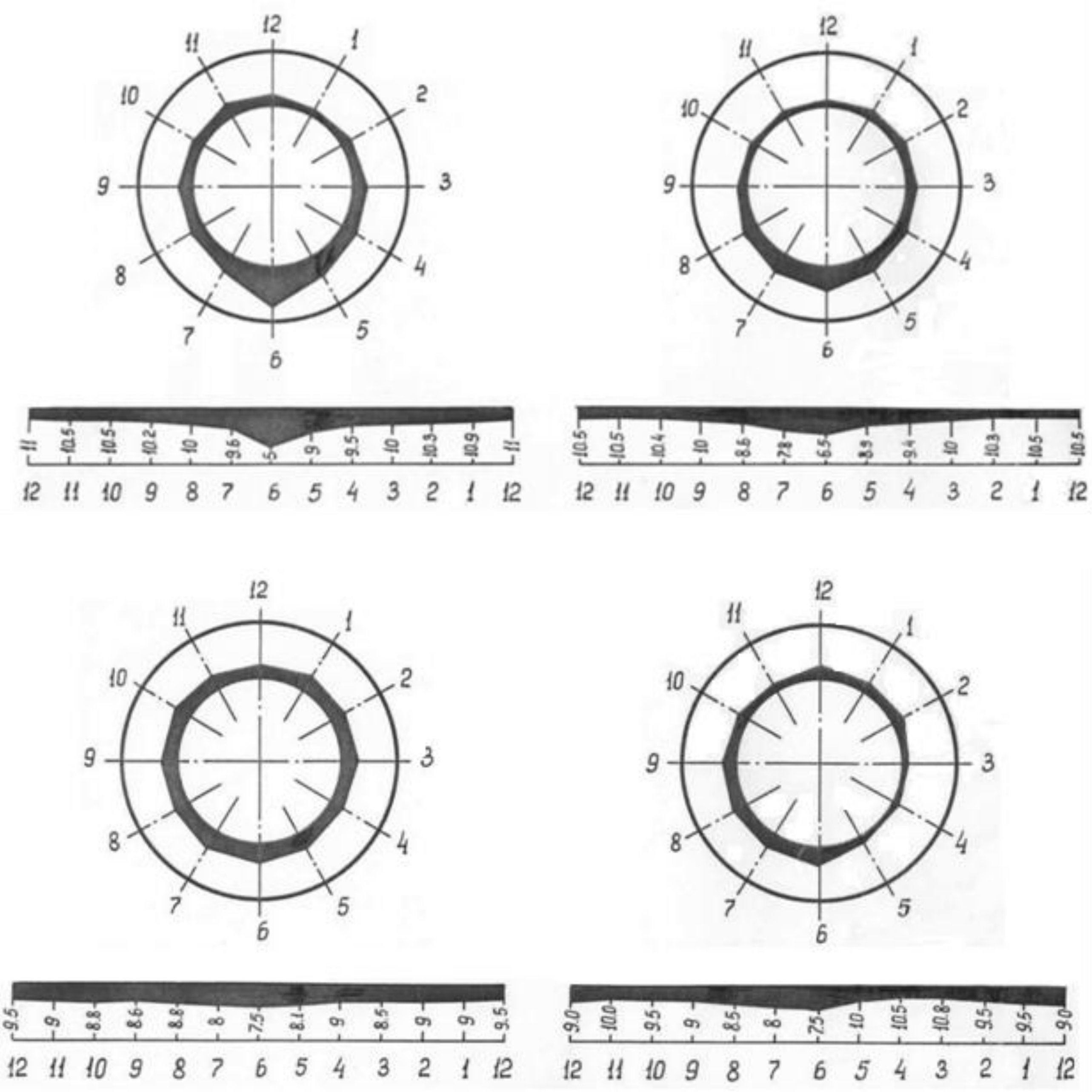

Fig. 1. Distributiondiagrams of hydroabrasive wear of hydrotransportsystem main pressure pipeline (D=426 mm) straight portion with slurry moving in them in various modes (with various parameters)

Similar large-scale studies were performed to study changes of pressures during transitional modes and non-stationary processes in multi-stage hydro transport systems on laboratory and large industrial objects.

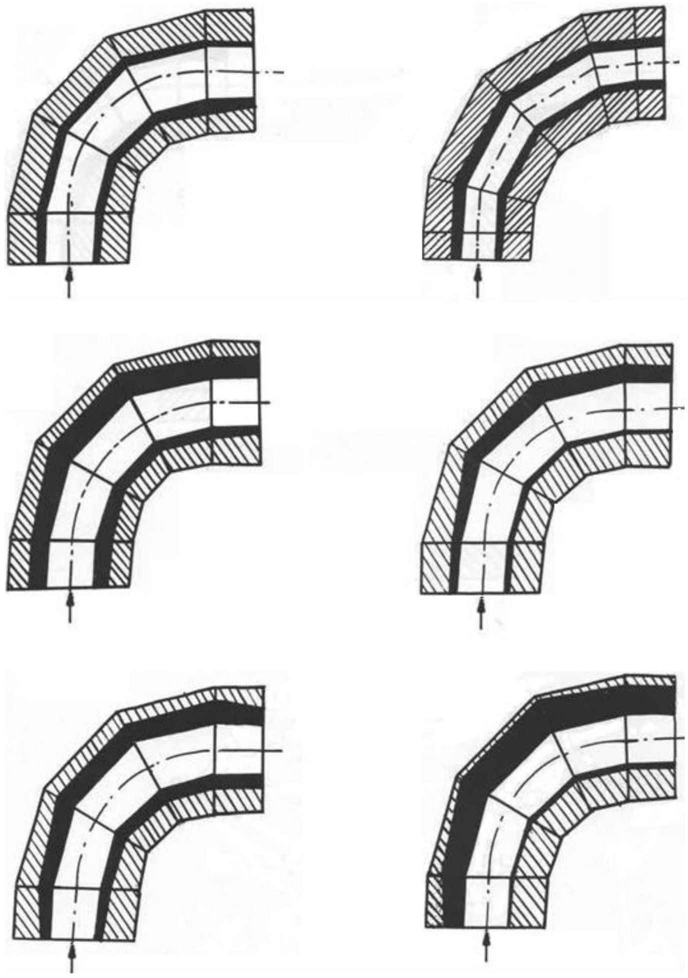

Fig. 2. Distribution diagrams of hydroabrasive wear of hydrotransportsystem main pressure pipeline (D=426 mm) curvy portion (of turns) with slurry moving in them in various modes (with various parameters)

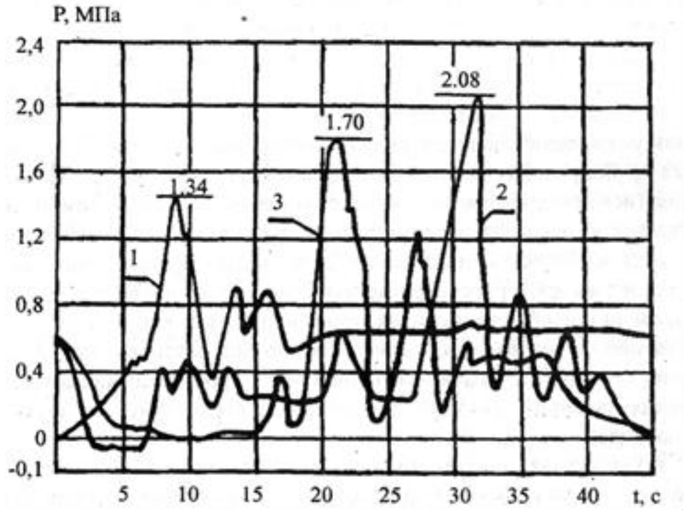

Fig. 3. Oscillograms of pressure changes in a 600 mm diameter main pipeline when 20P-11-type pumps are connected following the “pump in pump” scheme sequential circuit: 1 – when bringing them to operation; 2, 3 – when switching them off

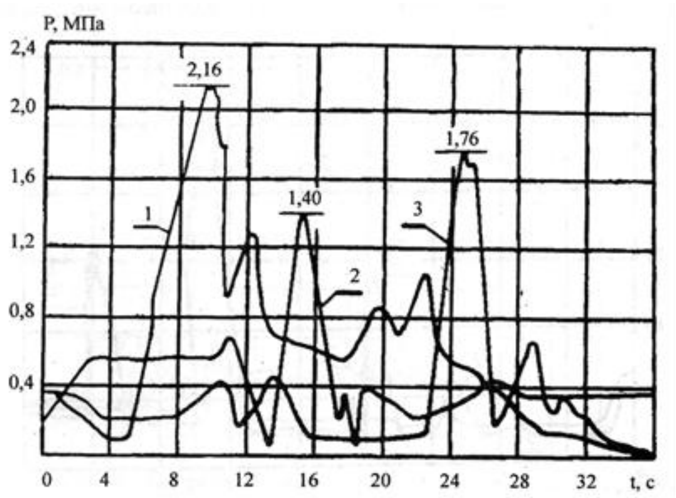

Fig. 4. Oscillograms of pressure changes ina 800 mm diameter main pipeline when 1000-80-type pumps are connected following the "pump in pump" schemesequential circuit:

1 – when bringing them to operation; 2,3 – when switching them off

3. Conclusions

The studies revealed that at the time of bringing to operation and switching off the pumps in main hydro transport systems working without breaking the stream of centrifugal pumps connected to main pipeline following a sequential circuit the numerical values of pressure changes significantly exceed their indexes during the established mode (Drawings 3 and 4), what negatively impacts the life cycle of the system as well as its reliability. Therefore, when designing similar systems, this factor should necessarily be given due consideration in the methodology of calculating the strengths of main pipelines.

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Some questions of mine safety of small mines in Hungary

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Abstract

Annual output of Hungarian underground coal mining has been obviously and continuously decreasing for the past four-five decades. Some events, e.g. reducing number of mines and especially longwalls, etc. were not really obvious, as they were real steps of modernizing mining technology. By the end of the 1980ies evident economic problems changed the perspective of the mines. Many of them joined to the neighboring thermal power plants and others operated as independent enterprises mostly for extracting household coal. The last coal mine, part of joint venture with a coal-fired power plant was shut down at the end of 2014. Only one small underground mine of low output and simple machinery are still in operation, sometimes having some difficulties from financial and environmental aspects. But fortunately several smaller mines operate economically. On the other hand a new safety regulation was issued some years ago for underground mining in Hungary. Questions of ability of small mines to meet requirements of this regulation are discussed in the paper.

Keywords: coal mining, ore mining, mining industrial minerals, small-scale mining, mine safety

Trends of coal, natural gas, crude oil and bauxite production of Hungary since 1960 are shown by Figure 1, according to the long-term data series of Hungarian Central Statistical Office. Mass of 1000 m^3 of natural gas was estimated 1 t by the authors.

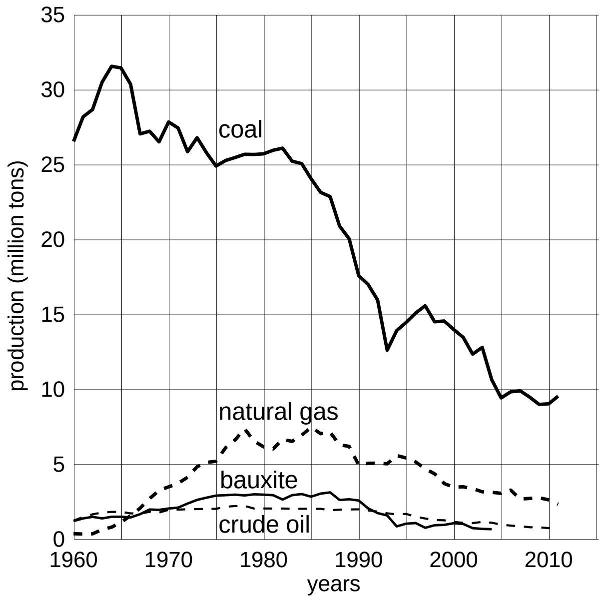

Fig. 1. Coal, natural gas, crude oil and bauxite production of Hungary since 1960 (KSH 2015b, *2015*)

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A new period began in Hungary after World War II, as there was no significant fuel source of the country but coal, so coal mining output increased continuously. Then numerous mines were shut down in the second half of the 1960ies. Only those ones were kept in operation which were suitable for operating mechanized longwalls. The sudden decrease of the production was avoided only by opening the first lignite opencast mine of approximately 7 million tons annual output. A slight increase could be found in the surface mining output during the past four decades, but production level of the underground mines has being decreased since the 1980ies. The last coal mine operating mechanized longwalls was shut down at the end of 2014. Similar trends could be found in the ore mining and to a less extent in the petroleum extraction as it is shown on Figure 1.

Periods of increase of the output, modernization and fall of the production can be observed in the Borsod coal basin northwest of Miskolc in the northeastern part of the country. This basin was the mined out the most household coal for heating. Summarized output of the mines and total (reduced) length of the coal faces, taking into account the periods when the longwalls were not in continuous operation can be seen on Figures 2 and 3.

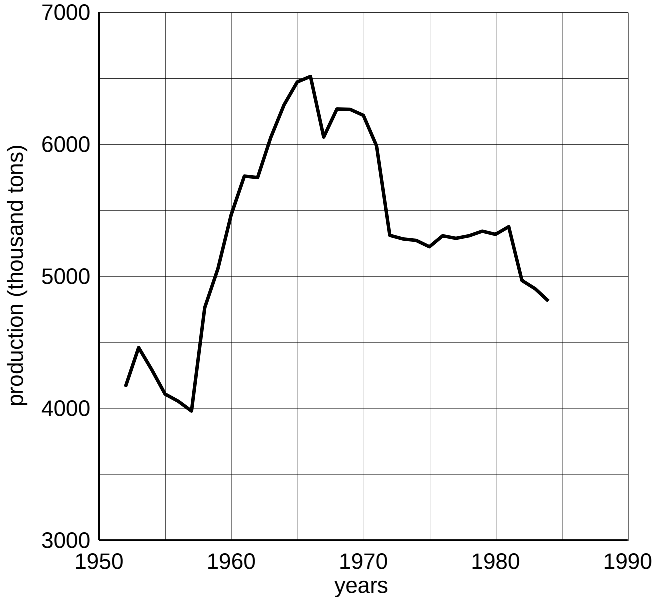

Fig. 2. Total mining output of the Borsod coal basin in North-Eastern Hungary (Bertalanfy et al., *1986*)

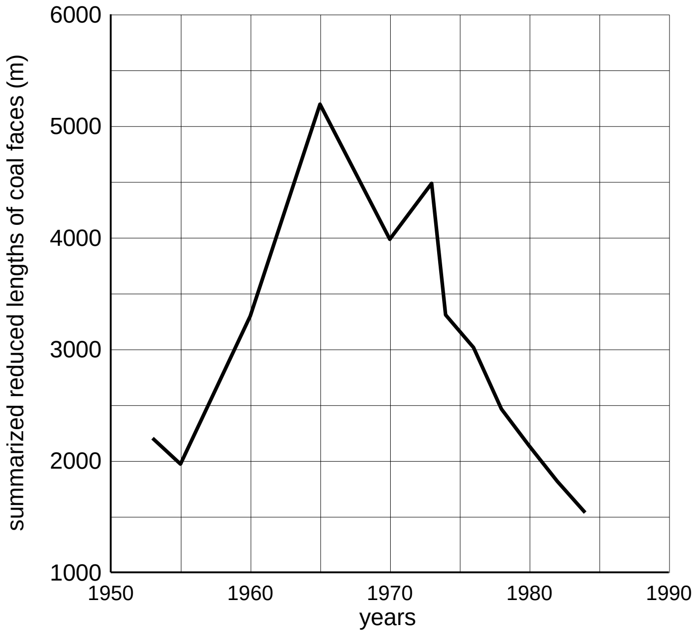

Fig. 3. Summarized reduced lengths of the coal faces in the Borsod coal basin in North-Eastern Hungary (Bertalanfy et al., *1986*)

Mineral reserve of some Hungarian coal basins which were mined during 100-200 years has really left. But there are some untouched areas which are explored, furthermore great areas which are suspected remarkable coal reserves. The main problem can be with these deposits that coal seams are geologically disturbed, deep and different mine hazards, such as methane and coal dust explosion, gas and rock outburst, karstic water inlet, etc. should be expected. This time opencast lignite mine can be considered profitable, but it is worth examining other ways of underground coal mining, e.g. underground coal gasification, shortwall mining, etc.

This time only one underground mine is in operation in Hungary. It is extracting a bauxite orebody and a coal seam covering it using the same room-and-pillar technology based on blasting and LHD machinery as bauxite mining. The coal is sold mostly for household heating purposes. Beside heating smaller houses, use of coal could be profitable in e.g. asphalt mixing plants, greenhouses, fertilizing, methanol and coke production, heat and power generation, etc. to make less dependent the country from importing fuel.

A short history of mine safety regulation

As it was demonstrated in the previous chapters, output of the mining sector of Hungary significantly decreased. Recently certain areas of surface mining, such as lignite and construction materials mining became dominant.

Number of employees decreased form approximately 80 000 to 10 000 during the past 25 years (including administrative staff). Consequently, scales of the mining operations are quite different from the ones that were usual formerly (Table 1). According to statistical statements, 328 of 428 Hungarian mining operations employ less than 20 persons (KSH 2015a, 2015*)*.

The first general mine safety regulation was issued in 1922 by the Budapest Royal Mining Authority. Originally it was valid only for the region of the Budapest authority, but the other authorities accepted and used it. It was replaced by a decree of the ministry of the interior in 1951 (625.625/1951. (VIII. 2.) BEM), which was obligatory as the first general mine safety and health preventing regulation. Chapters of this regulation changed from time to time and it was issued in book form in the 1980ies.

Remarkable changes could be observed in the legal regulation of the mining sector. The original version of the new mining law (XLVIII (1993)) entered into force in 1993 and was amended several times. Numerous decrees came out to complete the basic mining law serving Hungarian mine safety (Izsó, 2009). To be the most important ones are considered the following

- minimal requirements providing safety and protecting health in mines (4/2001. (II. 23.) GM),
- regulation of surface mine safety (43/2011 (VIII. 18. NFM),
- regulation of underground mine safety (61/2012 (XI. 22.) NFM), and
- general safety regulation of blasting of civil purposes (13/2010 (III. 4.) KHEM).

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Table 1. Number of mining operations as a function of number of employees (KSH 2015a, 2015*)*

Number of employees	Number of mines, employing this staff
1-9	341
10-19	42
20-49	30
50-249	13
more than 250	2
total:	428

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Most mine hazards occur in underground mining as it is obvious if extent of the texts are considered although not only number of mines and miners reduced but size of regulations too. Recent regulation of underground mine safety can be considered framework statute as it is significantly simpler than the former regulation, containing basic concepts of health and life protection. It is a little bit surprising that while concrete limitations of the concentration of some important explosive and poisonous gases (CH_4, CO_2, CO) in the mine atmosphere are determined, others (H_2S, NO_x, NH_3) are not regulated by this new version.

Results of mine safety regulation

It is important to analyse effects of regulations on both Hungarian and international mine safety. Nationalization of Hungarian mining was over in 1949. Significant development of heavy industry and political pressure after World War II resulted an increased fuel and electrical energy demand which endangered the whole sector. But only forced development of coal mining was continuous topic of the political speech.

Numerous disasters and accidents were resulted by the high level of manpower, unskilled labour, poor mechanization and mine safety conditions. Number of fatal accidents was rather high. The new basis of mine safety in Hungarian mining became General Mining Safety and Healthcare Regulation (Hungarian abbreviation: ÁBBEvSZ), the *625/1951 (VIII.2.) BEM: ÁBBEvSz* regulation issued by the minister of mining and energy affairs and then 3rd chapter of the new mining law in 1960 which described safety requirements, organization, technology, equipment and classification of the mines by mine hazards. Safety regulation was the very important reason of safer operations and less fatal accidents beside technical development (Kiss, 1976).

Especially remarkable improvement could be observed in underground coal mining as it was the most hazardous area of mining resulting most disasters. Furthermore international statistical studies of safety discuss coal mining in the mining sector separately.

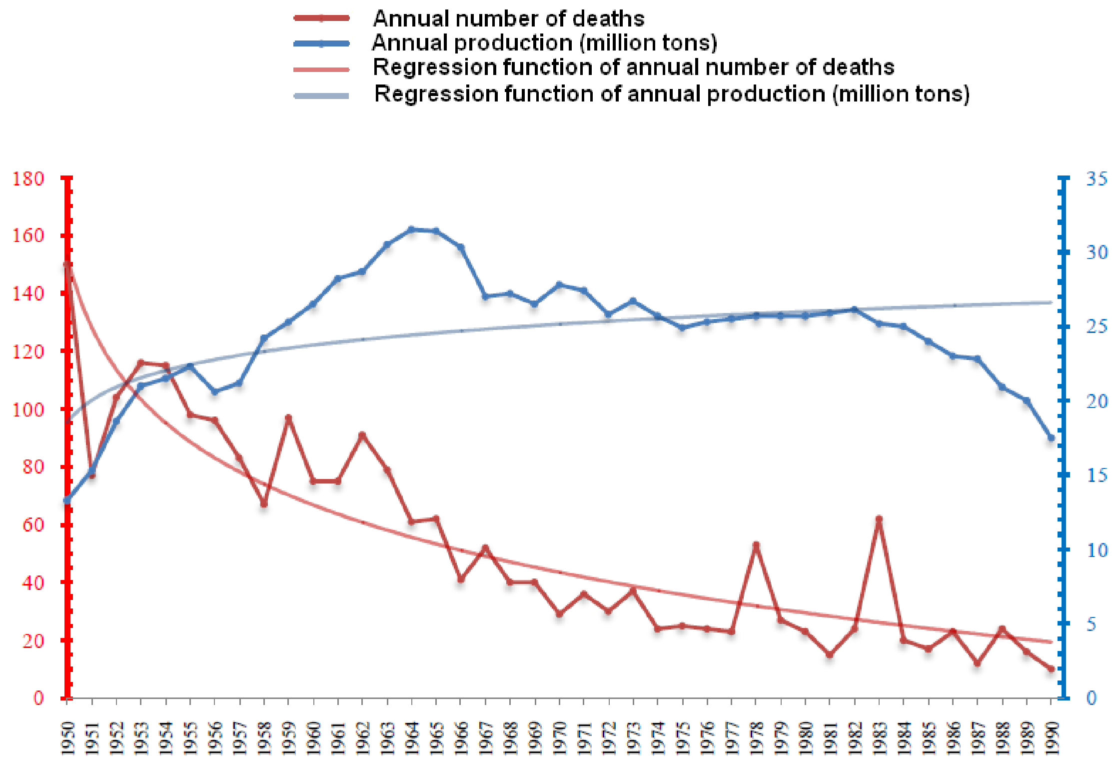

Fig. 4. Relationship between mining output and number of deaths in mine disasters (Szabados, 2011)

Number of employees amounted 49000 despite significant decrease of the output by 1990, but number of deaths did not exceed 10. Unfortunately role of underground operations in Hungarian mining is minimal, thus numbers of both accidents and deaths are minimal too as it is shown by Fig. 4.

A very favourable trend can be observed in the United States, which is one of the most significant coal producer of the world as safety regulations resulted a remarkable decrease of fatal mine accidents. Activity of Bureau of Mines that was established in 1910 could not reduce number of accidents. But federal regulation titled *Safety Standards for Bituminous Coal and Lignite Mines* (1947) ensured less than 1000 deaths annually (msha.gov 2016a, 2016). Further improvement was obtained by the *Federal Coal Mine Safety Act* in 1952, *Federal Coal Mine Health and Safety Act* in 1969 and *Federal Mine Safety and Health Act* in 1977 as it is shown by Fig. 5 (msha.gov 2016b, 2016). And finally the *Mine Improvement and New Emergency Response Act (MINER Act)* issued by the Bush administration in 2006 resulted an extremely low fatal accident rate by 2015 (msha.gov 2016c, 2016).

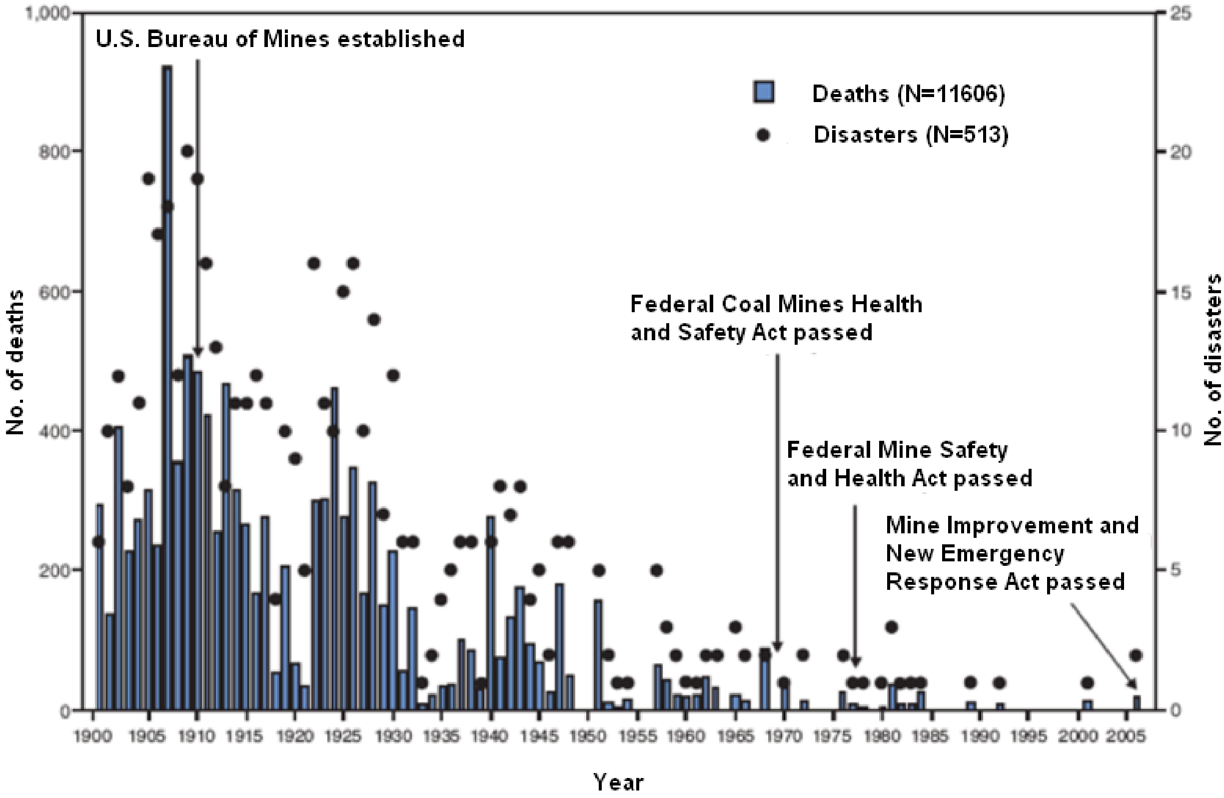

Fig. 5. Number of deaths and disasters in U.S. underground coal mining and milestones of mine safety regulation (cdc.gov , 2009)

Mine safety kits

There is an important question concerning small number of employees. Whether small firms able or not to employ specialists of higher education just for mine safety duties.

Beside these facts a serious challenge can be the ageing and continuous decrease of the experienced mineworkers and technicians from mine safety point of view as well.

Certain simplification of the mine safety regulation can be advantageous for the small underground mines. Further assistance can be a safety management kit provided by the state. Such expert system was worked out by New South Wales (NSW) Department of Primary Industries – Mineral Resources and The Institute of Quarrying Australia (resourceandenergy.nsw.gov.au, 2015), it can serve as an important and useful example. The basic aim of the Safety Management Kit for small-scale mines, quarries and extractive industry operations is to prevent mine accidents and assist mines to meet requirement of safety regulations.

The structure of the safety and management kit enables training miners and technicians of small and middle-sized mines to satisfy basic safety regulations and preparing their safety management plans (Mine Safety Management Plan - MSMP) and documentation. The document consist of the following 4 parts:

1. Information chapter, enlisting the mine hazards that should be expected in each mine of the state, protection methods and examples, responsibilities, areas of communication and training in the firm, documentation models.
2. Checklists, flow sheets and questionnaires helping working up all these are included in the second part.
3. A sheet is contained in the third part for the valuation of the safety plan (MSMP). Assistance of fellows of the NSW Mine Safety Operation bureau make development easier and more perfect.
4. A general list of tasks for controlling the safety condition of the working area, containing e.g. checking buildings, mobile and fix equipment, loaders, cleaning up, handling hazardous materials, etc.

The package in question was contributed by the state authorities and mines to ensure practical usage for the purpose in question. According to the experiences it proved to be useful to make safer small mining operations.

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Minimising the actuating power of multi-rope hoisting machinery

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Abstract

The specific energy consumption is mainly influenced by kinematics and dynamic measures of vertical transport installations as well as by the compatibility of different composing parts and their subcomponents. The optimisation of kinematics and dynamic parameters characterising a transport cycle is decisive considering the energy consumption. Also considering the operation of the vertical transport installations, as well as the character of the variation of kinematics and dynamic parameters during a race, it has been considered that one of the adequate optimisation methods of these parameters is the calculus of variations. In order to apply this calculus, the definition of the optimisation functional and restrictions is imposed. One of the basic performance parameters of the operation of the vertical transport installations is the specific energy consumption during a cycle. It therefore means that the optimisation of the transport cycle related to this parameter may be realised using a functional with a function under the integral depending on the electric energy consumption during a race.

Keywords: optimization; unbalanced installations; statically balanced installation; dynamically balanced.

1. General considerations regarding the calculus of variations

The purpose of the calculus of variations is the discovery of functions which may reach extreme values (either maximum or minimum), for some measures depending on them also called functional. The functional may be considered a generalisation of the analysis of some functions of a certain type in which the role of the variable being played by another function, such as:

$$\exists = \int_a^b f\left(x,y,y'\right)\,dx \tag{1}$$

Namely the defined integral of expression f which depends on the independent variable x, the searched function y(x) and its derivative y′. While functional (1) using the following sum:

$$\exists = \sum_{i=1}^{n} f\left(x_i; y_i; \frac{y_i - y_{i-1}}{\Delta x}\right)\Delta x \tag{2}$$

The issue is therefore the determination of the extreme of the function $Y(y_1, y_2, ..., y_n)$ of more variables. Higher as n will be as precise the approximation will be, getting closer to solving the problem of variations. If y(x) represents the extreme of functional (1), then the following is necessary:

$$f_y - \frac{d}{dt} f_{y'} = 0 \tag{3}$$

Relation also called Euler's equation. In the calculation of variations, functions are seldom met, which depend not only on the first one but also on the superior order derivatives of the determined function.

The aspects of these functions are:

$$\exists = \int_{x_0}^{x_1} f(x,\ y,\ y', y'',\ ...\ ,y^{(n)})\ dx \tag{4}$$

Therefore, the curve reaching an extreme value needs to satisfy the following equation:

$$f_y - \frac{d}{dx} f_{y'} + \frac{d^2}{dx^2} f_{y''} - .... + (-1)^n \frac{d^n}{dt^n} f_{y^{(n)}} = 0 \tag{5}$$

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For the case where functional (5) depends only on the first and second order derivatives and has the following form:

$$\exists = \int_{x_0}^{x_1} f(x, y, y', y'')\, dx \tag{6}$$

Function y = y(x) which realizes the extreme of functional ∃ is determined, and y and y′ are given in $x = x_0$ and $x = x_1$. Examining the effect on functional ∃ of a variation a of y with a small quantity δy which for function y(x) with its fixed ends satisfies the condition δy = δy′ = 0 when $x = x_0$ and $x = x_1$, the first variation of functional ∃ is:

$$\delta\exists = \int_{x_0}^{x_1} \left(\frac{\partial f}{\partial y}\delta y + \frac{\partial f}{\partial y'}\delta y' + \frac{\partial f}{\partial y''}\delta y'' \right) dx \tag{7}$$

If function ∃ takes an extreme value, then expression (7) becomes null. Integrating in parts the second and the third term in expression (54) in order to eliminate variations δy′ and δy′′, the following is obtained:

$$\delta\exists = \int_{x_0}^{x_1} \left(\frac{\partial f}{\partial y} - \frac{d}{dx}\frac{\partial f}{\partial y'} + \frac{d^2}{dx^2}\frac{\partial f}{\partial y''} \right) \delta y dx + \left[\left(\frac{\partial f}{\partial y'} - \frac{d}{dx}\frac{\partial f}{\partial y''} \right) \delta y \right]_{x_0}^{x_1} + \left[\frac{\partial f}{\partial y''}\delta y' \right]_{x_0}^{x_1} = 0 \tag{8}$$

If the limit conditions are imposed δy = δy′ = 0 for $x = x_0$ and $x = x_1$, then

$$\delta\exists = \int_{0}^{x_1} \left(\frac{\partial f}{\partial y} - \frac{d}{dx}\frac{\partial f}{\partial y'} + \frac{d^2}{dx^2}\frac{\partial f}{\partial y''} \right) \delta y dx = 0 \tag{9}$$

The above integral needs to be cancelled for all the admissible δy values, imposing that the expression in the parenthesis of relation (56) becomes zero:

$$\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'} \right) + \frac{d^2}{dx^2}\left(\frac{\partial f}{\partial y''} \right) = 0 \tag{10}$$

This expression is also known as Euler - Poisson’s equation. It is a fourth degree differential equation, the solving of which gives extreme values of function ∃.

2. Establishing the optimisation functional for single cable vertical transport installations powered by an asynchronous motor

The actual peripheral force is:

$$F_{ef} = \sqrt{\frac{\int_0^T F^2 dt}{T_{ef}}} \approx \sqrt{\frac{\sum F_i^2 t_i}{T_{ef}}} \quad [N] \tag{11}$$

Because function F(t) varies during different phases, the integral $\int_0^T F^2\, dt$ is solved separately for each phase:

$$\int_0^T F^2 dt = \sum_0^n \int_0^{ti} F_i^2 dt \tag{12}$$

According to the general equation of the dynamics of vertical transport installations, the force at periphery of the reeling organism is expressed using the following relation:

$$F = \left[kQ_u + (q - q_1)(H - 2x) \right] g \pm a\sum m \quad [N] \tag{13}$$

The functional based on which the electric energy consumption may be minimised during a race, may be established as follows:

$$\exists(x,a) = \int_0^T f(x,a)\, dt = \int_0^T F_i^2\, dt \tag{14}$$

In order to simplify expression (4) of the peripheral force, the following transformations are made:

$$F = kQ_u g + (q - q_1) g (H - 2x) + a\sum m$$

$$F = A + D(H - 2x) + a\sum m = A + DH - 2Dx + a\sum m \tag{15}$$

where $A = k \cdot Q_u \cdot g$; $D = (q - q_1) g$; only the positive sign has been considered for the acceleration.

By replacing the expression of the force it results:

$$f(x,a) = (A + DH)^2 - 4D(A + DH)x + 4D^2x^2 + 2a(A + DH)\sum m - 4Dx a\sum m + a^2\left(\sum m\right)^2 \tag{16}$$

Using the relation between the actual force and the quantity of heat developed within the reeling of the motor during a transportation cycle, the actual force expression (equivalent) may be used as an optimisation criterion. Therefore, between functional (1) and the actual force there is the following relation:

$$F_{ef} = \sqrt{\frac{\int_0^T F^2 dt}{T_{ef}}} = \sqrt{\frac{\int_0^T f(x,a) dt}{T_{ef}}} \tag{17}$$

The beginning and the end of a transport cycle are characterised by the following conditions:

$$x(0)=0;\ x(T)=H;\ v(0)=0;\ x^{'}(T)=v(T)=0 \tag{18}$$

3. Restrictions on the transport cycle

In optimising the parameters of the transport cycle the respect of a series of technical prescriptions is imposed in order to ensure the continuous operation in full safety conditions. The variation of kinematics parameters (speed and acceleration) during a transport cycle is defined by the diagram of speed (tachogram) as well as by the diagram of the acceleration, characterised by the relations:

$$\begin{gathered}
\int_0^T x^{'}(t)dt=\int_0^T v(t)dt=H\leftrightarrow a)\\
x^{'}(0)=v(0)=x^{'}(T)=v(T)=0\leftrightarrow b)\\
x^{'}(t)=v(t)\le v_{adm}\leftrightarrow c)\\
x^{''}(t)=\frac{dv(t)}{dt}=a\le a_{adm}\leftrightarrow d)\\
x^{'''}(t)\le\rho_{adm}\leftrightarrow e)\\
\frac{t_2}{T}\ge 0.6\leftrightarrow f)
\end{gathered} \tag{19}$$

Conditions (19, a) and (19, b) define the requirements regarding movement and speed: at the end of the cycle, the space undergone by the transport enclosures has to be equal to the length of the transport race; the speed, both at the beginning of the movement as well as at the end of the race has to be null. Conditions (19, c) and (19, d) are defined by the technical prescriptions regarding the speed limit and acceleration with their maximum admissible values. Condition (19, e) limits the maximum value of the variation of the force within the time unit, seldom used measure during the automated control of vertical transport installations. Condition (19, f) is imposed by the cooling off of the electric motors through their own ventilation. The power of the actuating motor needs to satisfy the following criteria:

$$P_{ef}=\frac{F_{ef}\cdot v_{max}}{1000\,\eta_a}=\frac{v_{max}}{1000\eta_a}\sqrt{\frac{\int_0^T F^2dt}{T_{ef}}}\le\ P_M \tag{20}$$

$$\frac{P_{max}}{P_{ef}}\ =\ \frac{F_{max}}{F_{ef}}\ \le\ \gamma \tag{21}$$

where:

γ is the overload admissible coefficient ($y=1,6\div1,8$ for asynchronous motors; $y=1,8\div2,0$ for continuous current motors); F_{max} is the maximum value of the peripheral force appearing during the transport race; P_{max} is the power corresponding to the maximum force.

Two models based on relations (17) and functional (1) may be used for the optimisation:

- The optimisation model with the limit conditions (19, a) and (19, b);
- The optimisation model with all the kinematics restrictions imposed by the motor given by relations (17) and (18).

The first model covers criterion (11) and the limit conditions (16). A practical model needs therefore to consider all the restrictions, such as the second one foresees.

Therefore the amendment of functional (11) and the optimisation criterion (15) needs to be made, dividing the transport cycle in several according to the expression:

$$F_{ef}=\sqrt{\frac{\sum_{i=1}^{n}\int_{t_{ii}}^{t_{fi}}F^2dt}{T_{ef}}}=\sqrt{\frac{\sum_{i=1}^{n}\int_{t_{ii}}^{t_{fi}}f(x,a)dt}{T_{ef}}}\quad[N] \tag{22}$$

where: n is the number of phases of the extraction cycle; t_{ii} is the beginning of all n phases; t_{fi} is the ending of all n phases.

4. The extremes of the optimisation functional; Euler-Poisson equations of the functional

The establishment of the function characterising the law of variation of space x(t), considering that the integral (1) represents a superior order function related to the first derivative, may be made using the Euler-Poisson equation. The equation (223) adapted for the present case is:

$$\frac{\partial f}{\partial x}-\frac{d}{dt}\left(\frac{\partial f}{\partial x'}\right)+\frac{d^2}{dt^2}\left(\frac{\partial f}{\partial x''}\right)=0 \tag{23}$$

Obtaining therefore:

$$\frac{d^4x}{dt^4}+\frac{4D}{\Sigma m}\frac{d^2x}{dt^2}+\frac{16D}{(\Sigma m)^2}x=\frac{2D(A\text{-}DH)}{(\Sigma m)^2} \tag{24}$$

or

$$\frac{d^4x}{dt^4}+\lambda\frac{d^2x}{dt^2}+\frac{\lambda^2}{4}x=\psi \tag{25}$$

where $\lambda=\frac{4D}{\Sigma M}$ and $\Psi=\frac{2D(A\text{-}DH)}{(\Sigma m)^2}$.

Considering that the difference in weight between the transport cable and the balance one is characterised by D, three cases may be distinguished in solving the above presented equation

a) $D=g\left(q-q_1\right)>0$ - unbalanced installation; the roots of equation (25) are real;

b) $D=g\left(q-q_1\right)<0$ - dynamically balanced installation; the roots of equation (25) are imaginary;

c) $D=g\left(q-q_1\right)=0$ - statically balanced equation.

For D = 0, based on expressions (17) and (24) the following are obtained:

$$\frac{d^4x}{dt^4}=0 \tag{26}$$

<u>Unbalanced installation (D > 0)</u>

For this case, the solutions of equation (26), space, speed, acceleration and the third derivative of space in relation to time are the following:

$$\left.\begin{aligned}
&x=e^{\alpha t}\left(C_1+C_2t\right)+e^{-\alpha t}\left(C_3+C_4t\right)+\beta;\\
&x'=v=C_1\alpha e^{\alpha t}+C_2e^{\alpha t}\left(1+\alpha t\right)-C_3\alpha e^{-\alpha t}+C_4e^{-\alpha t}\left(1-\alpha t\right);\\
&x''=a=C_1\alpha^2e^{\alpha t}+C_2\alpha e^{\alpha t}\left(2+\alpha t\right)+C_3\alpha^2e^{-\alpha t}+C_4\alpha e^{-\alpha t}\left(\alpha t-2\right);\\
&x'''=\rho=\alpha^3e^{\alpha t}\left(C_1+C_2t\right)+3C_2\alpha^2e^{\alpha t}-\alpha^3e^{-\alpha t}\left(C_3+C_4t\right)+3C_4\alpha^2e^{-\alpha t}.
\end{aligned}\right\} \tag{27}$$

where: $\alpha=\sqrt{\left|-\frac{\lambda}{2}\right|}$; $\beta=\frac{4\psi}{\lambda^2}$

C_i – integration constancies, i = 1; 2; 3; 4.

<u>Statically balanced installation (D = 0)</u>

For this case, the solutions of equation (26) are:

$$\left.\begin{aligned}
&x=C_1+C_2t+C_3t^2+C_4t^3 \quad x''=2C_3+6C_4t\\
&\quad x'=C_2+2C_3t+3C_4t^2 \quad x'''=6C_4
\end{aligned}\right\} \tag{28}$$

where C_i are integration constancies, i = 1; 2; 3; 4.

<u>Dynamically balanced equation (D < 0)</u>

In this case, the solutions of equation (26) may have the following form:

$$\left.\begin{aligned}
&x=\cos\alpha t\left(C_1+C_2t\right)+\sin\alpha t\left(C_3+C_4t\right)+\beta;\\
&x'=v=\sin\alpha t\left(-C_1\alpha-C_2\alpha t+C_4\right)+\cos\alpha t\left(C_2+C_3\alpha+C_4\alpha t\right);\\
&x''=a=\cos\alpha t\left(-C_1\alpha^2-C_2\alpha^2t+2C_4\alpha\right)-\sin\alpha t\left(2C_2\alpha+C_3\alpha^2+C_4\alpha^2t\right);\\
&x'''=\alpha^3\left(C_1+C_2t\right)\sin\alpha t-\alpha^3\left(C_3+C_4t\right)\cos\alpha t-3C_2\alpha^2\cos\alpha t-3C_4\alpha^2\sin\alpha t.
\end{aligned}\right\} \tag{29}$$

where: $\alpha=\sqrt{\left|-\frac{\lambda}{2}\right|}$; C_i are integration constancies, i = 1; 2; 3; 4.

4.1.Optimum transport cycle with limit conditions

Mathematically speaking, the optimisation of the transport cycle consists in founding the function x(t), the law of movement, ensuring the minimum of the integral:

$$F_{ef} = \sqrt{\frac{\int_0^T f(x,a)dt}{T_{ef}}} = \min$$

The case of unbalanced installations (D > 0)

Based on the solution of the equation given by expression (15) and the initial conditions, a four equation system is formed in order to determine the integration constancies. Following the solution of this equation system, the integration constancies are:

$$\left.\begin{aligned} C_1 &= -C_3 - \beta \\ C_2 &= 2C_3\alpha - C_4 + \alpha\beta \\ C_3 &= \frac{a_3}{a_1} - \frac{a_2}{a_1}C_4 \\ C_4 &= \frac{a_1 b_3 - a_3 b_1}{a_1 b_2 - a_2 b_1} \end{aligned}\right\} \qquad (30)$$

$$\left.\begin{aligned} a_1 &= e^{-\alpha T} - e^{\alpha T} + 2\alpha T e^{\alpha T} \\ a_2 &= Te^{-\alpha T} - Te^{\alpha T} \\ a_3 &= H - \beta + \beta e^{\alpha T} - \alpha\beta T e^{\alpha T} \\ b_1 &= \alpha e^{-\alpha T} + 2\alpha^2 T e^{\alpha T} + \alpha e^{-\alpha T} \\ b_2 &= e^{-\alpha T} - \alpha T e^{-\alpha T} - e^{-\alpha T} - \alpha T e^{\alpha T} \\ b_3 &= -\alpha^2 \beta T e^{\alpha T} \end{aligned}\right\} \qquad (31)$$

The case of statically balanced installations (D = 0) Proceeding analogically, based on the solution of the equation given by expression (28), the integration constancies are:

$$C_1 = C_2 = 0; C_3 = \frac{3H}{T^2}; C_4 = -\frac{2H}{T^3} \qquad (32)$$

The case of dynamically balanced installations (D < 0) Considering the relations (17), the values of the integration constancies are:

$$C_4 = \frac{a_1 b_3 - a_3 b_1}{a_1 b_2 - a_2 b_1}; C_3 = \frac{a_3}{a_1} - \frac{a_2}{a_1} C_4$$
$$C_2 = -C_3\alpha; C_1 = -\beta \qquad (33)$$

where:

$$a_1 = \sin\alpha T - \alpha T\cos\alpha T; a_2 = T\sin\alpha T$$
$$a_3 = H - \beta + \beta\cos\alpha T;$$
$$b_1 = \alpha^2 T\sin\alpha T + \alpha T\cos\alpha T$$
$$b_2 = \sin\alpha T + \alpha T\cos\alpha T; b_3 = -\alpha\beta\sin\alpha T \qquad (34)$$

4.2 The optimum transport cycle with all technological restrictions

Functional (10) will be adjusted with all the restrictions (6) imposed by the kinematics installation. Considering a three period transport cycle, where the second period is characterised by constant speed, the limit conditions for each period may be explained as follows:

During the first period (the acceleration period)

$$x(0) = 0; \quad x(t_1) = h_1; x'(0) = v(0) = 0$$
$$x'(t_1) = v(t_1) = v_{max} \qquad (35)$$

During the second period (constant speed operation)

$$x(t_1) = h_1; \quad x(t_1 + t_2) = h_1 + h_2$$
$$x'(t_1) = v(t_1) = x'(t_1 + t_2) = v(t_1 + t_2) = v_{max} \qquad (36)$$

During the third period (the deceleration period)

$$x(t_1+t_2)=h_1+h_2; \quad x(t_1+t_2+t_3)=H$$
$$x'(t_1+t_2)=v(t_1+t_2)=v_{max}$$
$$x'(t_1+t_2+t_3)=v(t_1+t_2+t_3)=0 \tag{37}$$

where:
- t_i - represents the duration of the corresponding periods;
- h_i – is the distances undergone by the extraction containers during different periods.

In the same time, relations (35), (36) and (37) also need to comply with the following requirements:

$$t_1+t_2+t_3=T; h_1+h_2+h_3=H$$
$$\frac{t_2}{T}\geq 0,6$$

5. Adopted optimisation model

According to the expression (22), the following optimisation model based on the equivalent force is adopted:

$$F_{ef}=\sqrt{\frac{\sum_{i=1}^{3}\int_{t_{ii}}^{t_{fi}} f(x,a)dt}{T_{ef}}}=\min(!) \tag{38}$$

The conditions from the start and the end of the cycle:

$$x(t_{1,1}=0)=0; \quad x(t_{f3}=T)=H$$
$$x'(0)=v(0)=0; \quad x'(T)=v(T)=0 \tag{39}$$

The requirements the actuating motor needs to comply with:

$$P_{ef}=\frac{v_{max}}{1000\eta_a}\sqrt{\frac{\sum_{i=1}^{3}\int_{t_{ii}}^{t_{fi}} f(x,a)dt}{T_{ef}}}\leq P_M; \frac{P_{max}}{P_{ef}}\leq\gamma \tag{40}$$

Restrictions imposed on periods:

For the starting period:

$$0\leq t\leq t_1; 0\leq x(t)\leq h_1; 0\leq x'(t)\leq v_{max}$$
$$a_{1min}\leq x''(t)\leq a_{1max}$$
$$x'''(t)\leq|\rho_{1max}|; \quad x(0)=0; \quad x(t_1)=h_1$$
$$x'(0)=v(0)=0; \quad x'(t_1)=v(t_1)=v_{max} \tag{41}$$

For the second period of constant speed operation:

$$t_1\leq t\leq t_1+t_2; h_1\leq x(t)\leq h_1+h_2$$
$$x'(t)=v_{max}=\text{const.}; x''(t)=0$$
$$x(t_1)=h_1; \quad x(t_1+t_2)=h_1+h_2 \tag{42}$$

For the deceleration period:

$$t_1+t_2\leq t\leq T; h_1+h_2\leq x(t)\leq H$$
$$0\leq x'(t)\leq v_{max}; |a_{3min}|\leq x''(t)\leq|a_{3max}|$$
$$x'''(t)\leq|\rho_{3max}|$$
$$x(t_1+t_2)=h_1+h_2; \quad x(T)=H$$
$$x'(t_1+t_2)=v(t_1+t_2)=v_{max};$$
$$x'(T)=v(T)=0 \tag{43}$$

Considering the expressions of x, x' and x'', the aspect of functional (16) for different balance degrees will be:

Unbalanced installation (D > 0)

$$f(x,a) = (A+DH)^2 - 4D(A+DH)\left[e^{\alpha t}(C_1+C_2t) + e^{-\alpha t}(C_3+C_4t)+\beta\right] +$$
$$+4D^2\left[e^{\alpha t}(C_1+C_2t)+e^{-\alpha t}(C_3+C_4t)+\beta\right]^2 +$$
$$+2(A+DH)\sum m\left[C_1\alpha^2e^{\alpha t}+C_2\alpha e^{\alpha t}(2+\alpha t)+C_3\alpha^2e^{-\alpha t}+C_4\alpha e^{-\alpha t}(\alpha t-2)\right]-$$
$$-4D\sum m\left[e^{\alpha t}(C_1+C_2t)+e^{-\alpha t}(C_3+C_4t)+\beta\right]\cdot\left[C_1\alpha^2e^{\alpha t}+C_2\alpha e^{\alpha t}(2+\alpha t)+C_3\alpha^2e^{-\alpha t}+C_4\alpha e^{-\alpha t}(\alpha t-2)\right]+$$
$$+\left(\sum m\right)^2\left[C_1\alpha^2e^{\alpha t}+C_2\alpha e^{\alpha t}(2+\alpha t)+C_3\alpha^2e^{-\alpha t}+C_4\alpha e^{-\alpha t}(\alpha t-2)\right]^2 \tag{44}$$

The C_i integration constancies are determined using relations (30) and (31).

Statically balanced installation (D = 0)

$$f(x,a) = A^2 + 2A\sum m(2C_3+6C_4) + (2C_3+6C_4)^2\left(\sum m\right)^2 \tag{45}$$

The C_i integration constancies are determined using relation (32).

Dynamically balanced installation (D < 0)

$$f(x,a) = (A+DH)^2 - 4D(A+DH)\left[(C_1+C_2t)\cos\alpha t + (C_3+C_4t)\sin\alpha t+\beta\right]+$$
$$+4D^2\left[(C_1+C_2t)+e^{-\alpha t}(C_3+C_4t)+\beta\right]^2+$$
$$+2(A+DH)\cdot\sum m\left[C_1\alpha^2e^{\alpha t}+C_2\alpha e^{\alpha t}(2+\alpha t)+C_3\alpha^2e^{-\alpha t}+C_4\alpha e^{-\alpha t}(\alpha t-2)\right]-$$
$$-4D\sum m\left[e^{\alpha t}(C_1+C_2t)+e^{-\alpha t}(C_3+C_4t)+\beta\right]\cdot$$
$$\cdot\left[C_1\alpha^2e^{\alpha t}+C_2\alpha e^{\alpha t}(2+\alpha t)+C_3\alpha^2e^{-\alpha t}+C_4\alpha e^{-\alpha t}(\alpha t-2)\right]+$$
$$+\left(\sum m\right)^2\left[C_1\alpha^2e^{\alpha t}+C_2\alpha e^{\alpha t}(2+\alpha t)+C_3\alpha^2e^{-\alpha t}+C_4\alpha e^{-\alpha t}(\alpha t-2)\right]^2 \tag{46}$$

The C_i integration constancies are determined using relations (32) and (33). Therefore, considering the three phases of the transport cycle, the numerator of expression (38) of the equivalent force may be written as follows:

$$\sum_{i=1}^{3}\int_{t_{ii}}^{t_{fi}} f(x,a)dt \;=\; \int_0^{t_1} f(x,a)dt \;+\; \int_{t_1}^{t_1+t_2} f(x,a)dt \;+\; \int_{t_1+t_2}^{T} f(x,a)dt \tag{47}$$

Considering the large volume of calculations, the digital integration of the components of expression (47) is imposed.

6. Example

Based on the proposed method a C language software has been developed. Software which was tested for an extraction installation with cages with the following parameters:

- practical load extracted during a race: Q_u = 6000 kg;
- extraction depth: H = 480 m;
- the sum of reduced masses: Σ m = 66368 kg;
- specific weight of the extraction cable: q = 5,77 kg/m;
- specific weight of the balance cable: q_1 = 6,72 kg/m;
- maximum acceleration at starting: $a_{1\,max}$ = 0,8 m/s^2;
- maximum acceleration in breaking: $a_{3\,max}$ = 1 m/s^2;
- maximum extraction speed: v_{max} = 9,35 m/s;
- operational period of extraction containers: T = 62 s;
- pause period between races: t_p = 20 s;
- transmission efficiency: η = 0,92.

In order to obtain a maximum efficiency, the following have been considered:

$$\frac{t_2}{T} \;=\; 0{,}6 \text{ and } t_1 = \; t_3 = \; 0{,}2\cdot T.$$

Eliminating q_1 for the unbalanced case and considering q_1 = q for the statically balanced one, minimum values of the equivalent force and the actuating power have resulted with approximately 10% smaller than the classic method. Figure 1 presents a print screen of the results obtained.

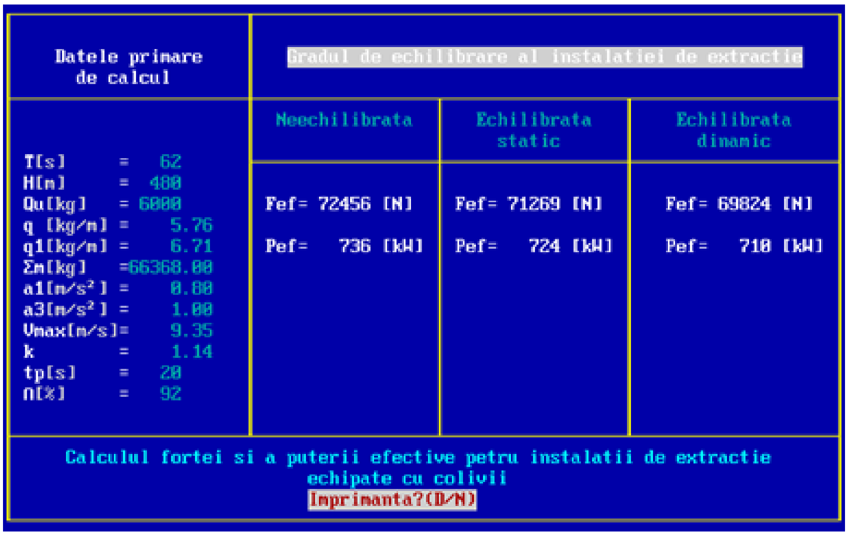

Fig.1 Print screen of obtained results for an extraction installation with cages

7. Conclusions

- Analysing the optimisation trials of electric operation of extraction installations, presented in the speciality literature, it is observed that these are valid only for trapezoid tachograms (with constant accelerations and linear variation of speed in extreme periods). There is no certainty that this type of variation is optimum for ensuring the value of the minimum power. Imposing from the beginning a trapezoid form of the tachogram does not have any scientific justification, being made empirically;
- In order to minimise the actuating power of the extraction installations, the method of the calculus of variations is used, establishing an adequate mathematical model;
- In order to use the proposed optimisation method, the definition of the optimisation and restriction functional was imposed. The optimisation functional is based on the peripheral force of the cable actuating organism results from the general equation of dynamics;
- The solutions of Euler-Poisson equations of the optimisation functional differ depending the degree of balance of the installation;
- The important determination volume for integrating the optimisation functional implies the use of computers. The software developed in C language and also experimented proved itself to be a fast tool for practical calculations;
- The proposed method is an operative and precise one and may serve to verify and design the extraction installations, determining the optimum functional parameters.

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Analysis of the possibilities of sliding conveyor belts used in mining, the drums drive as its source of ignition fire

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Abstract:

Modern drives are still with motorare induction, with the possibility of change in speed by using appropriate electronic components capable of starting slow. Any belt conveyor drive the construction of the station has one or more engines, one or more reducing placed properly drive a drum or two drums.

Keywords: conveyor, slip, source of ignition, tractive effort;

1. Main text

Movement and thus tractive effort from the drum / drums drive of the conveyor belt is transmitted to friction. In literature are theoretical and experimental studies on the theory of transmission friction efforts, taking into account to Euller's relationship:

$$S_i = S_d \cdot e^{\mu \cdot \theta}, N \qquad (1)$$

hence the effort is transmitted:

$$F_0 = S_i - S_d = S_d (e^{\mu \cdot \theta} - 1), N \qquad (2)$$

For the analysis of environmental transmission of efforts was drafted their purge is shown in the following figure.

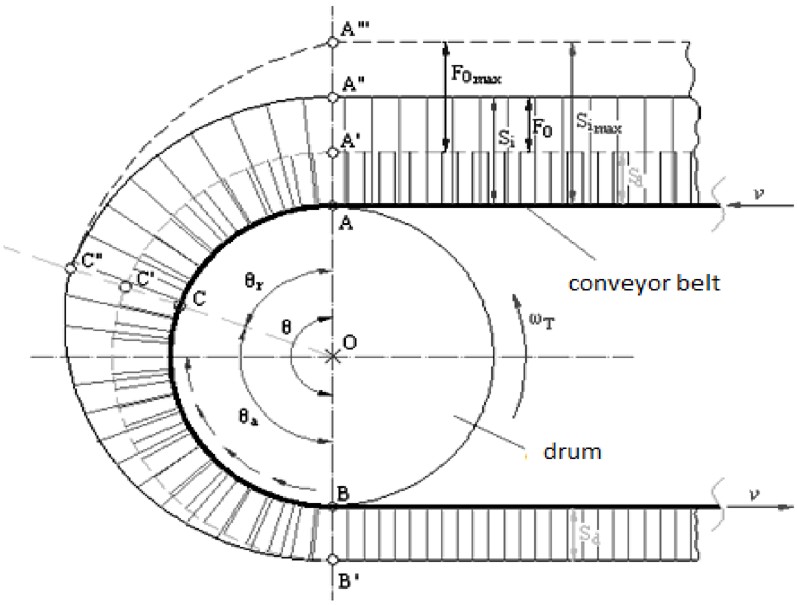

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Fig. 1. Purge efforts conveyor belt

In figure 1 the following symbols have been used:

O – the center of rotation of the drum drive;

A – the point of winding of the belt on the drive drum;

B - point the conduct of the drive belt on the drum;

C - point limit deformations conveyor belt;

S_d – effort from point swing band on drums, in *N*;

S_i – point effort of wrapping tape on pipe, in *N*;

$S_{i\max}$ – maximum effort possible on pipe wrapping tape, in *N*;

F_0 - effort (force) of traction;

$F_{0\max}$ - effort (force) of the traction maximum possible;

Curve $B'C'A'$ - circle, limit curve (extreme) lower;

Curve $B'C''$ - exponential curve;

Curve $C''A''$ - circle;

Curve $B'C''A'''$ - limit curve (extreme) higher;

Curve $B'C''A''$ - real curve (graphics, continuous blue line);

θ - the tape winding angle on the drum drive (for example in the above figure, θ=180°);

The winding angle of the tape drum drive is divided into two, delimiting an area of relative rest between the tape and an area where landslides occur partial (elastic elongation), so:

θ_r - relative angle rest area;

θ_a - partial angle landslide area.

a. If θ_a= 0 => θ=θ_r and accordingly the winding effort S_i and deployment effort S_d there are equal and therefore according to the relation $F_0 = S_i - S_d = S_d\,(e^{\mu\cdot\theta} - 1), N$ traction effort F_0 = 0, which means it does not transmit any traction effort. In these circumstances conveyor belt will not work.

b. Assuming the other extreme situation, namely θ_r=0 => θ=θ_a which means that elastic deformations of the strip due to landslides will cover the entire contact surface of the drum and belt. In this case, the maximum effort is transmitted, well $S_i = S_{i\max}$ and as a consequence $F_{0\max} = S_{i\max} - S_d$. Basically it means that the transmission is done with maximum efficiency efforts being made possible maximum value of tractive effort. Instead slippage occurs on the pipe band (drum will rotate and the band would stand still) leading to a high friction, heating and lighting conveyor belt.
It follows therefore that this situation should be avoided because of the danger of ignition conveyor belt.

c. From the foregoing it follows that in practice the two angles θ_r and θ_a does not have to be 0, namely, θ_r≠0 , θ_a≠0 total wrap angle θ=θ_r+ θ_a , which leads to the lawfulness expressed to Euller relationship $S_i = S_d \cdot e^{\mu\cdot\theta}, N$.
Looking at the overall shape of the Euler relationship that is amended:

$$S_i = S_d \cdot e^{\mu\cdot\theta_a}, N \tag{3}$$

this relationship and could also write:

$$k_s \cdot S_i = S_d \cdot e^{\mu\cdot\theta} \tag{4}$$

where:k_s is the safety factor on the conveyor belt slippage on drums engines.

This form of relationship has practical use as carrier during operation θ_a it has variations around the base and can not determine directly.

In the two relationships above were used following elements:

$e^{\mu\cdot\theta}$ - traction factor (drive) of the drum (drums) engines;

$e = 2{,}718$ - base of the natural logarithms;

μ - coefficient of the friction between the bank and pad drum drive;

But as values, $S_i = S_d \cdot e^{\mu\cdot\theta}$, so, $\frac{k_s \cdot S_i}{S_i} = \frac{S_d \cdot e^{\mu\cdot\theta}}{S_d \cdot e^{\mu\cdot\theta_a}}$, namely:

$$k_s = \frac{e^{\mu\cdot\theta}}{e^{\mu\cdot\theta_a}}$$

whence $k_s \cdot e^{\mu\cdot\theta_a} = e^{\mu\cdot\theta}$ and $\ln k_s \cdot \mu \cdot \theta_a = \mu \cdot \theta$

In the final: $\theta_a = \frac{\theta}{\ln k_s}$

If you write the system of equations $\begin{cases} S_n = f(S_1) \\ k_s \cdot S_n = S_1 \cdot e^{\mu \cdot \theta} \end{cases}$, and resolves, results S_1 şi S_n, apoi $S_2 \ldots S_{n-1}$.

Scheme drive of roller belt conveyors

Analysing Euler's relationship, namely: $k_s \cdot S_i = S_d \cdot e^{\mu \cdot \theta}$, it can be seen that the traction effort which will be:

$$F_0 \cong S_i - S_d = \frac{S_d}{k_s} \cdot e^{\mu \cdot \theta} - S_d \,, \tag{5}$$

whence:

$$F_0 \cong S_d \cdot \left(\frac{e^{\mu \cdot \theta}}{k_s} - 1 \right), N \tag{6}$$

Traction effort is all the greater the higher is S_d, μ, respectively θ.

S_d - effort conveyor belt at the point of deployment on the drum drive has limited value, since increasing his lead to increased efforts all around the conveyor, drive power and band request.

If we analyze the friction coefficient– μ, between conveyor belt and drum, it appears that it has values $\mu=0,1...0,3$ (the minimum values for wet and dry conditions the maximum);

If the drive steel drum is covered with rubber coating, contact with drum / rubber band / rubber, we will have: $\mu=0,3...0,5$ (the minimum values for wet and dry conditions the maximum). If contact is made corrugated rubber / rubber (the drive drum is coated with rubber inclined embossed channel), then μ will increase to values $\mu=0,35...0,55$;

Using metal-ceramic materials for lining drum drive, μ will grow, respectively: $\mu = 0{,}6 \ldots 0{,}8$ (0,6– for wet conditions; 0,8 – for dry conditions).

It can be said that basically the friction coefficient μ it is between 0,1 and 0,8, but growth is limited and the probabilities of F_0 is reduced.

The angle of wrap θ offers the greatest scope for increased tractive effort F_0, what can be achieved with different winding schemes of the tape on the head drum drive motor of the conveyor.

In practice the angle of winding has the value $\theta=180°...270°$, in the case of a single drive drum, respectively $\theta=360°...540°$, the use of two drums drive schemes.

When used at both ends of the conveyor operation (rarely used in practice) may be made by winding angles of more than 1000^0. In addition, the possibility of using more than two drums drive is not used in practice due to reduced effort drum transmitted third, fourth, etc., plus the total number of drums that wraps tape on a tour displacement increases exaggerated leading to premature belt wear and fatigue.

In figure 2 are examples of simple drive schemes, and they are representative. There are dozens of possible schemes and practices.

Figure 3 presents a more complicated scheme, which used a band aids that weigh belt conveyor drum extra drive. This scheme applies rarely in practice.

F_N – the tension in the auxiliary strip.

In this case Euler's relationship is amended:

$$k_s \cdot S_i = (S_d + \mu \cdot F_N) \cdot e^{\mu \cdot \theta} \tag{7}$$

Analyzing the diagrams in figure 2, follows a series of observations, namely:

1. Schemes a), b) and c) have one drum drive and schemes d), e), f) and g) have two drive drums;
2. Schemes a), d) and f) have a small number of drums, while other schemes have a greater number;
3. Schemes a), b), f) and g), the tape drive reaches the surface of the non-working drums (free), the scheme c) with the working surface (in contact with the material) and the diagrams d) and e) of the drum reaches the tape drive both surfaces.

To secure and efficient operation of the conveyor is recommended:

1. Number of drums is minimized to ensure high durability as carpet tape;
2. Sending a tractive effort as possible to ensure rational operation efficiency;
3. Maintaining the safe operation of the conveyor in terms of the risk of slipping and therefore the danger of ignition strip;
4. Ensure maximum possible friction in the given conditions.

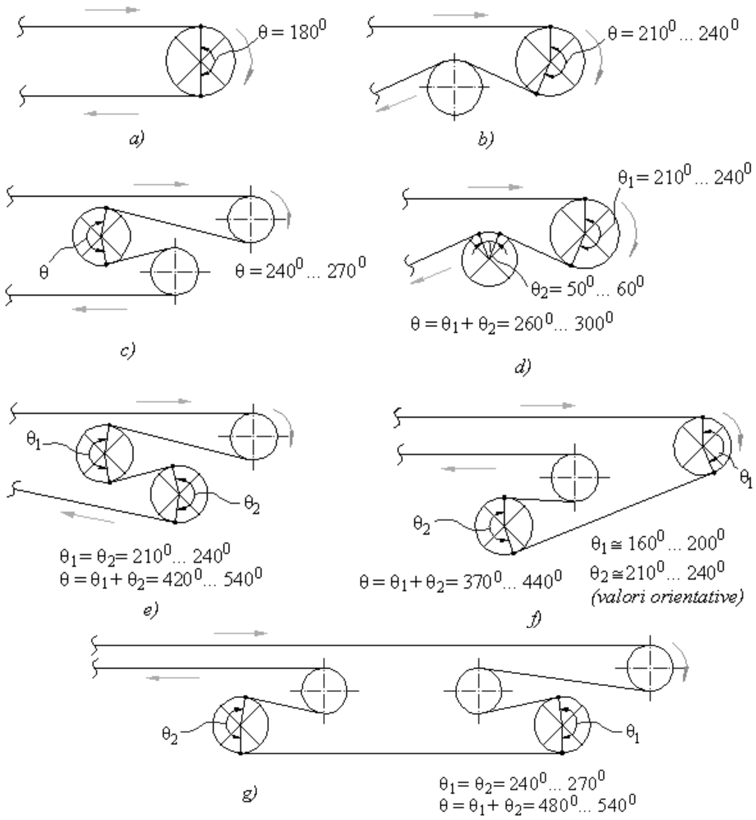

Fig. 2. Winding scheme of the tape head actuator

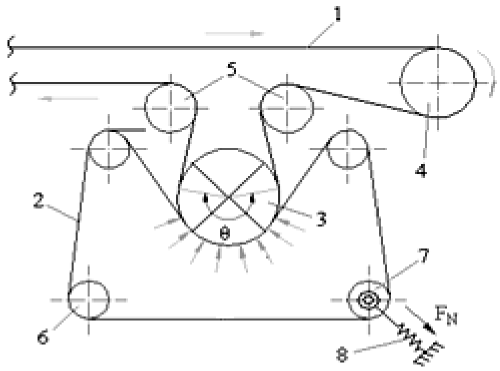

Fig. 3. Winding scheme of the tape head actuator
1 – transport band (main band); 2 – band aids (push); 3 – drive drum (the main strip); 4 – download drum; 5 – deflection drum the main band; 6 – diversion drum band aids (auxiliary);7 – tensioning belt drum helpful (sliding); 8 – elastic belt tensioner helpful.

Conclusions

Therefore we can say that thanks to it slipping and ignition conveyor belt can be avoided if these conditions imposed in the design, manufacture and operation. Hence for the given conditions, the carrier selected must be verified by concrete calculations, where will result and ensure the normal functioning of the conveyor belt without the risk of ignition from the technical reasons listed above.

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Current status on the manufacture of conveyor belts and their resistance to fire

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Abstract:

Material handling systems are the backbone of a modern mining operation, without efficient transport, production can be seriously affected. Transport efficiency depends largely trouble working lifetime of the conveyor belt itself, but the conditions under which it must operate can be extremely difficult, given resistance, impact, abrasion, bacteria, acid, water, fire and general mechanical damage.

The construction of a conveyor belt used in mining, should we assume that the tape used is a generator element of fire nor should help its propagation.

Conveyor belt is the most expensive element of the conveyor, which is up to 70% of the conveyor cost and whose life depends mainly on economic efficiency of using belt conveyors.

Keywords: conveyor belt, resistance, flammability;

1. Main text

The main conditions that must be met for conveyor belts are as follows:

- large longitudinal tear resistance;
- flexibility longitudinal (the winding drums) and transverse (to take the form of riverbed);
- transverse stiffness limited to not open too much between two stands roller;
- longitudinal elastic deformations and permanent as low as workload;
- peeling strength due to crossing drums and reels;
- puncture resistance (for large lumps of rock);
- high resistance to wear once the material to be transported;
- minimized wettability;
- resistant to rotting;
- splicing as smooth;
- high stability to the increases temperature;
- autoflammability;
- not electrostatic load;
- preservation of characteristics at low temperatures 30...40°C;
- stability against aging due environment.

Construction of textile reinforced conveyor belt

Inserts with cotton or rayon warp the great advantage that they both small elastic elongation and permanent and good grip with rubber. Inserts of this kind in the form of fabrics are used mainly for demountable joints.

Warp cotton inserts, it is recommended cotton fiber type long karakum have reduced specific tensile, of 600...900 *N/cm* width of the insert, and when they warp yarn thick can reach 1800 *N/cm*, at the same time increasing the

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thickness of the insert up to 2...2,5 *mm*. For this reason meet the small-scale mining.

Warp insertions of the artificial silk (rayon) have the tensile strength of 1,5...2,5 times higher than that of cotton, on the other hand they have the main disadvantage that they are hygroscopic, and lose water by imbibing 30...50% of resistance. It is therefore recommended to be used only to transport dry materials under conditions of low humidity. They require good maintenance coating rubber inserts unveiled as can absorb moisture from the atmosphere directly.

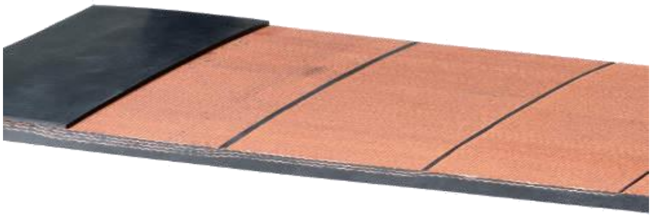

Fig. 1. Textile reinforced conveyor belt

These types of conveyors are not resistant to high temperatures that can occur due to friction with drums engines because both cotton and synthetic inserts are inflammable.

Construction of the conveyor belt with synthetic inserts

Are widely used conveyer belts having cord insertion longitudinal (warp) yarns of polyester synthetic that provides a specific tensile strength inserts of 1500...8 000 *N/cm* (strength of the strip reaches to the 40...50 kN/cm), have greater flexibility and fatigue, are not susceptible to moisture penetration to the conveyor belt and have very small permanent elongation (practically does not appear creep) and the elastic elongation are 2% under workload. For normal workload, laboratory tests are done at a load equal to 10% of tensile strength. Group of polyester fibers (terylene, diolen, tergal, decron etc), best behave terylene fibers, which have high toughness and resistance to abrasion. As drawback of polyester fibers remain relatively high elastic elongation under load variation, which requires a great race tightening device transport is great length.

Fig. 2. Conveyor belt with synthetic inserts

The elongation of the elastic strips reinforced with synthetic fibers can be reduced by pre-tensioning the tape at a high temperature during the manufacturing process.

Some companies strip mill thermostable at high temperatures, which cord, glass fiber, or asbestos.

Currently, the use of glass fibers which have very high tenacity, elongation very small and are resistant to high temperatures. The use of these fibers for large conveyor length is retained by their high price, especially because they are energy-intensive. The study also found positive using aramid fibers which have resistance to breaking of 2800 N/mm^2 and elongation at break of only 4%, instead it remains to solve the high price and rubber grip.

A new trend in construction is the conveyor belts instead of multiple insertions are woven unitary, monolithic, having warp consists of several rows of thick wires high strength polyester, polyamide, terylene or nylon and are linked together by a common tinsel made of polyamide. Each weft cord bind either all the rows of the longitudinal or in pairs, which means 1 with 2-2 with 3-3 with 4 etc. These bands, which have specific tensile strength of 3 000-10 000 *N/cm* and widths up to 1300 *mm*, it has advantages over those with multiple inserts:

- have smaller thickness to the same strength (6...13 *mm*);
- remove the exfoliation phenomenon;
- have greater flexibility, both longitudinal and transverse;

- rubber has better adhesion to such fabrics;
- have lower elongation;
- more resistant to impact loads;
- strip edges are more resistant to wear;

maximum size pieces of material that can be transported is slightly larger than the other bands, for the same width thereof are cheaper.

Construction of the conveyor belt reinforced with steel wires

Fig. 3. Conveyor belt reinforced with steel wires

The housing consists of strips of steel cords embedded in a mass of elastic typically have on both sides 1-2 inserts cotton fabric or synthetic aromatic polyamide fibers (usually perlon), which have high elongation and resistance to flame. They are designed to take hits from pieces of material, to ensure cross-resistance rubber band and protect against cutting of the cable passing over drums.

In addition to having high breaking strength, steel cord belts also presents advantages that have smaller thickness and diameter drums requires approximately 25% less than the bands inserts have longitudinal flexibility and especially larger cross (side rollers may be inclined to 45...50°), better take the hits, from large pieces of material have low elongation (0,15...0,3%), allow easy control of the cables even during operation of the conveyor, have higher speed of transmission of the traction force and can be reconditioned easier (and may reach a total duration of life to 10 years, which equals 2 ... 3 times higher than normal bands). These conveyors belts have the following drawbacks to the inserts: cross-resistance are small, have greater mass (1.5 ... 2 times), joint heads band is made more difficult, and in places where it is uncovered damage to cables through protective layers of rubber and mine water enters wear out quickly.

Tensile strength, ignition, elasticity, advantages - disadvantages in using conveyors

The carcase of textile inserts or cords of steel, which is the resistance element of the conveyor belt, has a protective coating. This coating is usually made of rubber, which has the advantage that it is very elastic. Instead lights at moderately elevated temperatures (even only due to friction at high speed band on drums or other objects) and has relatively low resistance to mechanical wear of the material. To increase the flammability resistance band, different rubber is mixed with additives such as silicon and chloroprene. They started to use on a larger scale conveyors coated materials with high resistance to mechanical wear, which usually based on polyvinylchloride. Their disadvantage is that it limits the maximum angle of transport is 16...18°, as the material slides easily (if rubber reaching 20 °); cold vulcanization is difficult because it needs 12 hours for hardening; they are less flexible than rubber, which is why the tapes are used particularly with high resistance to tearing, which is wound on large diameter drums. The coating of these bands is 55 ... 60% polyvinyl chloride and 30% of substances which provides elasticity at low temperatures. The limits of operating temperatures frequently encountered are from -25 ° to + 60 ° C for the rubber strip and from -20 ° to + 50 ° C for the polyvinyl chloride.

Textile reinforced conveyor type Gj, with high resistance, are made to C.A.T.C. Pitești, and their working temperature range between -30 ° and + 40 ° C, and fluctuations in temperature can reach -40 ° and + 70 ° C. There are designed to transport minerals, coal, gravel and sand. Conveyor belt type O2, intended for normal working conditions (transport coal, sand and gravel) has a temperature range of -25 ° to + 40 ° C, and the tips can reach temperatures from -30 ° to + 70 ° C. Conveyor belt type ST with steel wires can work at ambient temperatures between -30 ° and + 60 ° C.

If temperatures are low coated tapes are used natural rubber, which does not lose its flexibility to -45 °.

The thickness of the protective coating (top, bottom and sides) is based on the working conditions of the tape and should have a life span equal to the strength of the housing (insertions or steel wires). Higher protective coating is recommended to have 3 ... 5 mm thick when transporting coal, limestone etc. into small pieces, and 6 ... 12 mm when transporting abrasive materials such as limestone and countries, sandstone, minerals etc.. This coating is recommended to increase and tilt transporto¬rului, lower shroud inserts strips has thickness of 1 ... 4 mm (commonly 2 ... 3 mm), recommending maximum value for hard conditions. Protective coatings on both sides of the cable bands, as well as those based on polyvinyl chloride have equal thickness (both sides are working by turning lane), but not exceeding 8 mm (10 mm rarely reach). Some firms running and strip steel cables that have higher protective coating thickness up to 16 mm (on request up to 30 mm), and the lower (non-working) by 8 mm.

When transporting abrasive material (even in small pieces) especially inclination, there is a rapid aging of the coating superior in the middle of the strip. For such cases, some firms that insert upper strip mill or two inserts are placed above the two strips in marginal areas, lacking in the middle of the band that ensures a thicker layer of coating. In marginal areas, instead of the upper insertion strips may find rows of textile cord or steel cables. In this way, there is also a strengthening of the strip edges especially needed when transporting lumps.

Conveyor belts are delivered in pieces with length of several tens of meters up to 200 ... 300 m joints can be demountable or not. Demountable joints are commonly used in semi-stationary conveyor, which lengthen or shorten periodically, but can also be used in stationary conveyor when conditions are not curing, or when joint operation must be performed in a short time. They have the advantage that the running light, for 20 ... 60 min, and without the need for complicated equipment or not at all. Lengthening or shortening also allow quick and easy assembly and dismantling only band without a cut.

Conclusions

There are recognized very few tests carried out in the country about the risk of ignition of conveyor belts used in mining. This is due to the complexity of equipment for testing, challenging and varied conditions in which it operates and the environment (temperature differences, humidity, drafts etc.) that may generate unexpected developments of the emergency situation caused.

Worldwide were conducted similar research but their results can not be taken because the technology manufacturing belt and a belt conveyor design differs depending on the manufacturer. Some of the results are under secrecy and waiting until their publication is prejudicial and irrelevant, if one takes into account technological advances and market dynamics in general.

Fire safety testing is based on the premise that a band should not be a fire, it would be hard to ignite and if was ignited by an external source of fire should not propagate this one.

Tests on conveyors to assess their compliance with fire safety standards are associated with the following four specific hazards:

- Friction testing
- Laboratory test flame
- Fire test in gallery
- Electrical resistance test

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Research regarding the reliability of subassemblies and mechanical energy losses of the centrifugal pumps

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Abstract

Mine dewatering and water supply works of the equipment (batteries cyclone etc.) of coal preparation are made using centrifugal pumps. Subassemblies wear during operation of these pumps determines stops and production losses; beside this aspect the centrifugal pumps mechanical efficiency are low reason for which it is necessary their pursuit into operation to establish the reliability and improve their energy efficiency. In the paper are quantified some mechanical performances about the reliability of subassemblies and components of energy balance real hourly of the centrifugal pumps.

Keywords: centrifugal pumps, failures, reliability parameters, mechanical losses, energy efficiency;

1.Introduction

Dewatering a mine [Georgescu et al],[Patrascu and Vatavu], can be done using centrifugal pumps type turbo-pump characterized by axial and radial leaving by of scheme of figure 1.

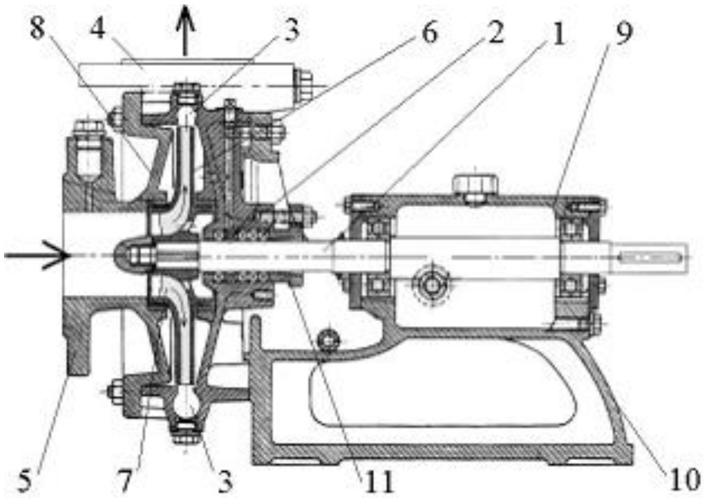

Fig. 1. Centrifugal pump: 1-shaft ; 2-sealing system ; 3-volute chamber ; 4-discharge flange ; 5-aspiration flange ; 6-pump impeller ; 7-rotor blades ; 8-pump casing ; 9-bearing block ; 10-pump support ; 11-gland

Hydro-cyclone batteries supply from coal preparation is done with type Warman centrifugal pumps with capacity of 550 m^3/h and the discharge height over 45 m. The importance of studying the wear and failure of the centrifugal pumps subassemblies (fig.2) result from the influence they exert these aspects on continuity of the technological flows, In this

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context the reliability analyzes can be sources of knowledge and improvement of the design and management of various industrial technological lines.

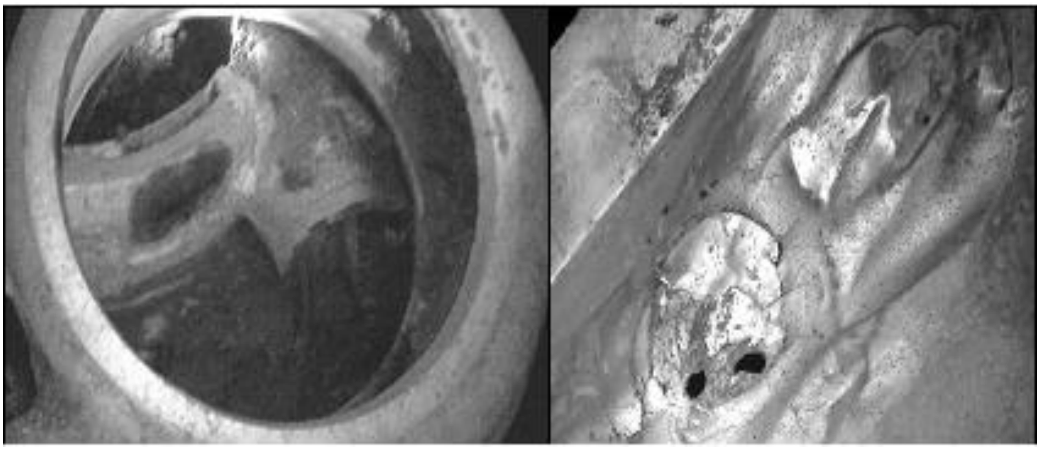

Fig. 2. Worn subassemblies of the pump Warman

2.Determining the parameters of reliability for certain subassemblies of the centrifugal pumps

The calculation of the reliability parameters it constitutes a methodology including the steps and analytical relations corresponding scope using databases resulting from long pursuit of the functioning of centrifugal pumps Warman.

1.1 Calculation of reliability of the Warman pump bearing housing

The expression of reliability [3] for exponential distribution is:

$$R(t_i) = e^{-\lambda \cdot t_i} \tag{1}$$

where, λ –failures rate

In the table 1 are given values of operating time between failures T_f and time for repair T_{rem}, for n=14 events (in increasing order)

Table 1. Values of operating time between failures and time for repair

T_f [hours]	7	7	21	28	35	56	105
T_{rem} [min]	30	30	30	30	30	30	40
T_f [hours]	175	231	245	392	413	742	1890
T_{rem} [min]	50	60	60	60	60	100	110

The mean operating time between failures is,

$$M[t] = \frac{\sum_{i=1}^{n} T_{f_i}}{n} = \frac{4347}{14} = 310.5 \text{ [hours]}$$

In the case of exponential distribution, failures rate will be:

$$\lambda = \frac{1}{M[t]} = \frac{1}{310.5} = 0.00322 \text{ [hours}^{-1}\text{]}$$

The theoretical distribution function is:

$$F(t_i) = 1 - e^{-\lambda \cdot t_i} \tag{2}$$

and the distance between experimental and theoretical functions will be,

$$d = |F_e(t_i) - F(t_i)| \tag{3}$$

In the case of bearing housing, it is found that the law of exponential distribution validates according to concordance test Kolmogorov (table 2) because:

$$d_{max} = 0.2471 < \frac{1.36}{\sqrt{n}} = \frac{1.36}{14} = 0.363$$

Value of mean time to repair is:

$$MTR = \frac{\sum_{i=1}^{n} T_{r_i}}{n} = \frac{721}{14} = 51.4 \text{ [min]}$$

Table 2 Values of experimental and theoretical functions

No.	Interval size Δt	Average value t_i	Number of failures n_i	Relative frequency $f(t_i)$	Cumulative frequency $F_c(t_i)$	Distribution function $F(t_i)$	Distance d
1	0-391	195.5	10	0.7142	0.7142	0.4671	0.2471
2	391-782	586.5	3	0.2142	0.9284	0.8487	0.079
3	782-1173	977.5	-	-	0.9284	0.9570	0.028
4	1173-1564	1368.5	-	-	0.9284	0.9878	0.059
5	1564-1955	1759.5	1	0.0714	0.9998	0.9965	0.003
			n=14				

For different values of the operating time, the values of reliability are given in table 3.

Table 3. Variation of reliability of the bearing housing according to operating time

t [hours]	50	100	150	200	250	300	350
R(t)	0.851	0.724	0.616	0.525	0.447	0.380	0.324
t [hours]	400	500	600	700	800	900	1000
R(t)	0.275	0.199	0.144	0.104	0.076	0.055	0.039

In a similar way it was established reliability of other subassemblies of the pump (figure 3) such as transmissions belts, seals, etc. Shall be made in evidence, in this way, the components with the weakest operating results like seals and bearings.

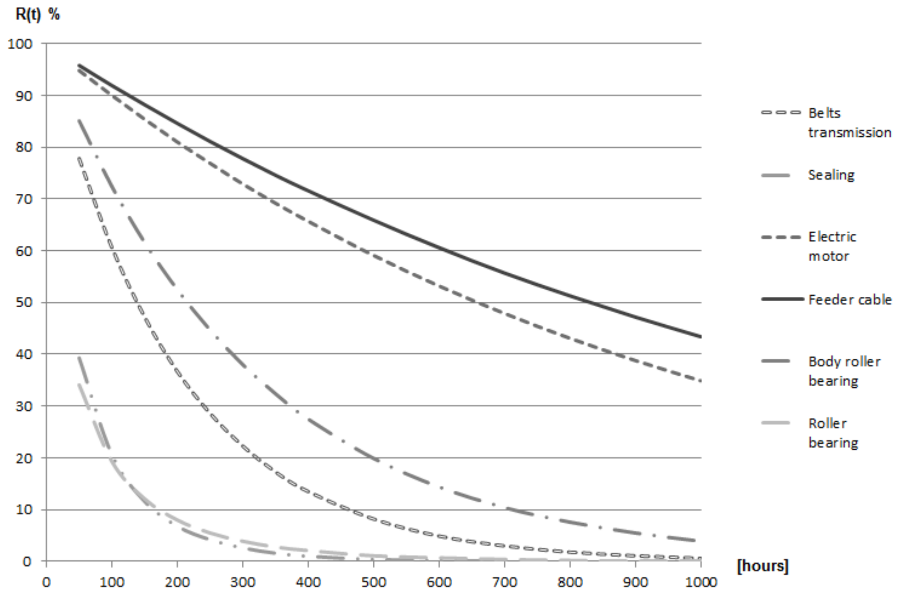

Fig. 3. Variations the reliability of the pump Warman subassemblies with defects

Knowledge reliability and maintenance activities contribution [Florea] to reduce energy consumption, should be seen as part of determining energy performance. For this purpose the question is achieve pumps energy balance.

3.Hourly energy balance of centrifugal pumps

The balance sheet elements have been determined for a centrifugal pump 5.5 kW with following technical characteristics [5]:

- $Q=150\ m^3/h$;
- $H=5\ m$;
- $P_{engine}=5.5\ kW$;
- Pump shaft power $P_{ps}=4.086\ kW$;
- Mechanical efficiency $\eta_m=0.82$;
- Hydraulic efficiency $\eta_h=0.70$;
- Volumetric efficiency $\eta_v=0.87$;
- Total pump efficiency $\eta_p=0.50$.

Mechanical efficiency, η_m takes into account the mechanical losses due to friction in the bearings and the elements of shaft and hydraulic efficiency, η_h depends losses hydraulic pump, due to friction between the fluid and the walls that come in contact all the way, from entry to exit pump.

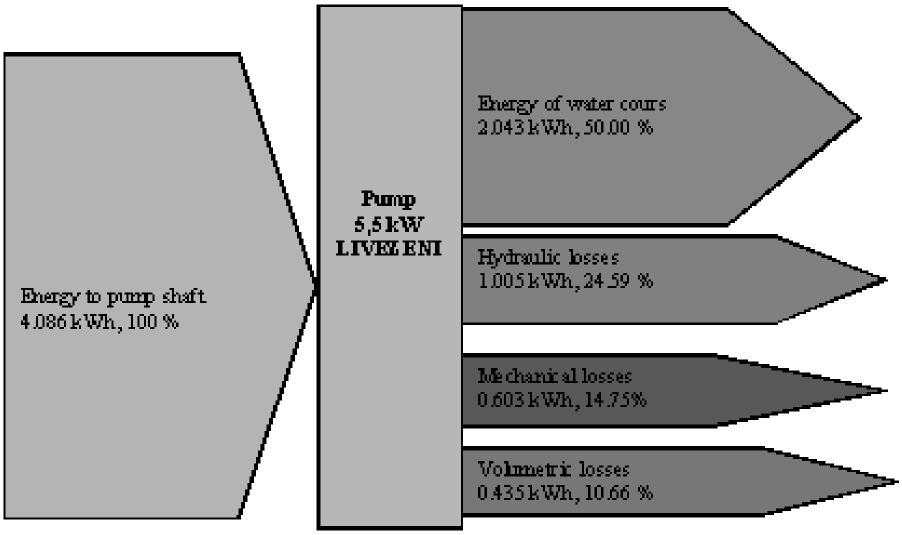

Fig.4. Sankey diagram for a centrifugal pump

The total hydraulic, mechanical and volumetric losses represents 50% of energy available to centrifugal pump shaft analyzed. Element bearings and sealing elements is not only sources of energy losses but also the high costs of spare parts. For a production of over 500,000 tons coal washing, cost of spare parts required centrifugal pumps are 280,000 lei from which element bearings and sealing elements is 50%, which underlines the necessity of timely quality revisions and repair such equipment.

4.Conclusions

Mechanical efficiency of the centrifugal pumps, depends on the mechanical losses due to friction depends on bearings and sealing elements so as to increase this parameter should be used in the execution of their, new material with anti-friction properties.

The cost of purchasing the pump is only a small part of total for their life cycle. Maintenance is a significant cost but the majority of operating costs come result from the energy consumption.

Making evident the contribution of maintenance activities in connection with reliability to reduce energy consumption of centrifugal pumps represents a modern approach to the problems regarding to finding solutions to improve equipment availability. Subassemblies that have low reliability causing interruptions in operation, energy losses and additional maintenance activities, respectively high costs.

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Tests on inertisation of oil sludge resulted from oil extraction activities

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Abstract

In the industrial activity occurr in many cases technical incidents followed by crude oil contamination of adjacent areas, ie liquid petroleum products. Spreading liquid petroleum products to the soil surface may have negative effects on both the subsoil and groundwater by infiltration and the atmospheric air by evaporation of pollutant compounds with high volatility. Making remediation of a site contaminated with petroleum liquid and its sustainable ecological restoration and is one of the most complex environmental projects, both in the technical, economic and organizational. Choosing the optimal remediation technologies technically and economically is a difficult decision because a large number of involved parameters and a large number of interactions that influence the system and make it virtually impossible to control completely the final results.

Keywords: oil sludge, characteristics of the oil sludge, inertization, effects of pollution

1. Introduction

In the industrial activity occurr in many cases technical incidents followed by crude oil contamination of adjacent areas, ie liquid petroleum products.

Spreading liquid petroleum products to the soil surface may have negative effects on both the subsoil and groundwater by infiltration and the atmospheric air by evaporation of pollutant compounds with high volatility. Making remediation of a site contaminated with petroleum liquid and its sustainable ecological restoration and is one of the most complex environmental projects, both in the technical, economic and organizational. Choosing the optimal remediation technologies technically and economically is a difficult decision because a large number of involved parameters and a large number of interactions that influence the system and make it virtually impossible to control completely the final results.

The composition and structure of the soil, together with the nature of the organic part gives the system and the humidity of their physico-chemical characteristics very different. On the other hand, the volume and composition of the oil contribute to the soil contaminating system with very different characteristics.

With such diverse systems remediation technology selection is made on empirical principles that take into account primarily the availability and less than scientific issues.

Before you decide which technology is most appropriate remediation of a specific situation should carry out a diagnostic inventory in which to establish:

- The composition and structure of the soil in the contaminated area;
- Qualitative and quantitative characterization of the pollutant;
- Extending to the surface and depth of the polluted area;
- The degree of quality degradation of soil germination;
- Negative effects of pollution on human activity in the area;
- Risk of groundwater contamination.

If current pollution delineation of contaminated areas can be achieved by a variety of factors that depend on the nature and location of the pollutant source, amount and pollutant characteristics, such as the relief of the area, soil composition and structure of the system - the basement - groundwater .

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Determining the extent of contaminated areas at ground level and basement or the first underground water is combining direct visual observation method (from the ground or air means type helicopter, airplane or satellite photos) specific analysis methods for determining pollutant content of soil samples, surface water or groundwater.

Given the relatively high cost of pollutant analyzes of soil samples and surface water and groundwater have established the optimal strategy in terms of the number of analysis and precision needed for delineation of contaminated areas.

For these cases it is recommended that the sampling of soil or contaminated water to realize the concentrated system, the source of the pollution.

If historical pollution, usually not known when exactly the position of the source of pollution or when there was a source distributed mode contaminated delimitation is based on information obtained from analysis of samples pollutant in the system uniformly distributed on the surface potentially polluted.

Information obtained through analysis of pollutant to be supplemented by information obtained from scenarios that shape the evolution of pollutant in time and space.

Inventory of contaminated areas include elements that relate to:

- Inventory site with detailed information on the location, technology flows installations / equipment related neighboring sewage system and so on
- Inventory flows with accurate information about potential pollutants (identification, quantity, their variability over time, etc.),
- Inventory sources of pollution, effluent quantification, assessment and validation causes pollution
- Estimated with an accuracy as high as the extent of the contaminated area, both at ground level and in depth.

The information contained in the inventory of contaminated sites are needed to establish optimal remediation strategy.

2. Physico-chemical characteristics of oil sludge

Slurry resulting from the extraction of crude oil consists of deposition of particles of minerals (sand, clay) strongly impregnated with oil in separators, tanks, catch basins related to oil flow in the scaffold (parks collectors-separation station oil-storage treatment, wastewater treatment plant). In appearance these are in the form semisolid sludge.

Mechanical impurities in the oil are solid inorganic or organic nature (minerals) that form sediment (slurry or sludge) that sinks to the bottom of tanks for storing crude oil.

From the extraction process, the collection and treatment of sludge resulting in varying amounts depending upon the amount of oil extracted and processed, for slurries that are stored in pits located apart from separation units. Waste material deposited in deposit is made and composed of:

- liquid phase - waste water, storm water, oil;
- phase semi - material debris, heavy petroleum fractions, drilling mud.

By gravitational separation bund surface forms a film of oil that is captured and evacuated by a pump periodically sip phone on the right in the park.

Generaly, the slurry obtained has the following features:

- Water content varied as slurries stored in bunds are from different backgrounds;
- Content of volatile and implicit oil content from sludge varies greatly from sample to sample;
- Calorific different from one sample to another;
- Different sulfur content;
- Variable density from 1.17 to 1.22 kg/dm^3;
- Percentage of water 25-39%;
- Volatile 15-31%;
- Minerals 60-84%;
- 0.05% sulfur;
- Calorific power 720-900 kcal / kg;

Sludge resulting from purification tanks collection, separation and storage of crude oil and the cellars, wells clippings are collected and stored in specially designed pits subsequent to recover the oil. These pits are located within the separator parks, warehouses and storage of crude oil treatment and sometimes near the extraction wells and / or central battle.

The laboratory determined the characteristics of the oil sludge, resulting in the table 1.

In order to obtain a waste inerted (nepericulous) will mix the following material components (figure 1):

1. Slurry oil at a rate of 30-60%;
2. Residues of coke, charcoal or wood chips in a proportion of 35-65%;
3. Lime in a proportion of 5 - 10%.

Mixing is done on a concrete platform covered:

1. Depossit a 10 cm layer of coke residues, charcoal or wood chips
2. Depossit a layer of 30 cm oil sludge.
3. Adds lime by spraying

4. They adds a layer of 10 cm of coke residues, charcoal or wood.chips

Table 1. The laboratory determined the characteristics of the oil sludge

Sample	Win [%]	Aanh [%]	mcin [%]	Qinf [kcal/kg]
Sample 1	34.45	51.99	31.47	2262
Sample 2	11.87	43.93	49.41	3819
Sample 3	6.99	53.18	43.55	3347
Sample 4	25.69	73.47	19.72	1312
Sample 5	20.10	60.66	31.43	2302
Sample 6	24.59	69.27	23.18	1603
Sample 7	45.14	25.33	40.96	3017

The results of physico chemical analysis pa raw material are presented in the table 2.
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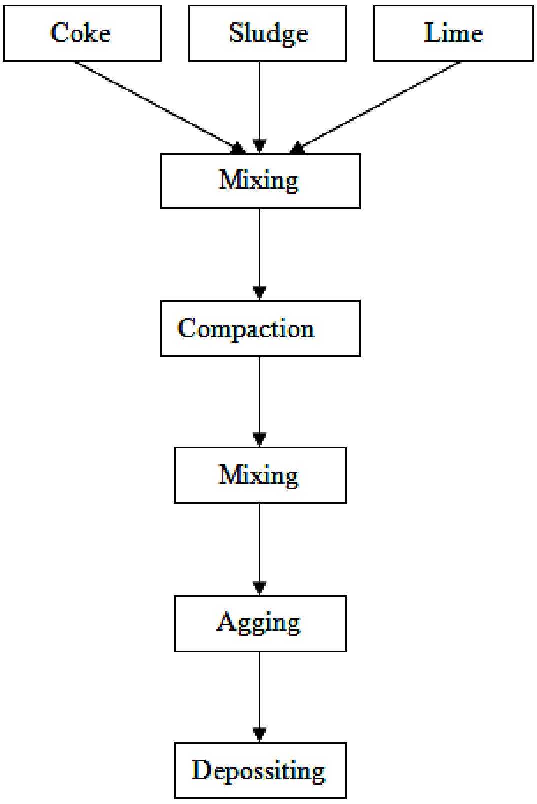

Fig. 1. Technological flow scheme proposed

Pressing material will be achieved by repeated passage over a SCC mixture.

After the material has achieved at a degree of compaction of more than 80% will pass to its loosening by means of a compost turning machine.

Such material will leave the rest loose at least three days to complete neutralization and adsorption reactions of volatile compounds by coke.

Advantages it presents the proposed technology are:

- oil sludge transformation, which is hazardous waste, into composite materials marketable, with the characteristics of nonhazardous waste;
- permanently remove waste treated by conversion to solid fuel.
- the resulting solid fuel combustion ash material that has characteristics of inert waste.

To determine the inerting of the waste recipes were carried out using three sets of test adsorbent material is coke, in a proportion of 35%, 25% and 15%.

The results of the tests of inertization carried out with the addition of the adsorbent material in a proportion of 35% are shown in the table 3:

The results of the tests of inertization carried out with the addition of the adsorbent material in a proportion of 25% are shown in the table 4.

The results of the tests of inertization carried out with the addition of the adsorbent material in a proportion of 15% are shown in the table 5.

From the above data it is observed that by mixing with inert adsorbent material obtained a mass with certain energetical characteristics.

Table 2. The results of physico chemical analysis pa raw material

Sample	1	2	3	4	5	6	7
A anh	73.4680	43.9348	53.1827	60.6604	69.2659	51.9899	23.3271
MgO	0.0410	0.0811	0.0571	0.2188	0.0306	0.0000	0.0000
Al_2O_3	0.9861	1.0810	1.3806	1.7340	1.7103	0.6884	0.1544
SiO_2	6.5104	4.5398	6.9098	7.4924	8.8604	3.5236	0.7823
P_2O_5	0.0586	0.0832	0.0727	0.0444	0.0456	0.0504	0.0000
SO_3	2.8307	1.1277	0.8716	1.1991	1.4398	1.1363	0.7340
Cl	0.1561	0.0282	0.0386	0.0570	0.0563	0.0243	0.0222
K_2O	1.2944	0.7613	1.4923	1.2767	1.5792	1.0136	0.0000
CaO	9.0034	11.5887	5.3302	7.6842	7.1774	9.8464	1.0425
TiO_2	3.8440	2.0776	2.8396	2.0082	3.4084	3.0045	0.9264
V_2O_5	0.6606	0.3847	0.1200	0.4563	0.2610	2.7330	0.0000
Cr_2O_3	0.7710	1.2448	0.0000	0.7624	1.2669	0.0000	0.7809
MnO	0.9325	0.2492	0.3774	0.5696	0.5980	0.4171	0.1207
Fe_2O_3	25.7830	16.4362	27.6780	25.4778	34.6262	19.3288	8.2948
Co_2O_3	0.0000	0.0000	0.0000	0.0000	0.1565	0.0000	0.0000
NiO	0.1382	0.0550	0.1256	0.1746	0.1460	0.1759	0.1111
CuO	0.2281	0.0000	0.0000	0.0920	0.2049	0.1251	0.0537
ZnO	0.0000	0.0000	0.0000	0.1074	1.0878	0.0731	0.2529
Ga_2O_3	0.1610	0.0000	0.0666	0.0000	0.1343	0.0831	0.0000
GeO_2	0.4782	0.2838	0.3774	0.3920	0.4435	0.4542	0.2790
As_2O_3	0.0000	0.2310	0.4986	0.5639	0.6052	0.0000	0.0933
SeO_2	0.1397	0.0532	0.0589	0.0000	0.0000	0.1255	0.0000
Br	0.1067	0.0457	0.0498	0.0000	0.1157	0.0594	0.0446
Rb_2O	0.2013	0.0000	0.0000	0.0000	0.0000	0.0327	0.2839
SrO	0.3729	0.1559	0.1630	0.1696	0.2460	0.2599	0.0902
ZrO_2	0.0000	0.0000	0.1325	0.0000	0.0000	0.0000	0.3679
MoO_3	0.0000	0.0000	0.0000	0.0495	0.0366	0.0000	0.0000
CdO	0.4540	0.0000	0.0000	0.3096	0.0000	0.0000	0.9739
BaO	9.4409	1.0787	2.1908	1.6694	0.5969	3.9407	1.0901
PbO	1.4288	0.0000	0.0000	0.0000	0.0000	0.0000	0.1056

Table 3. The results of the tests of inertization carried out with the addition of the adsorbent material in a proportion of 35%

	Win	Aanh	Vanh	Qinf
Sample 1	2.79	43.86	20.80	4275
Sample 2	2.66	30.47	36.18	5364
Sample 3	2.75	33.82	27.23	5087
Sample 4	26.96	61.63	26.47	1998
Sample 5	2.46	37.22	28.73	4829
Sample 6	2.86	21.88	38.77	6044

Table 4. The results of the tests of inertization carried out with the addition of the adsorbent material in a proportion of 25%

	Win	Aanh	Vanh	Qinf
Sample 1	0.59	44.19	29.06	4357
Sample 2	0.25	52.51	17.24	3685
Sample 3	1.83	33.60	37.82	5158
Sample 4	1.42	37.49	30.80	4865
Sample 5	1.24	48.74	23.80	3952
Sample 6	0.64	48.65	22.13	3986

Table 5. The results of the tests of inertization carried out with the addition of the adsorbent material in a proportion of 15%

	Win	Aanh	Vanh	Qinf
Sample 1	0.59	44.19	29.06	4357
Sample 2	0.25	52.51	17.24	3685
Sample 3	1.83	33.60	37.82	5158
Sample 4	1.42	37.49	30.80	4865

3. Conclusion

Oil industry generates large amounts of waste oil, including oil slurries that have the strongest negative impact on soil and surface water sometimes;

Petroleum wastes are included in the category of hazardous waste, also considered persistent pollutants;

By mixing with the adsorbent material as coke dust, these wastes can be stabilized and brought to the characteristics of nonhazardous waste, except of course the parameter "total organic carbon";

Inerted resulting product has real energetical characteristics, can be mixed with coal and burned in power plant designed to burn any coal with a volatile content of over 20%.

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Study of vibration regime to control noise produced by belt conveyors

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Abstract

Vibrations are dynamic phenomena that are found both in the human body through the heartbeat, the activities of humans and animals through running and walking, various natural phenomena such as swaying trees in the wind and buildings shocks to earthquakes, vibrations produced by musical instruments, pneumatic drills, reciprocating belt conveyors etc. The vibrations are often referred to shake that produce relatively high noise or mechanical stress. To reduce and control the level of noise pollution produced by conveyor is necessary to determine the vibration regime. In this paper we propose to study the vibration mode of belt conveyors to control noise from the belt conveyors.

Keywords: vibrations, noise, belt conveyors, screen

1. Introduction

Most often "vibrations" are defined as unwanted movements that produce relatively high noise or mechanical stress. In this case particularly we are interested in the effect of vibrations on humans, machines and buildings. Modeling involves defining the structure and parameters of vibratory bodies in vibration excitation functions and levels that describe the dynamic response.

Control the frequency and amplitude of vibration are necessary because they are harmful to machines and systems, particularly affecting the proper functioning of machines, wear their precision and their foundations, and human health.

Exceeding the limits of tolerance of vibrations have negative influence on human health and on labor productivity, producing physical trouble and intellectual activity, damage to parts of the body, as subjective phenomena: the perception of vibration, discomfort, pain and fear.

To reduce noise produced by conveyer belts and sound-absorbing acoustic panels we realized the polycarbonate plates mounted directly on the metal structure of the conveyor belts. Their behavior is influenced by regime vibration that is transmitted from their belts.

Vibration from conveyors are generated by structural vibration effect creating waves that propagate in the metal structure with low rigidity, in which case antinode areas are sources of radiating noise.

2. Theoretical considerations

Soundproofed and sound-absorbing panels located on conveyor belts metal structure is attached to a height of 0.5 m from the ground. This height was chosen to be screened all the moving parts of the conveyor belt.

These soundproofing panels used in noise shielding acts as a monopartition.

Isolator panel can be modeled as a homogeneous tile referring to a system of axes Oxyz and normal wave radiation directly enters a vibratory motion in the direction Ox simultaneously bending wave propagation.

Considering excitement bending waves in one direction, the bending moment $M = M_Z$ to give the appearance of a strong variable in the direction Ox:

$$F = \frac{\partial M}{\partial y};\ \frac{\partial^2 x}{\partial y^2} = -\frac{M}{B}, \qquad (1)$$

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in which:

$$B = \frac{EI_y}{1-v^2} = \frac{Eh^3}{12(1-v^2)}$$

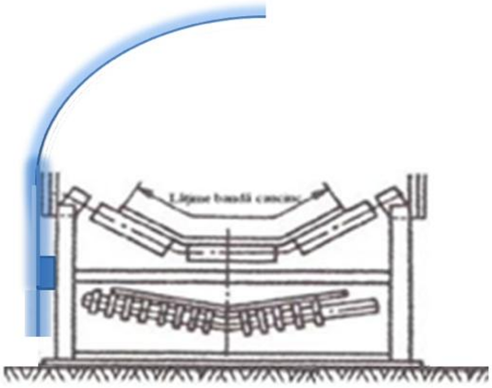

Fig. 1. Curved screen for noise protection

It is the plate rigidity per surface unit;
E- Young module's;
v – coefficient of Poisson

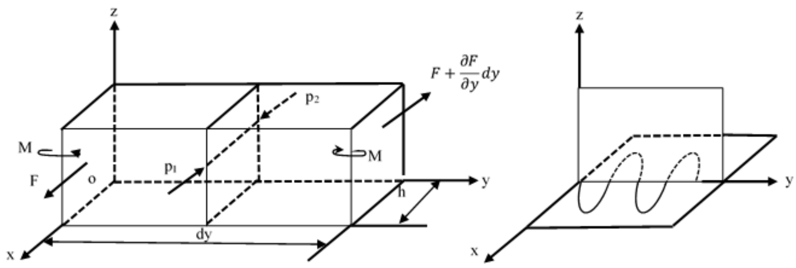

Fig. 2.

The equation of motion of the unitary wall element after the division with surface plan yOz (dA = l dy) is:

$$m\ddot{x} = p_1 - p_2 + \frac{\partial F}{\partial y}, \tag{2}$$

Where m=l·l·h, and after using the expression (1), becomes:

$$m\ddot{x} = p_1 - p_2 - B\frac{\partial^2 x}{\partial y^2}, \tag{3}$$

Provided that particular air wall surface sp to not detach is:

$$\frac{dx}{dt} = v = Ve^{i\omega t}, \tag{4}$$

Integrated which leads to expression:

$$x = \int v dt = \frac{1}{i\omega} Ve^{i\omega t} = \frac{v}{i\omega} \tag{5}$$

Replacing (3) in (2), we obtain:

$$m\frac{dv}{dt} = p_1 - p_2 - \frac{B}{i\omega}\frac{\partial^4 v}{\partial y^4} \tag{6}$$

from where,

$$p_1 - p_2 = i\omega m v + \frac{B}{i\omega}\frac{\partial^4 v}{\partial y^4}. \tag{7}$$

This raises a bending wave which is transmitted along the axis Oy

These bending waves occur due to vibrations make sound-insulating screen where they fall on different angles of incidence θ, which make it appear a phase shift in the direction Oy. The phase angle difference is due to the road $Dr = y\sin\theta$.

Speed v of air particle in contact with points will be expressed by Dr as follows:

$$v = Ve^{i\omega\left(t - \frac{\Delta r}{c}\right)} = Ve^{i\omega\left(t - \frac{y\sin\theta}{c}\right)}$$

In this case results:

$$\frac{\partial^4 v}{\partial y^4} = \left(\frac{\omega}{c} sin\theta\right)^4 v,$$

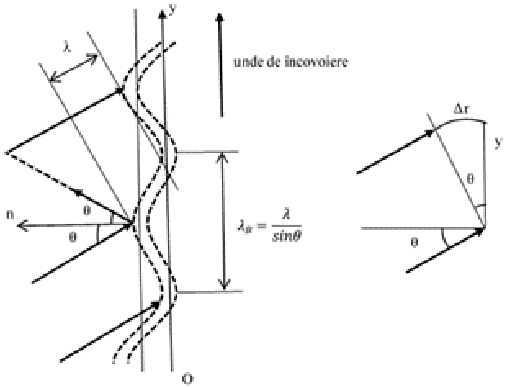

Fig. 3.

Expression (6) become

$$p_1 - p_2 = \left(i\omega m - i\frac{B\,\omega^3 sin^4\theta}{c^4}\right) v. \qquad (8)$$

It has specific nature wave impedance containing reactant:

Inertion ω m

- Mechanical compliance $\left(\frac{B\omega^3 sin^4\theta}{c^4}\right)$

It will be considered critical if the pressure is transmitted entirely through wall, so $p_1=p_2$.

So:

$$\frac{\partial^4 v}{\partial y^4} = \omega^2 \frac{m}{B} v \qquad (9)$$

Wave velocity bending the wall is:

$$C_B^4 = \omega^2 \frac{B}{m};\ C_B = \sqrt{\omega}\sqrt[4]{\frac{B}{m}} = \sqrt{\omega}\sqrt[4]{\frac{EIy}{m(1-\vartheta^2)}} \qquad (10)$$

Introducing (9) in (10) equation become:

$$\frac{\partial^4 v}{\partial y^4} - \left(\frac{\omega}{C_B}\right)^4 v = 0 \qquad (11)$$

Which leads to integrated overall solution:

$$v = C_1 e^{\alpha y} + C_2 e^{-\alpha y} + C_3 e^{i\alpha y} + C_4 e^{-i\alpha y}, \alpha = \frac{\omega}{C_B} \qquad (12)$$

From expression (10) results that speed CB flexural wave is dependent upon the angular frequency ω, and condition $p_1=p_2$ imposed equation (8), result:

$$1 - \frac{B\,\omega^2\, mc\, sin^4\theta}{mc} = 0 \Rightarrow C_B = \frac{c}{sin\theta} \qquad (13)$$

So, for the critic case will result critical velocity of pressure waves which induce wall where bending, forming integral to transmit sound pressure through the wall:

$$\frac{c^2}{sin^2\theta} = 2\pi f_{cr}\sqrt{\frac{B}{m}}, \Rightarrow f_{cr} = \frac{c^2}{2\pi sin^2\theta}\sqrt{\frac{m}{B}} \qquad (14)$$

The lower critical frequency is obtained for θ=π/2 (waves parallel with the wall)

$$(f_{cr})_{min} = \frac{c^2}{2\pi}\sqrt{\frac{m}{B}}. \qquad (15)$$

In case of wall h=d,

$$(f_{cr})_{min} = \frac{c^2}{2\pi d}\sqrt{\frac{12\rho(1-\vartheta^2)}{E}}. \qquad (16)$$

To avoid sound transmission through the wall without damping aims throwing minimum frequency within the audible frequencies.

3. Results and discussions

To study the regime vibration of conveyor belts we used MSR145. This is a device that perished measurement of parameters such as temperature, humidity, pressure and acceleration on three axes X, Y, Z. The acceleration can be measured both in 2G and in 10 G.

For the study we conducted measurements on a conveyor belt, which operate unloaded careers tape used to open pit, but also before starting it, to be able to see the differences between the two situations.

Following measurements made can be seen as relative stretching values when the conveyor belt does not work in all three areas are: ACCx - -0.313, ACCY - 0049, ACCz - from 0.873 to 0905 (Figure 4).

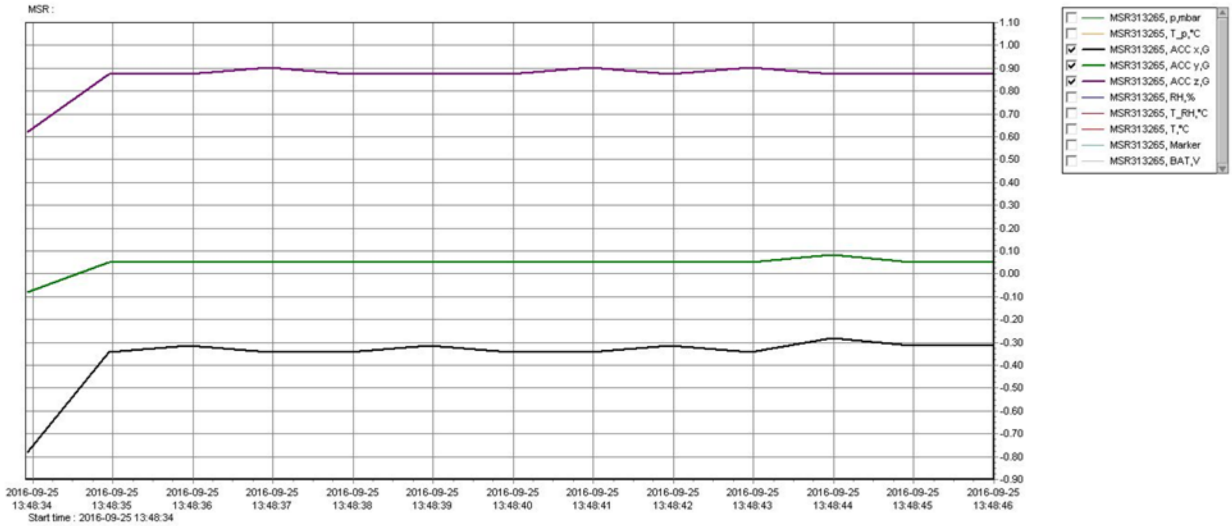

Fig. 4. Relative elongation waves on three axes before starting the conveyor belt

From measurements made after starting the conveyor belt can be seen that there are significant differences to relative stretching on all three axes (Figure 5).

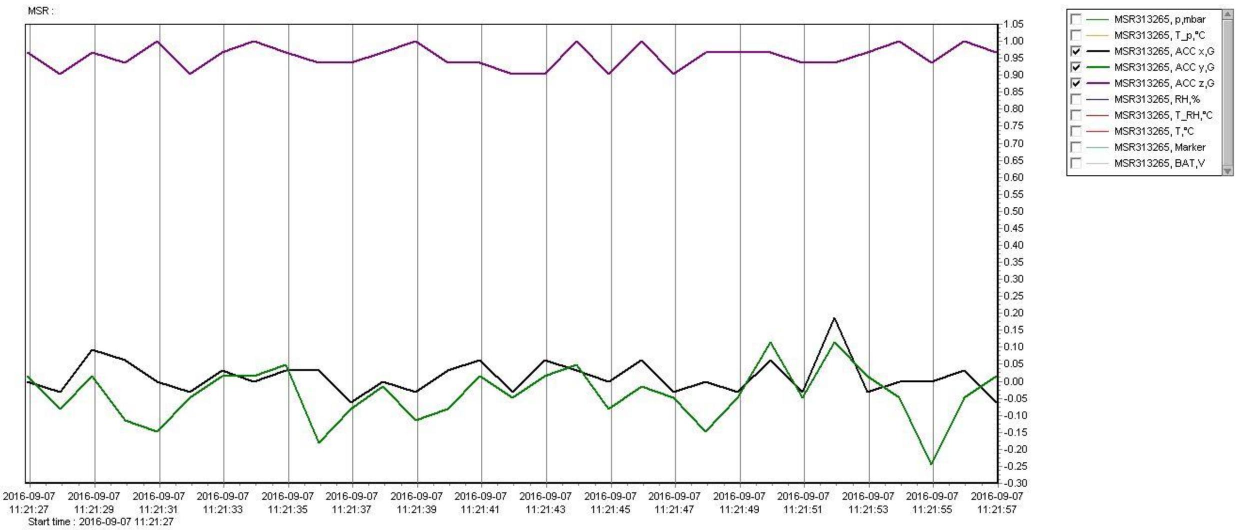

Fig. 5. Relative elongation waves on three axes after starting the conveyor belt

From measurements recorded large variations observed structural vibrations generated by creating waves that propagate effect fraught metal structure on all three axes.

Can be observed that the relative elongation on the x axis between -0.031 which represents the value rest on this axis and 0.188. Y-axis variations are targets for 0049 (the value rest) and -0.148. Z axis shows values between 0.905 (the maximum amount awarded for conveyor belt at value rest) and 1.

Conveyor band operation may influence performance and sound absorbing of soundproofed panels by structural vibration transmission.

4. Conclusion

Vibration from conveyors can influence the reduction of noise by absorbing panels and soundproofing panels.

Following measurements made on the conveyor belt which operate without load can be seen this vibration on three axes x, y and z.

Vibration produced by conveyor band lead to degraded performance soundproofing and sound absorbing panels.

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Research concerning the improvement of operation times of some subassemblies of the crushers

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Abstract

Research has pursued finding technological solutions for manufacturing and reconditioning crushers subassemblies used in the coal preparation and stone quarries, in order to reduce production costs. Crusher rollers used for crushing coal or mineral agglomerated as well those with a cone, used to process raw stone work in under heavy working conditions and have low reliability subassemblies, for which appear accidental breakage, which influences directly and negatively production flows, causing them stopping for periods ranging from several days to several weeks. In this paper are presented experiments for reconditioning of a crushing roll as well as manner of solving some cracks occur during operation in bearing support of the connection region with crushing chamber sleeve.

Keywords: crushers subassemblies, reconditioning, reliability;

1. Introduction

Coal preparation plant in Coroieşti, (part of SC CEH SA) is equipped with roller crushers Φ1000x1000 production polish (fig 1). These crushers (table 1) are designed to break up the medium and low strength materials and high density up to 1000 kg / cm^3 as for example, coal, chalk, gypsum, etc.

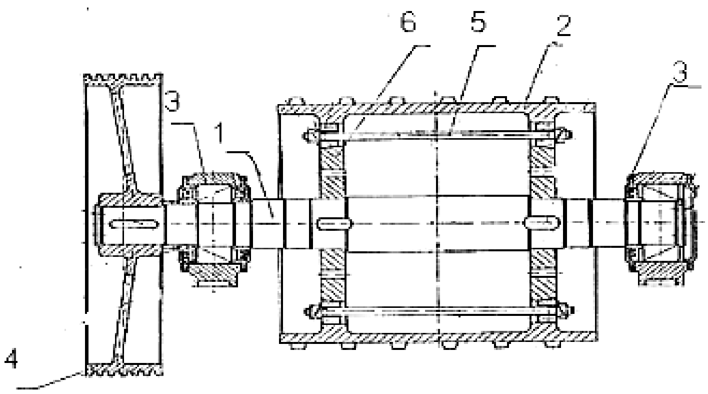

Fig. 1. Constructional detail of the roller crusher
1-shaft; 2-toothed roller; 3-bearings, bearing housing; 4- pulley; 5- reinforcing elements; 6-inside wall;

Cone crusher of the type used in career Bata (Romania) are intended broken stone grain of 0÷200 mm, resulting sorts of 0÷63 mm. The main subassemblies consist of a housing jacket and a cone (fig. 2) both equipped with manganese steel armor; cone has a circular motion but does not rotate, the movement is generated by an eccentric assembly.

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Table 1.Technical characteristics roller crusher Φ 1000x1000

No	Name	Value
1	Roll diameter	1000 mm
2	Roll width	1000 mm
3	Feeder dimension	200 mm
4	Productivity	40÷120 t/h
5	Roller speed	107 rev/min
6	Nominal power	2x37 kW
7	Crusher weight	3,000 kg

Both types of crushers are elements of technological flow of production so that subassemblies which are subject to abrasive wear intense rollers, respectively cone and mantle must be able to be reconditioned in their conditions of work to not introduce great times of break functionality and cost high as spare parts.

Fig. 2. Subassemblies grinding of cone crusher

In industrial practice different methods are used to increase the life of the technological equipment by implementing technology in production:

- New high-performance materials;
- Forms (designs) that incorporate intelligent systems for wear protection;
- Optimized maintenance procedures on the basis of predetermined life.

2. Reconditionning crushers

2.1. Roller crusher

As was found during operation crushers, most exposed to wear are rollers (fig. 3), respectively teeth on their surface, so it was considered useful to test solution their reconditioning by loading welding, on permitting obtaining structures with optimum strength characteristics and appropriate application specific conditions ie the following requirements:

- the use materials and loading welding technologies that will lead to achieving couples, base metal-deposited metal capable of providing good resistance to specific requests concrete operating conditions;
- ensure protection from wear of the active surfaces of the parts loaded;
- establish regulations that ensure maintenance and operating performance while maintaining the original parts.

Fig. 3. Rolling crusher with worn teeth and teeth reconditioned

Method for deposition of hard granules (tungsten carbides) by welding [Tihanov-Tanasache et al,], [Binchiciu, H.,] is considered to be the best solution for creating composite laminates with thicknesses of 2.5÷3 mm necessary to execution subassemblies with increased resistance to requests by shock, such as the phenomenon of abrasion wear and abrasion in this way is the basic matrix of the steel, and the deposition of the tungsten carbide granules, the binder is cobalt.

The optimal loading technology tungsten carbide must be based on the following basic requirements:

- the process to participate in a small amount of the material which the tubular electrode is a metal sheath and comprising, on the inside, granular tungsten carbide;
- dissolution of the carbides of alloying elements must provide without the percentage of tungsten lead to the formation of undesirable phases (or graphite).

Laboratory tests of resistance against shock, has 48 roller teeth (fig. 3) reconditioned by charging granular tungsten carbide, confirmed the validity of the method and opportunity to enlarging its field of application to other subassemblies of mining equipment preparation operating under similar conditions.

2.2. Cone Crushers

Recondition cracks occurred during operation, in the case of crusher cone, put special technological problems, especially when they are located in the connection zone of bearing plate, made by casting, from carbon steel (fig. 4). Previously it was necessary to create conditions for achieving the site diagnostic operations, to make ready casing crushing for welding, welding and optimization of residual stresses on the criterion of minimum residual deformations.

Fissure diagnosis was made by experimental research regarding the operating conditions, the compositional characteristics and fracture toughness of the adjacent area.

The study revealed a cracked area its positioning near a bearing, showing a significant variation in the thickness of casing, from 250 mm to approximate 100 mm, and the presence in the crack to a relatively large volume of mineral oil due to pressure due of the hydrodynamic sustentation of the cone crusher. During the operation, efforts casing crusher is subject to cyclical efforts, aleatory, due to inclined forces, whose components have variable values.

Elementary analysis, carried out in four distinct areas of point near the fissure, was made with a portable spectrometer SPECTROMAX 800. The obtained results confirmed the hypothesis that the casing material was a low alloyed carbon manganese steel with a relatively high carbon dispersion.

Spectral measurements were accompanied by sclerometer analysis which revealed large variations in hardness, HB 273÷315, which implies the existence of a structural heterogeneity.

Fig. 4. Casing fissured cone crusher

Research has revealed that at the joint, missing the minimum preheated of piece in order to welding, difficult to achieve on site, in conditions maintaining the processing precision of the sustentation hydrodynamic bearing.

Analysis of the data presented, imposed the necessity of realization of welding materials with properties appropriate to the work under site conditions in difficult positions for chamfering, and welding access.

The large volume of material displaced to generate chamfering impose arc-air gouging proceeding. Arc-air gouging solutions, existing with tubular graphite electrodes, have two disadvantages to the present situation, namely: carburizing zone processed and orientation difficult airflow to the work area. In these conditions, it was necessary to provide a novel electrode core in a thick-walled pipe and the shell base, fluoro-calcium. Making coating was done under the conditions of refractory high, good electrical and thermal conductivity and low coefficient of diffusible hydrogen.

For this purpose have been developed, produced and optimized gouging short series of electrodes, which were tested for determining the efficiency of work and flexibility.

Joint preparation (fig. 5), consisted in the development and initial depositing, by welding an austenitic-ferritic alloy layer, class 500 N/mm^2 a high capacity of deformation-hardening.

In order to achieve the desire proposed and obtain deposits with low diffusible hydrogen, it was established and implemented the basic recipe, a microalloying system that favored increased participation of retained austenite in the weld metal structure. At the same time, the recipe electrodes basic current production has been adapted to a welding easy in difficult positions; in these conditions were achieved electrodes with a diameter of 4 mm, which were tested for determining the behavior of the welding, the behavior when trying to break the traction and for the determination of diffusible hydrogen.

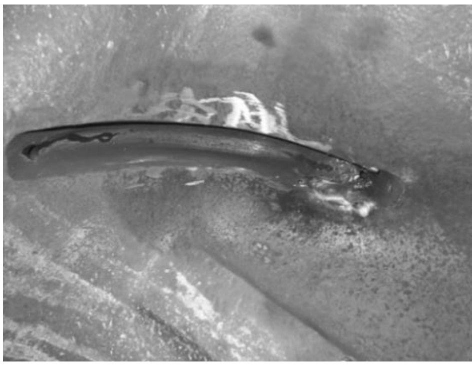

Fig. 5. Preparing the surface for welding

Removal of the fracture was achieved in several steps: it has established and blocked crack by forming two holes with a diameter of 10 mm, applied to the ends (fig. 6); it was achieved double chamfer in U by arc-air gouging with new electrodes created to this scope. The welding current [Niculescu, T., et al.,] was 140±10A, and a working pressure of 6÷7 atm., obtaining smooth surface and less carburized. Redistributing of residual stresses was obtained by additional welding, perpendicular to the welding of plates (fig. 6).

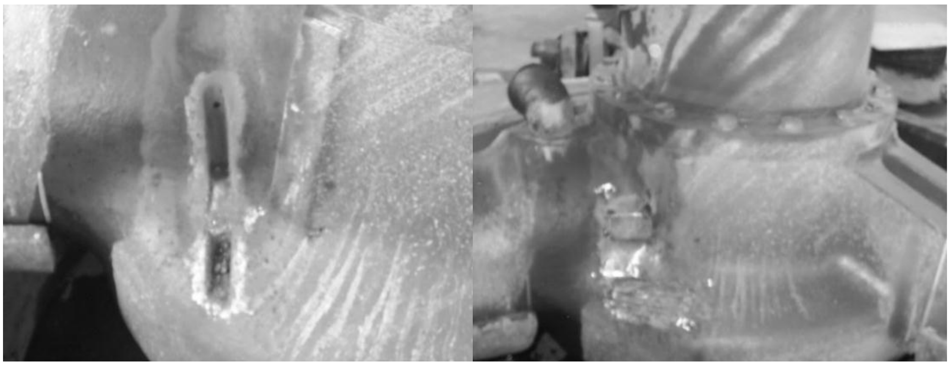

Fig. 6. Welding segment

After conducting a pressure test in advance progressive hydrodynamic casing reconditioned crusher was used under conditions of intense exploitation. Operational monitoring revealed a life without defect, 2 years and 3 months.

3. Conclusions

In many cases where on the technological equipment is the same or different as the S.C. CEH SA, point of preparation work Jiu Valley, coal spare parts are purchased according to the needs arising during the production activity. Much of spare parts introduced high specific costs that influence negatively the production costs, as demonstrated in this chapter.

The solution to decrease costs mentioned and increase uptime can be setting parts which can be reconditioned, on the one hand, and the method which can be used without additional investment, as exemplified and shown for rolls crusher.

Experiments carried out in order to increase the life of the heavy duty equipment surfaces in contact with basaltic rock type, have resulted in:

- Realization and verification of loading welding technologies with special electrodes and getting highly stressed active surface at abrasion equipped with intelligent systems self to wear;
- Develop a new generation of materials for welding and gouging of steel cast as thick (150÷300 mm) that are used in the manufacture of casing crusher;
- Elaboration and realization reconditioning technology, the site of cracks occurring in the casing crusher.

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Comparative study regarding the break-out angle and specific energy consumption at overburden rock and lignite cutting from Oltenia coalfield

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Abstract

The paper deals with the experimental and laboratory assay results regarding the mechanical cutting of overburden rocks and lignite from Jilț open pit mine, with special accent on the dependence of break-out angle and specific energy consumption on the geometric parameters of teeth in view to optimize them, for lignite and overburden rock efficient cutting.

Keywords: coalfield; energy; break-out angle; rocks; cutting; Oltenia ;

1. General Considerations

The non-homogenous material cutting theory in general, and the lignite and overburden rock cutting in particular, highlights that dislocation occurs as the result of the interaction between the cutting tool and solid, characterized by a resultant force which breaks down into three components acting on the main directions (tangent , normal and binormal) compared to the trajectory of the tool. Research conducted to date in this area, both worldwide and in our country, revealed that the cutting phenomenon has a strong random character, defined by random variables and their appropriate probability functions.

For the experimental determination of the cutting characteristics of the rocks, the laboratory method was chosen. In order to conduct the experimental research, proper work methodology and experimental data processing and capitalization methods were established. It was proven, both theoretically and experimentally, that application of modeling and geometric similarity methods - in the study of cutting characteristics of lignite and overburden rock - is accurate enough so that the values obtained in the laboratory are translated into real linear equations.

2. Determination of the break-out angle of the chip

Both technical literature and our own experience show that all non-homogeneous materials break from the solid at a certain angle not related to the shape of the cutting tool. If the break-out angle is ψ, as shown in figure 1, the value of this angle varies ψ = 20...80° for different material and working conditions.

Determining the most probable value of this angle ψ is very important because it affects the cross-section area of the chip, the volume of material cut from the solid and the specific energy consumption at cutting. Moreover, it is used to define the distance and position of teeth on the excavator bucket.

The break-out angle of the chips ψ has a random variation, like all the other variables of rock cutting characteristics. Therefore, during experimental trials we determined the median value of the angle, with the highest probability to happen in real life conditions.

First, the cross-section area of the displaced (cut) chip is calculated using the relation:

$$S_0 = \frac{V}{L},\ [\,cm^2] \tag{1}$$

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where V is the volume, in cm^3, and L is the length, in cm, of the cut, experimentally determined using the method of modeling clay molds.

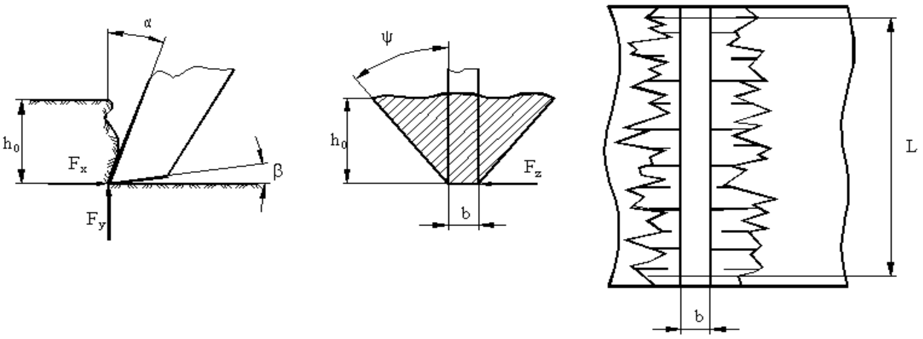

Fig. 1. Determination of the break-out angle ψ

Based on the values of S_0 we can calculate the break-out angle of the chips ψ using the equation:

$$\psi = arctg\left(\frac{S_0}{h_0^2} - \frac{b}{h_0}\right) \tag{2}$$

where: b – is the width of the chip, in cm;

h_0 – is the thickness of the chip, in cm.

Based on the values obtained during the experimental tries and using the methodology described above, the empirical values of the break-out angle ψ were determined.

The values of the angle ψ corresponding to the depth of cut h_0 for different values of the rake angle of the tooth - α, are snowed in figure 2, while the values of the angle ψ corresponding to the rake angle of the tooth - α, for different values of the depth of cut h_0, are represented in figure 3.

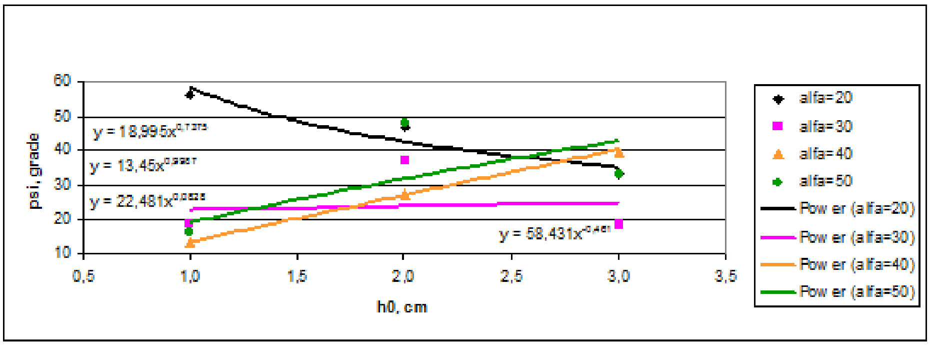

Fig. 2. Values of the angle ψ corresponding to the depth of cut h_0 for different values of the rake angle of the tooth - α,

In figure 2 we can observe that the angle ψ has a curvilinear variation described by a power function, with the variation between 15° and 50°. Values smaller than 25° correspond to smaller depths of cut ($h_0 < 2$ cm), while for values of $h_0 > 2$ cm the angle ψ presents values between 25° and 40°. Dependency curves tend to plateau at values of 25 ° to 40 °, regardless of the thickness of the chip displaced.

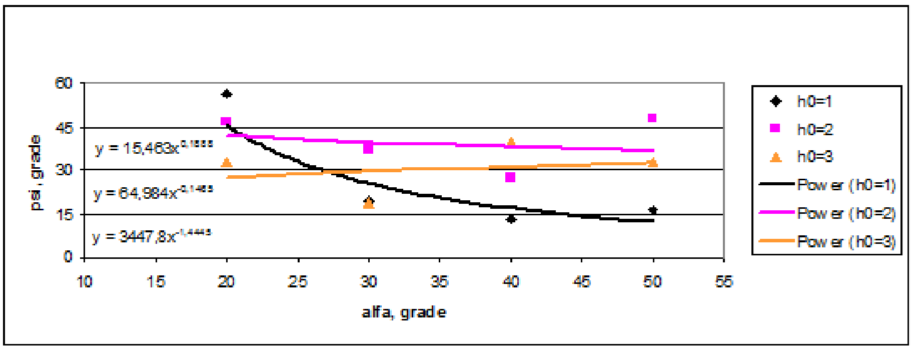

Fig. 3. Values of the angle ψ corresponding to the rake angle of the tooth - α, for different values of the depth of cut h_0

In figure 3 we can see that the break-out angle of the chip ψ is not influenced by the rake angle - α – of the tooth, especially at depths of cut close to 2 cm.

Upon analyzing the results obtained for the break-out angle of the chip ψ, for the overburden rock found in the Jilt open pit mine, we can conclude that the most probable break-out angle is between 25° and 40°.

3. Determination of specific cutting energy

One of the indicators of digging (cutting) difficulty is the Specific Energy E_s. which is described as the electrical energy consumed in cutting unit volume of rock, ore and/or coal. The principle of this indicator is the harder the formation the higher the energy needed to cut it. It is a parameter independent of the bucket size. It can be determined either by recording the measured energy consumption of the bucket-wheel drive and of the cut volume, or by experimental approaches in laboratory or in situ.

Based on the data presented in this paper, the specific cutting energy was calculated using equations (3):

$$E_s^{'} = \frac{F_{xm}}{100S_o} = \frac{A \cdot h_o}{100S_o}\text{, } J/cm^3 \qquad (3)$$

And (4):

$$E_s = \frac{F_{xm}}{360S_o} = \frac{A \cdot h_o}{360S_o}\text{, } kWh/m^3 \qquad (4)$$

The values of the specific energy E_s corresponding to the depth of cut h_0 is graphically represented in figure 4, and the values of the specific energy E_s corresponding to the rake angle of the tooth - α, is traced in figure 5.

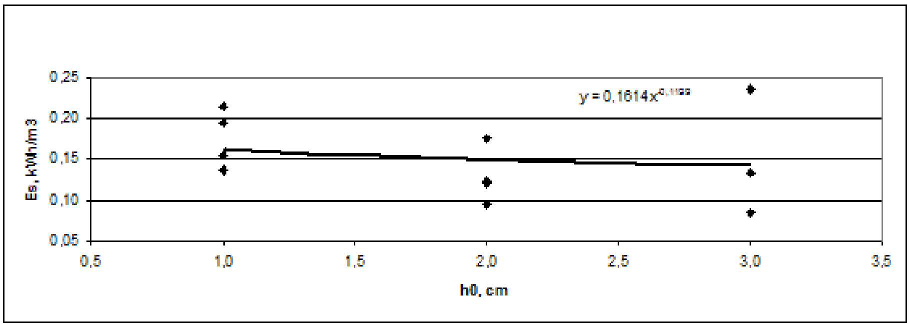

Fig. 4. Values of the specific energy E_s corresponding to the depth of cut h_0

From the figures above, we can see that the specific energy variation during cutting of overburden rock is between 0,08 and 0,24 kWh/m^3.

The dependence curve $E_s = f(h_0)$, presented in figure 4, varies by a power function which decreases proportionally with the increase of the depth of cut, and for values of $h_0 > 2$ cm, it tends to plateau.

Also, the dependence curve $E_s = f(h_0)$, presented in figure 5, shows a decrease of the specific energy consumption proportionally with the increase of the rake angle α of the tooth, with a median value of 0,2 to 0,12 kWh/m^3.

In order to stress and analyze the influence of the depth of cut h_0, and of the rake angle - α - of the tooth respectively, on the specific energy, the corresponding curves were traced as seen in figures 6 and 7.

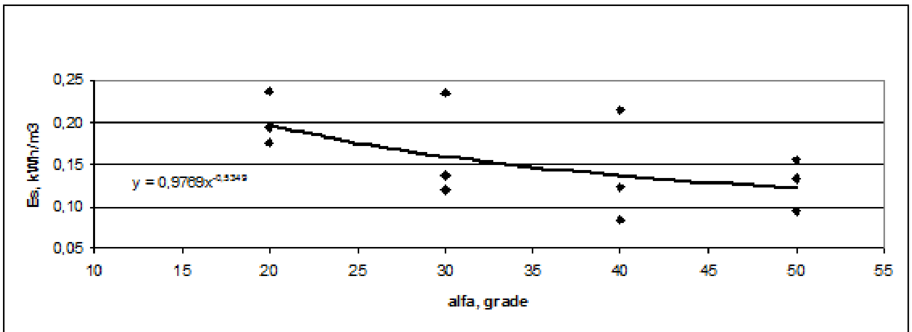

Fig. 5. Values of the specific energy E_s corresponding to the rake angle of the tooth - α,

If we take into consideration, as a parameter, the rake angle of the tooth α, then the specific energy $E_s = f(h_0)$ will be a family of curves where we can observe the increase of specific energy, when overburden rock is cut, corresponding to h_0 for small rake angles, and a decrease of the specific energy when overburden rock is cut, corresponding to h_0 for large rake angles. Likewise, if the depth of cut h_0 is considered a parameter, then the specific energy $E_s = f(\alpha)$ will show the same tendencies : decrease of the specific energy E_s corresponding to the angle α, for different values of h_0.

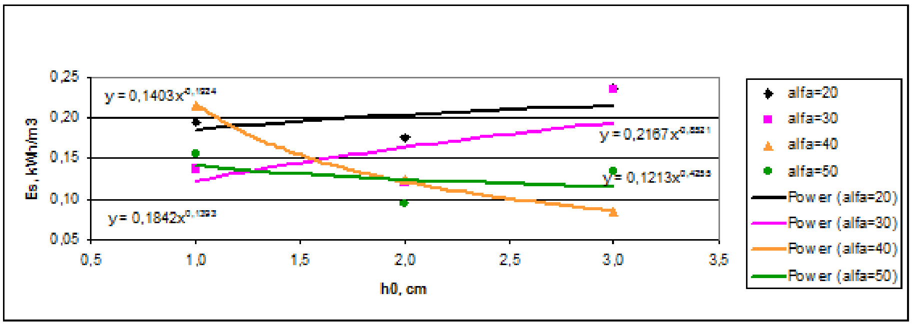

Fig. 6. Values of the specific energy E_s, corresponding to the depth of cut h_0 for different values of the rake angle of the tooth - α

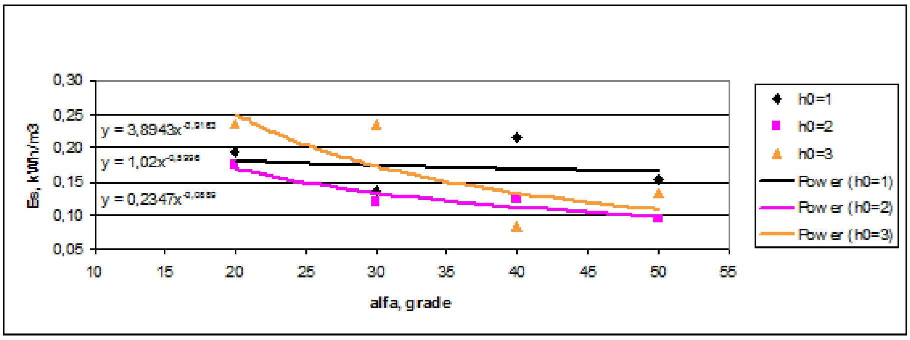

Fig. 7. Values of the specific energy E_s, corresponding to the rake angle of the tooth – α, for different values of the depth of cut h_0

4. Determination of the break-off angle of the chip

Experimental trials were conducted using samples of both lignite and overburden rocks, taken from various open pit mines from Oltenia coalfield. Using measuring and recording devices, we obtained diagrams of cutting forces, penetration forces and lateral forces acting on the standard teeth variations over time.

Based on the empirical data obtained, the specific cutting resistance and the specific energy when cutting were determined, and then links and rules were established between the cutting regime parameters and the parameters of the teeth and chips displaced from the field.

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Modelling and checking the cable tension balance devices

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Abstract

The cable tension balance devices make the connection between the extraction vessel (the skip) and the cable connecting devices, the DLCs, and they have the role to equalize the tensions within the multi-cable extracting installation cables. The devices that are used for the mining working in the Jiu Valley are made up of two cables for the 12 tons skips and of four cables for the 8 and 14 tons extracting capacity skips.

Keywords: cables, device, balance, tension ;

1. Introduction

When modelling, drawing up the 3D execution papers for the cable tension balance devices, the following techno-economical aspects were taken into account:
- improving the constructive solutions technologically speaking (the prop plate welded, the splint pin);
- standardizing, as possible, the constructive solutions for the cable tension balance devices that equip the multicable extracting installation cables in the Jiu Valley;
    - using the constructive solutions that have been put into practice and checked with similar devices;
    - keeping the existing safety coefficient and, in some cases, having it increased (at the 14t skip the pins were smaller than those from the 8t skip);
    - decreasing the price by reducing their making up manual labour (reducing the connection piece, which has the lowest degree of using the material and establishing the correct usage of the alloy steel pieces).

Table 1 The constructive-functional characteristics of the DEC-12 and DEC-14 cable tension balance devices

Nr.	Characteristic name		M.U.	Characteristic value	
				DEC-12	DEC-14
1	Nominal static charge		tons/kN	12/120	14/140
2	Maximum static charge		tons/kN	60/600	52/520
3	The type of the device		-	Mechanic with working beam	
4	The number of working beam		piece	1	3
5	The type of tensions equalising mechanism		-	Screw-screw nut	
6	The operation of tensions equalising mechanism		-	Mechanism with a catch	
7	The motion of tensions adjusting		mm	375	265
8	The angle of lever tipping		degree	±45	±30
9	The maximum vertical difference between two DLCs		mm	500	150
10	The type of cable binding device		-	DLC-30	DLC-1 DLC-13
11	The number of cables		piece	2	4
12	The distance between cables		mm	900	300
13	The diameter of the DLC connection pin		mm	110	70
14	The diameter of the skip connection pin		mm	110	80
15	The number of the skip connection pins		piece	2	2
16	Clearance gauge dimensions	Length (height)	mm	3286	2528
		Width	mm	1284	1145
		Thickness	mm	869	732
17	The mass		kg	1936	1235

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The constructive-functional characteristics of the DEC-12 and DEC-14 cable tension balance devices are shown in table 1.

2. The construction and function of cable tension balance devices

The main component sides of the DEC-12 cable tension balance device are presented in fig.1

The DEC-12 cable tension balance device realizes the connection between the skip and the two cable connection devices, assuring the balance between the tensions in the two cables.

The device is made up of the catching cover plate of skip *1*, fixed by this one by means of two pins *2,* with the diameter of 110 mm, fixed on the cover plate with the help of the fixing plates and thev M12 screws. Label *20,* of device identification, is attached to the cover plate.

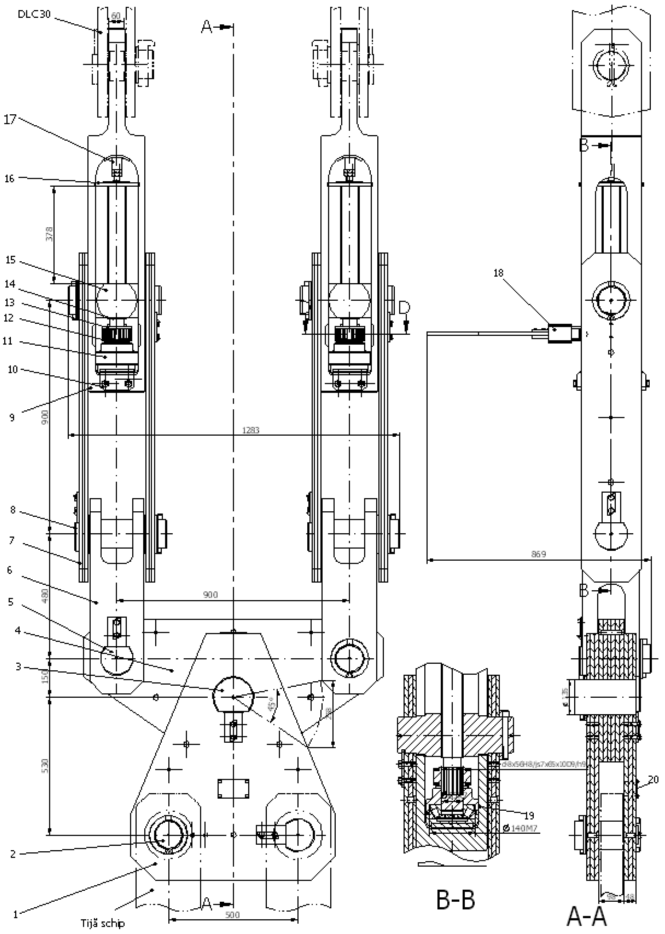

Fig. 1. The DEC12 cable tension balance device

On the upper side, the cover plate is connected to the main lever *4*, which plays the role of working beam, by means of the main pin with the diameter of 135 mm *3*.

The connection is assured by means of two forks *6*, and of two superior cover plates on each branch. The connection between the forks and the working beam is made through the inferior secondary pins *5*, and between the forks and the superior cover plates through the superior secondary pins *8*, with the diameter of 110 mm.

On the superior side of the cover plates, the screw nut with clefts is mounted *15*, which makes the connection with the mobile connection piece *9*, whose superior side is fixed by the cable connection devices. The mobile connection piece is conceived in such a way as to assure a motion of tensions adjustment of 375 mm.

The structure of resistance that takes over the tensions from the cable as well as the mechanism that assures the vertical shifting is assured by the plinth plate *10*, fixed by the mobile piece by means of screws, the rod plinth *11*, the oscillatory axial bearing *8*, the screw cutting rod *14*, which is screwed in the axels screw nut, the guidance plate *16*, and the fixing slide plate *17*, the last two pieces being in connection to the mobile piece.

The operation of the crew-screw nut mechanism is realized throughout a device with a click *13* (fig. 2), fixed through flutes on the screwed rod, operated by means of a handle *18*.

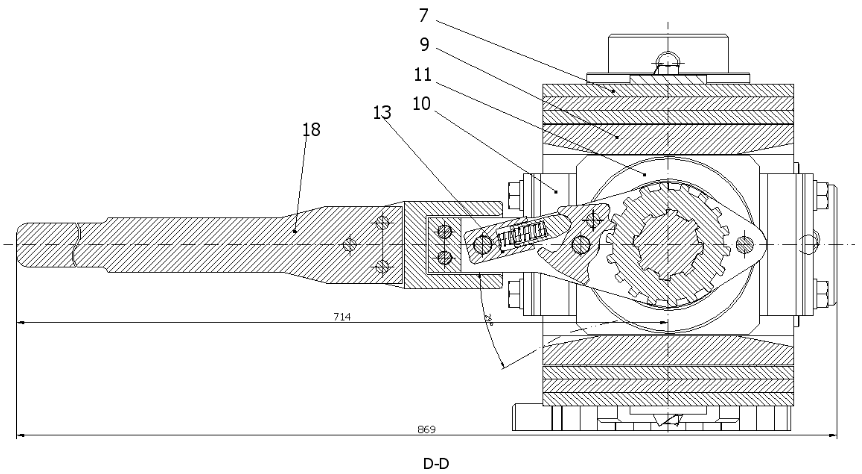

Fig. 2. Device with a catch

The main parts of the DEC-14 cable tension balance device are presented in figure 3.

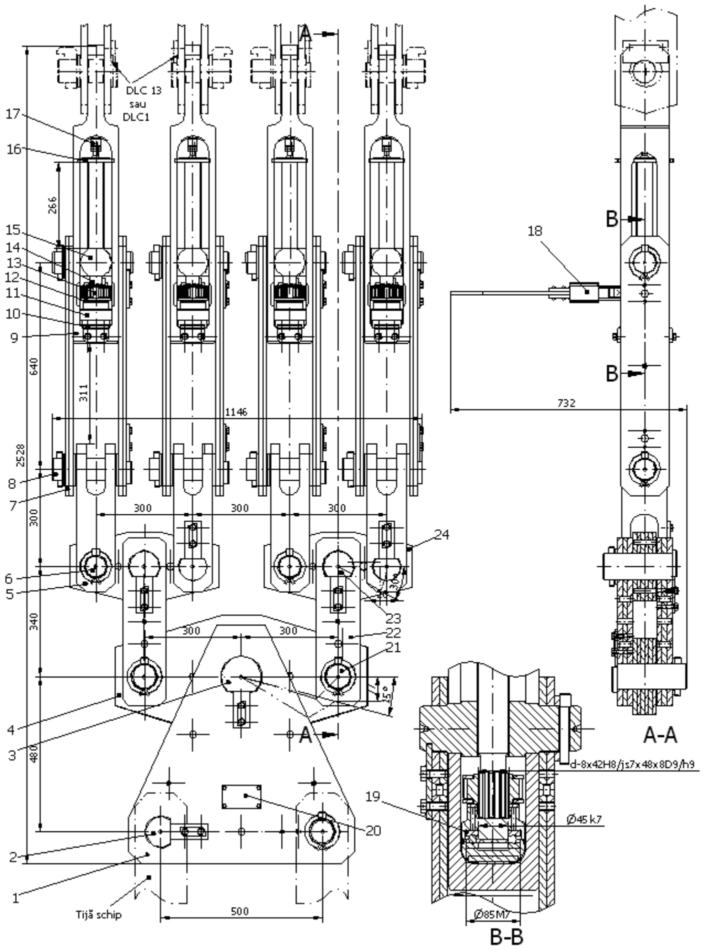

Fig. 3. DEC14 cable tension balance device

The DEC-14 cable tension balance device makes the connection between the skip and those four cable connection devices, assuring the balance of the tensions in those four cables.

The device is made up of the same elements as DEC-12, except the fact that there is a difference of the elements dimensions and of the connection pins from the device joint given in table 1.

In order to assure the branching for those four cables, two intermediate cover plates *22* are used, two secondary levers *24*, playing the role of working beams, fixed through the inferior and superior secondary pins *21* and *23* with diameters of 80mm.

3. Checking the cable tension balance devices

Because of the high safety coefficient that has to be applied to these devices, it is necessary an exact determination of the tensions in those elements, to make a better dimensioning.

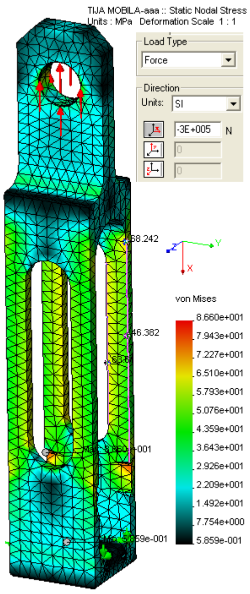

Fig. 4. The finite element analysis of the connection piece

Modelling the elements of the device has been made with the help of the Solid Edge software, and the analyses with finite elements has been made with the COSMOS Design STAR software.

The element with the most complex shape is the connection piece between the cable connection device and the screw - screw nut mechanism, that realises the cables stretching, respectively the limiting of the bending angle of the working beam when balancing.

By the classic calculus, that of traction stressing at a force of $3 \cdot 10^5$ N, there results a tension within the minimum section (those four rectangular section tie bars) of 51,44 MPa.

By the finite element analysis, presented in fig. 4, it is noticeable that the allocation of the tensions in the transversal section of a tie bar varies from 46,68 MPa, outside, to 63,61 MPa, inside, with tension concentrates up to 86,6 MPa.

Acknowledgements

Due to those mentioned above, we are to achieve, throughout attempts in the laboratory, the checking of this hypothesis given by the finite element method, that the allocation of the traction tensions within interior emissions pieces is not uniformly allocated on the entire transversal section.

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Structural and functional markers and calculation particularities for the pumping systems comprised by the hydraulic assemblies supplying the roof supports used in Jiu-Valley mines

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Abstract

Roof supports are essential systems for carrying out the underground coal mining process, offering the safety conditions for the manpower as well as for the coalface and the technological components involved. The particularities of the hydraulic system of the hydraulic roof supports are determined by their specific structure, by the operating liquid and by the length of the coalface to be supported.

The pumping systems comprised by the hydraulic power packs which supply the hydraulic roof supports are complex structures which together with the electric engine-decelerator-hydraulic pump also comprises a system of hydraulic devices used for the regulation and control of the hydraulic energy supplied. The hydraulic pumps used are most in line reciprocating plunger pumps, and their functional and constructive characteristics are determined by the required flow, by the type of liquid used as well as by the underground mining conditions.

The paper highlights all these particularities, giving some benchmarks for the computation of geometrical and hydraulic pumps parameters.

Keywords: mining equipment, coal mine roof supports, hydraulic power

1. Introduction

Underground mining is a complex activity which implies important as well as continuous costs and efforts. The mining method is therefore chosen according to the conditions of the coal deposit ensuring thus the safety of the massif as well as that of the activity being carried out. At present, the long wall face ensures the maximum production of coal for underground mining; this type of mining supposes a specific extraction technology as well as solutions to problems related to the ventilation of the working environment and the provision of conditions for the activity to be carried out in a high risk environment.

Carrying out the activities at the coal face requires the use of different types of energy: electric, hydraulic, and pneumatic, used individually, although most of the times combined. Considering the three categories of energy used, the maximum safety degree is represented by the pneumatic and hydraulic energies (the pneumatic energy brings forward zero risks in gassy environments, while hydraulic energy comes close to the same level of risk using hard flammable operational liquids). The supply of hydraulic and pneumatic energy is made through either rigid or flexible pipe networks; usually the main pipes of the gallery are metallic, while in the area of the coal face the pipes are required to be flexible to ensure the necessary mobility for the equipment, machineries and installations.

Considering the longwall faces, the mining of coal is made using drilling-blasting technologies and mechanised cutting using longwall combination machineries; both technologies comprise common elements such as roof supports and the machinery which ensures the haulage of the excavated material.

Hydraulic systems are used either for full operation or for the operation of different parts of the roof support, the combination machinery and the conveyor. The roof support is a hydraulic operated autonomous system, its supply being made from a high pressure pumping system which uses a hard flammable operating liquid; considering the combination

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machinery, these are autonomous, ensuring the vertical position of the machinery and the cutting parts, while considering the conveyor they are used for secondary functions such as anchoring the operation and turning stations, the operating liquid under pressure being supplied from the supply network of the roof support.

2. General reference points for coal face roof supports

The support of the mine work and the control of the pressure of the roof seeks to ensure that all the operations of the processes meet the safety conditions required for the human factor and the technical aspects of this type of works.

The roof support is a mining construction carried out to create the necessary working conditions free of danger for the entire duration of the underground production processes. The support is required to take over the pressure of the roof and not to allow tearing and the falling of rocks in the working space, to head off detachment and caving in of the fake roof and not to pierce the bedrock when it is weak.

Considering the connection of the support elements, i.e. prop and beam and their complexity, the roof supports are divided in two main categories: individual supports (with props and beams) and mechanised supports.

As it has already been mentioned, face roof supports are hydraulically operated autonomous systems, their supply being made from a high pressure pumping station which uses a hard flammable liquid: the liquid is an oil in water emulsion poor in oil (3 – 5 % oil in water). The transport of hydraulic energy over long distances is made through pipes of hundreds of meters long, because, according to regulations, the positioning of the pumping station is made in fresh air current, usually in the main gallery in a static position for a longer period of time; the maximum distance between the support complex and the station corresponds to the initial point of the exploitation, during the extraction of coal the distance decreases following the movement of the support.

Inside the coal face, the roof supports together with the conveyor and the technology / the main cutting machinery form the main coal face cutting and loading system which ensures the partial or complex mechanisation of works required for the extraction of coal.

3. Structural and functional markers of the hydraulic systems supplying the roof supports

The sectional and repetitive construction of a roof support, composed of a number of identical supports disposed in the entire length of the face determines in the form of the main hydraulic system a repeating pattern of the hydraulic circuits of each component, identic in number and type of execution, command and regulation elements. The support is created therefore of a large number of parts disposed along the coal face on lengths which may exceed 100 m, each operated by a number of hydraulic cylinders which may vary, depending on the type of support, from 3 or 5 for the individual supports and at least 4 for the mechanised supports.

The hydraulic cylinders are supplied with operating liquid by a pumping station (tank + pumping system) known as a hydraulic assembly. The operating liquid is a 3 – 5 % oil in water emulsion and it runs between the hydraulic aggregate and each supporting component through one, two or three main pipes which may be either rigid or flexible pipes, out of which at least one is a supply pipe while in the case of closed circuits one of the pipes is a return pipe.

The aforementioned structure of the hydraulic system of the support comprises thus a pumping station, a large number of hydraulic cylinders, a corresponding number of hydraulic devices (distributers, safety and retention valves, etc.), as well as an impressing length of rigid and flexible pipes of different diameters, the connection of which is realised using sealing fittings of different shapes and dimensions.

The main block diagram of the hydraulic system of the face roof support is presented in Figure 1.a where: FRS is the face roof support system composed of the supporting parts SP, while PSt / HA is the pumping station also called the hydraulic assembly; the diagram also presents two main pipes, i.e. a supply pipe and a return pipe to the tank.

The pumping systems PS (Figure 1,b) are systems for the generation of hydraulic energy which comprise the before mentioned hydraulic pumps HP, their actuating motors AM and all the operation command and control devices, the hydraulic parameters measurement and adjustment devices OCMAD; usually the pump HP-reducer gear R- actuating motor AM system is called the pumping unit PU. As it may be observed from the Figure, the command and control of the operation of the station may be carried out by acting upon the actuating motor or / and the pump and the control of the outlet hydraulic parameters is made with the help of pressure valves and through the division of the flow.

The individual roof support with hydraulic props and beams is used within the complex system with a scrapper conveyor, the excavation of the coal being carried out either through drilling and blasting either with a special machinery destined for this operation; this type of complex ensures the partial mechanisation of coal mining and extraction.

Considering the case of open circuit individual hydraulic props, the supply of pressurised oil in water emulsion is made from the pumping station through the distributors also called setting guns; after the supply the beam is positioned on the roof and the props are fastened with the maximum outlet pressure of the station. The bearing function and detensioning of the props is carried out by directly discharging the pressure into the environment, the pros not being fitted with a return circuit to the tank of the station. The hydraulic system is therefore simple, comprising a hydraulic

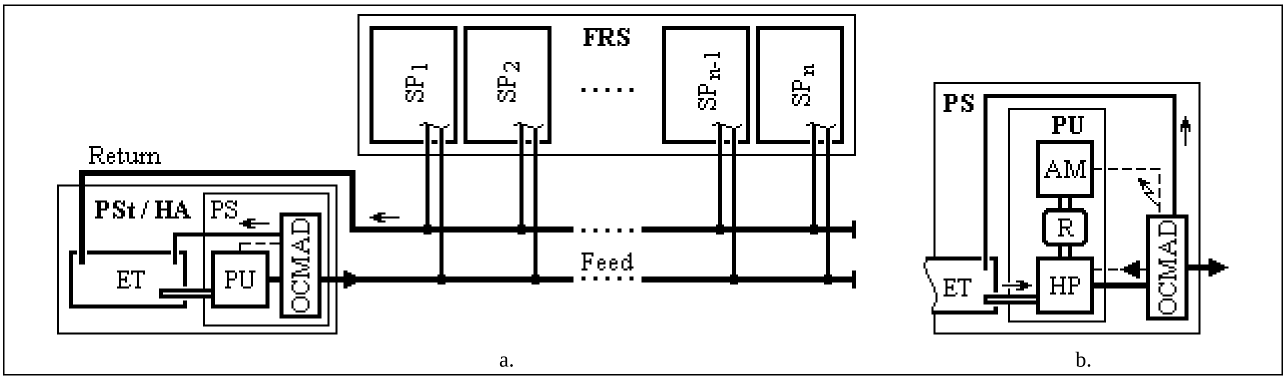

Figure 1. (a) hydraulic system for the operation of the face roof support RS: block diagram; (b) structure of the pumping system PS.

assembly with an reciprocating pistons pump and a one way main supply pump spread along the coal face, several stampling guns being disposed along the main pipe allowing the supply with liquid of all the props for the support roof parts SP_n

The mechanised roof support together with the coal cutting machine and the conveyor create a coal face combination machine, i.e. a system of cinematically interconnected machineries which ensure a complex mechanisation of all the necessary works required for the extraction of coal from long wall coal faces. It is composed of several identical support roof sections (components) disposed along the coal face, sections which move towards the face, following a certain pattern, as coal is being mined out. Each section is fitted with a self-actuating hydraulic system with double action hydraulic cylinders: the hydraulic system of each section is supplied from the pumping station through a pressurised main pipe, being connected to the main tank of the station PSt through a return pipe. The pressurised oil in water emulsion is discharged into the main pressurised pipe of the station through a regulating multifunctional circuit in order to regulate and control the outlet pressure through the variation of the flow and eventually to ensure the supply of reduced pressure to a second main pressure.

The pumping station PSt used to supply the roof support may contain one, two or more pumping systems / units PS / PU, one tank for the preparation and storage of emulsion ET, the control, safety and regulation panel, the distribution and auxiliary elements. The pumping units PU are composed usually of fixed volumetric pumps with outlet flows comprised within the range 35 to 600 (1000) L/min: the pumps mostly used are triplex reciprocating plunger pumps, although radial piston pumps are also used. The pumping units PU comprised by the pumping systems PS may be used either on independent lines, or their outlets may be connected in parallel to a single discharge main pipe.

4. Calculation particularities for the pumping systems composing the hydraulic assemblies used in Jiu Valley mines

There are three types of mining hydraulic assemblies manufactured in Romania:

- AH 78/350 at I.U.M. Filipeştii de Pădure and
- ACH 40/200 and AHC 40/320 at UPSRUEEM Petroşani, only the ACH 40/200 being still manufactured.

The mines in Jiu Valley are currently using the ACH 40/200 and the AH 78/350 hydraulic assemblies, as well as Polish manufactured units such as AZ-2sM and AZE-3. The hydraulic assemblies placed in the centre coal face, i.e. ACH 40/200, are used only for supports with individual hydraulic props, while the AH 78/350, AZ-2sM and AZE-3 hydraulic assemblies supply both the mechanised supports as well as the individual ones. All power packs are fitted with triplex reciprocating plunger pumps.

From the structure of the pumping systems composing the hydraulic assemblies used in Jiu Valley mines presented in Figure 2 it may be observed that the control of the operation of the station is carried out through the action of the actuating motor (a system of pressure switches supervises the presence of pressure in the lubricating mechanism of the pump and in the main supply pipe); the outlet parameters of the hydraulic pump HP, i.e. flow Q_P and pressure p_P, are constant, while at the station PSt outlet, after the measuring, control and command device of the hydraulic parameters OCMAD, the the values of the hydraulic parameters Q_{Si} and p_{Sj} are variable, determined by the initial settings, as well as by the operating characteristics of the hydraulic system.

A representative assembly for pumping unit composing the hydraulic assemblies used in mines for the supply of coal face supports is presented in Figure 2,b: the hydraulic pump HP + the reducer gear R. The valve assembly composed of three pairs of valves is placed in front of the three cylinders assembly: i.e. the suction valves SV and the discharge valves DV. The plunger pump and the valves are presented in Figure 2,c where: 1- plunger, 2- cylinder, 3- actuating system, 4- suction valve, 5- discharge valve.

The main parameters of the pump HP are constituted by the parameters of the stations PSt, and are the following:

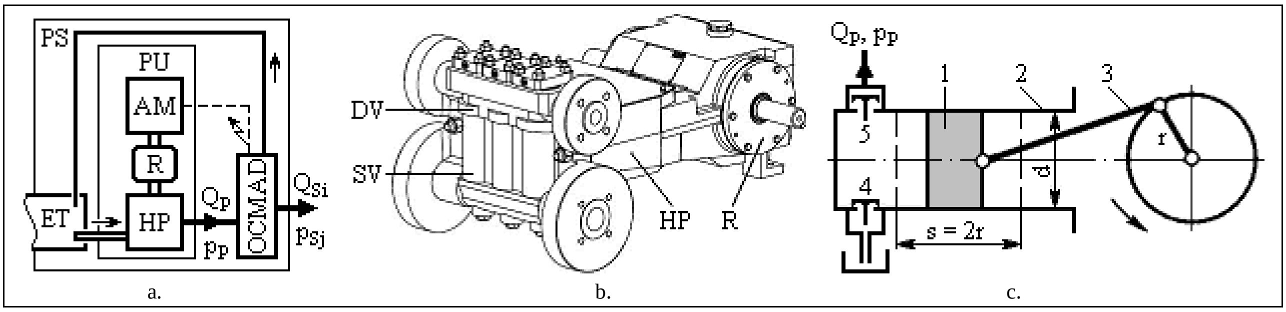

Figure 2. (a) the structure and hydraulic parameters of the pumping system PS comprised by the hydraulic assemblies used in Jiu Valley; (b) the hydraulic pump – actuating system assembly; (c) the plunger pump and the fix cylinder.

- The theoretical quantity of operating liquid pumped during a rotation of the shaft is called *Geometrical capacity*:

$$V_{gP} = \frac{\pi d^2}{4} s \cdot z = \frac{3\pi}{4} d^2 \cdot s \cong 2{,}355 d^2 \cdot s, \tag{1}$$

where: d is the diameter of the plunger; s – is its stroke inside the cylinder; z = 3 – is the number of cylinders.

- *The theoretical flow of the pump* is determined using the following relation

$$Q_{TP} = V_{gP} \cdot n_{aP}, \tag{2}$$

where n_{aP} is the rotation speed of the shaft of the pump.

- *The real flow* of the pump may be determined using the following relation

$$Q_P = Q_{TP} - \Delta Q_P, \tag{3}$$

where ΔQ_P is the internal volume loss of the pump due to the leaks between the plunger and the walls of the cylinder, the incomplete filling of the cylinder during the aspiration phase and compression of the volume during the outlet phase of the pump, usually the internal volume loss is not calculated but experimentally determined.

- *The real flow of the station* $Q_{Si} \le Q_P$ is determined by the existence of a high capacity accumulator placed at the outlet following the one way valve and the OCMAD structure, which comprises a hydraulic command distributer which automatically discharges into the tank the outlet of the pump when it reaches a pre-set pressure p_d: as long as the pump discharges into the tank, the hydraulic system of the support is serviced by the accumulator. After the discharge of the accumulator and reaching the pressure p_c, the distributor automatically connects the outlet of the pump with the main supply pipe and the accumulator.
- *The pressure of the station* $p_{Si} \le p_P$ is determined by the load of the of the supplied, by the energetic consumption established by the operating characteristics with the installation and the difference between the connecting and respectively the disconnecting pressures p_d and the reconnecting pressure p_c previously mentioned.
- *The maximum pressure* developed by the pump is limited by the safety valve, its characteristic being that of dissipating the pressure when it opens and closes,

$$p_{max P} = p_{SV} + \Delta p_{SV}, \tag{4}$$

where p_{SS} is the trigger action of the safety valve, $\Delta p_{SV} \approx (0{,}05 – 0{,}08) p_{SV}$.

- *The maximum torque* at the shaft of the motor of the of the pumping unit PU is

$$M_{max aP} = \frac{V_{gP}}{2\pi}\left(p_{max P} + \Delta p_P\right), \tag{5}$$

where Δp_P is the mechanic-hydraulic loss of the pump.

5. Conclusions

Calculation principles presented allow the value estimation of the hydraulic output parameters of the hydraulic assembly, being the starting point for a subsequent calculation combined with the information obtained from an experimental study on pumping station and hydraulic system of face roof support.

Effects of material quality and span length on the optimum design of non-standard sized above-ground pipelines

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Abstract

The optimum design is widely used in engineering practice. It is always important to aim at the best price or just material saving. The optimum dimensions of the pipeline can be determined using different steel grades, span lengths and different geometrical and loading conditions. Span length, material quality, tube diameter and thickness are variables. In this study only the material cost is minimised with non-standard sized geometrics.

Keywords:optimization, pipeline, non-standard, stress, stability, slenderness

1. Introduction

Using optimum design is the best way to find the best price or material savings. Structural optimization is one of the most developing design method in structural design. The main requirements for high load-bearing structures are safety, capacity, efficiency and manufacturability. Design and fabrication conditions are formulated at the level of analysis, as well as the objective function (Farkas and Jármai, 1997).

Theoretical and experimental knowledge of different loaded structures allows finding the optimal solution for a given task. To make sure you get the optimum solution you need a sufficient number of data. Earlier studies already carried out a number of structural optimal design, which confirmed the importance of the optimization of structures (Farkas et al., 2004, Virág, 2006 and Virág, 2009). The results are significantly influenced by the considered conditions. In this paper above-ground pipelines are investigated which look similar to the structure in Figure 1, where a pipe-bridge is not installed.

Fig. 1. An above-ground pipeline

Transportation pipelines are investigated where we disregard geometries used in practice which put a serious obstacle to finding effective structural optimum (Virág, 2013). The numerical example examined the effect of the material quality and the spanlength that these changes will influence the optimal geometry. In each calculation only the tube diameter and thickness are variables. The inner pressure is calculated for each inner diameter.

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2. Design constraints

The following conditions should be taken into account in case of design of high-pressure pipelines: stress, deflection and stability constraints, and although hydrodynamic investigation is not taken into account the velocity of flow is limited.

2.1. The limit of flow velocity

The specific conveyed medium always determines the economic flow rate (Table 1.). In case of too high flow velocity undesired phenomena may occurs e.g. noise, vibration or erosion. Therefore there is a limitation of flow velocity. In the numerical example it is limited by 20 m/s.

Table 1. Economic flow rates of gases and fluids (Juhász 1995)

Medium	Type of pipeline	Velocity (m/s)
Water	Waterworks and distribution system conduits	
	- main	1...2
	- long-distance	<3
	- local network	0,6...0,7
	Feedwater	1,5...3
	Cooling water	0,6...2
Steam	low pressure (up to 10 bar)	15...20
	medium pressure (10...40 bar)	20...40
	high pressure (60...125 bar)	40...70
Air	compressed air	20...25
Oil	Long-distance pipelines	1,5...2
	Lube oil	0,5...1

2.2. Stress constraint

The stress constraint can be calculated as known inner pressure, dead-load.
The distributed load is

$$p = \left(1,2A\rho_a + 1,1A_t\rho_g\right)g \tag{1}$$

where ρ_a is the density of the steel, A_t is the area of transportation, ρ_g is the density of high pressure gas and the area of the pipe wall is

$$A = \frac{\left(D^2 - d^2\right)\pi}{4} \tag{2}$$

In structural analysis, Clapeyron`s theorem of three moments is a relationship between the bending moments at three consecutive supports of a horizontal beam. Let *A*, *B*, and *C* be the three consecutive points of support, and denote by *l* the length of *AB* and by *l`* the length of *BC*. Then the bending moments M_A, M_B, M_C at the three points are related by

$$M_A l + 2M_B(l + l') + M_C l = \frac{6a_1x_1}{l} + \frac{6a_2x_2}{l'} \tag{3}$$

where a_1 is the area on the bending moment diagram due to vertical loads on AB, a_2 is the area due to loads on BC, x_1 is the distance from A to the center of gravity for the bending moment diagram for AB, x_2 is the distance from C to the center of gravity for the bending moment diagram for BC.
So the bending moment at the middle support according to the Clapeyron formula is

$$M_2 = \frac{2,5pL^2}{4} \tag{4}$$

where *L* is the distance between the supporters.
The stress is

$$\sigma_1 = \frac{M_2}{K_x} \tag{5}$$

where

$$K_x = \frac{\left(D^4 - d^4\right)\pi}{32D} \tag{6}$$

where *D* is the outside diameter and *d* is the inside diameter.
Barlow’s formula can be calculated as

$$\sigma_2 = \frac{p_b d}{2t} \tag{7}$$

where D is the outside diameter and d is the inside diameter.
Reduced stress is

$$\sigma_R = \sqrt{\sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2} \tag{8}$$

The permissible stress is

$$R_{adm} = \frac{f_y}{n_e} \tag{9}$$

where safety factor n_e is 1,2 and f_y is the yield stress.
The stress constraint is

$$\sigma_R \le R_{adm} \tag{10}$$

2.3. Deflection constraint

The deflection of the pipe between the supports can be calculated as follows

$$w = \frac{pL^4}{284EI_x} \tag{11}$$

where E is the elastic modulus and the moment of inertia is

$$I_x = \frac{\left(D^4 - d^4\right)\pi}{64} \tag{12}$$

The limitation of the deflection is

$$w \le \frac{L}{300} \tag{13}$$

2.4. Stability constraint

Stability is a major problem in the construction design, because instability causes malfunction or failure in many cases. This constraint depends on the ratio between the outer diameter and the wall thickness. The limit is given by Eurocode to avoid local buckling in the tube walls:

$$\frac{D}{t} \le 90\varepsilon^2 \tag{14}$$

where

$$\varepsilon = \sqrt{\frac{235\text{MPa}}{f_y}} \tag{15}$$

3. Numerical example

The aim of this survey is to find the lowest mass per unit length pipe for a given transporting volume flow rate. To obtain this optimum, the best outside diameter and wall thickness combination has to be found. In this numerical example the mass flow rate is about 30 m^3/s of carbon dioxide. The distance between the supports are L = 20, 30, 40 and 50 m and the yield stresses of the material of the tube are f_y = 235, 355, 460, 590 and 690 MPa.

The optimum results for different tasks are calculated by Excel Solver Non-linear module which uses gradient method where the unknowns were the outside diameter and wall thickness. The results for different spanlengths and material qualities are shown in Table 2, 3, 4 and 5.

Table 2. Results for spanlength of L = 20 m

yield stress [MPa]	Outside diameter [mm]	Wall thickness [mm]	Mass per unit lenght [kg/m]
235	***1155***	***13***	***366***
355	1169	20	567
460	1181	26	741
590	1197	34	975
690	1209	40	1153

Table 3 Results for spanlength of L = 30 m

yield stress [MPa]	Outside diameter [mm]	Wall thickness [mm]	Mass per unit lenght [kg/m]
235	***1155***	***13***	***366***
355	1169	20	567
460	1181	26	741
590	1197	34	975
690	1209	40	1153

Table 4. Results for spanlength of L = 40 m

yield stress [MPa]	Outside diameter [mm]	Wall thickness [mm]	Mass per unit lenght [kg/m]
235	1921	22	1030
355	***1291***	***22***	***688***
460	1181	26	741
590	1197	34	975
690	1209	40	1153

Table 5. Results for spanlength of L = 50 m

yield stress [MPa]	Outside diameter [mm]	Wall thickness [mm]	Mass per unit lenght [kg/m]
235	3000	34	2487
355	2017	34	1663
460	1575	35	1329
590	***1243***	***35***	***1043***
690	1209	40	1153

In the tables there are optimum geometrics for different spanlengths and material qualities. The difference between these optimums can be more than double. The optimum geometrics for different spanlengths are marked by bolt italics. The smaller spanlength gives the global optimum for this case, but the costs of supports are not taken into account.

4. Conclusions

The aim of this paper was to find the lowest mass per unit length pipe for a given transporting volume flow rate. The optimum geometry is fundamentally influenced by the maximum flow velocity. Increasing the yield strength the stability constraint changes the optimum geometry. Increasing the spanlength the stress constraint than the deflection constraint becomes activated. These changing trends confirm the real value of the optimum design.

Acknowledgements

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Strength properties of fullerene-containing composite materials based on phenylone

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Abstract

The task of finding possible ways of obtaining polymer composite materials (PCM) combining a certain set of operating characteristics remains topical in the engineering industry. The work contains the examination of properties of nanocomposites based on phenylone C-2 filled with nanostructured carbon. The influence of the filler’s concentration on the properties of the developed composition materials is shown.

Keywords: polymer composite materials (PCM); phenylone; fullerene; fullerene soot; fullerene black.

1. Introduction

Thermally stable aromatic polyamides are promising as binders in the process of PCM development (Sokolov, et al. 1975). Details made of aromatic polyamides possess high strength and heat resistance, and filling phenylone with conventional solid lubricants (PTFE, graphite, etc.) greatly improves its antifriction properties (Burya, et al. 1996). Authors of (Prylutskyy, et al. 2003) examined fullerence-based composites for bio-nanotechnology. (Vityaz', et al. 2012) presented techniques for obtaining fullerene-containing materials based on metals and semiconductors. Degradation of fullerene composites macromolecular chain was analyzed by (Chubarova, et al. 2005). Interaction between fullerene and graphene in a polymeric matrix was studied by (Alzari, et al. 2015).

On discovery of a new molecular form of carbon - fullerenes (Kroto, et al. 1985) - in 1985, the choice of fillers that allow to diversify the range of synthesized materials has significantly expanded. It is possible to develop a vast amount of PCM using carbon nanotubes, fullerenes, fullerene soot, fullerene black, as well as other nanostructured carbon.

The present work is aimed at developing and investigating properties of newly elaborated composite materials based on thermo-resistant aramide phenylone C-2. The objective has been achieved by filling the initial polymer matrix with nanostructured carbon.

2. Objects and research techniques

Phenylone C-2 (TC 6-05-226-72) is a linear heterocyclic copolymer containing an amide group -HNCO-, connected phenyl fragments on both sides, within its major chain. It is obtained by polycondensation of emulsion (Sokolov, et al. 1975) of m-phenylenediamine with a mixture of dichloranhydrides of isophthalic and terephthalic acids taken in the molar ratio 3:2.

To improve phenylone performance, disperse fillers (Fl) have been used, in particular, nanocluster carbon modifiers: fullerene C_{60}, fullerene soot (FS), fullerene black (FB) (manufacturer "JSC NeoTechProdukt", St. Petersburg).

Fullerene C_{60} is a product obtained by means of arc evaporation of graphite. Preparing its concentrate is conducted as described in (Sedov, 1963). Final cleaning to merchantability is carried out with the use of activated carbon. The content of fullerenes makes 99.9 %.

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Fullerene soot is a kind of soot obtained by means of arc evaporation of graphite. It is black powder, insoluble, with bulk density of 0.25 g/cm^3, fullerene content makes 11 %.

Fullerene black is soot remaining after removing the fullerene mixture by means of non-polar organic solvents and treated with steam to remove the organic solvent. It is insoluble black powder which possesses bulk density of 0.5 g/cm^3, and contains no more than 0.1 % of fullerene.

3. Research results

Analyzing the behavior of materials under compression (Fig. 1) for all composite materials it has been noted that the "stress-strain" dependence is similar to that of the initial phenylone C-2. Namely, the curve contains a straight segment which corresponds to elastic deformation; a segment showing a deviation from Hooke's law related to the features of macromolecules' segmental mobility; yield strength, after which plastic deformation develops; a stage of deformation strengthening and destruction.

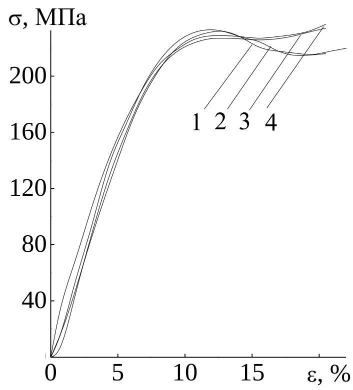

Fig. 1. Typical curves σ-ε for phenylone C-2 (1) and nanocomposites containing fullerene C_{60} (2), fullerene soot (3), fullerene black (4)

Varying the content of fullerene C_{60} within the investigated range has shown that the value of the factor of yield stress at compression is somewhat reduced in case of the filler content of 0.5 wt.%, and in case of further increase of its concentration (1.5 and 3.0 wt.%) there is a tendency of σ_m increase. In this case, the elastic modulus increases within the whole investigated range. Nanocomposites containing 0.5 and 1.5 wt.% of fullerene C_{60} possess the maximum relative deformation, Fig. 2.

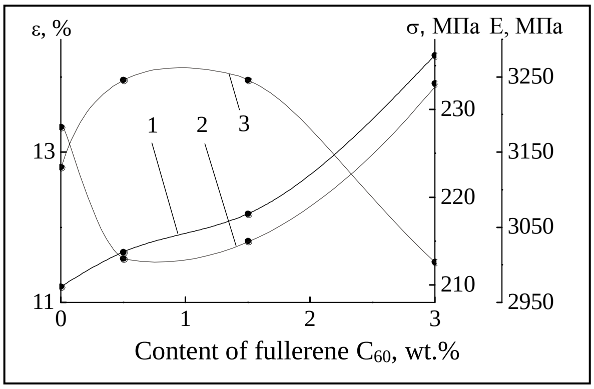

Fig. 2. Effect of fullerene C_{60} content on the value of elasticity modulus (1), yield strength (2) and relative deformation (3) at compressing of nanocomposites' samples

Regarding the features of PCM samples' deformation, it should be noted that the initial stage of destruction is connected with crack development starting with the equilibrium state of the compressed part of the material near the crack. The second stage of destruction is connected with the development of cracks, starting with the state appearing after stability loss. In this case, these compositions show the tendency to samples' fragility increase with the growth of the filler concentration. Thus, the proportion of brittle fracture is 0 % for the samples containing 0.5 wt. % of fullerene C_{60}, and 20 and 30 %, with a degree of filling of 1.5 and 3.0 wt. % respectively.

In case of using FS it has been noted that at the filling degree of 0.5 wt.% the minimum values are observed, and the further increase in filler concentration in the compositions (1.5 and 3.0 wt.%) leads to a monotonous increase of such indices as elasticity modulus and yield strength at compression, Fig. 3. At the same time these compositions also show the tendency to samples' fragility increase with the growth of filler concentration. the proportion of brittle fracture is 0 % for the samples containing 0.5 wt. % of FS, and 30 and 60 %, with a degree of filling of 1.5 and 3.0 wt. % respectively. The concentration dependence of relative deformation reaches the maximum when the content of FS makes 1.5 wt.%.

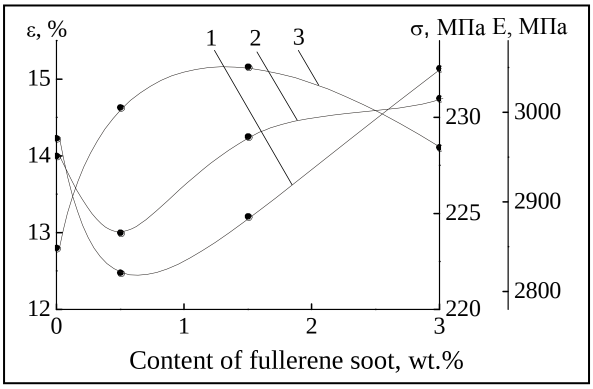

Fig. 3. Effect of fullerene soot content on the value of elasticity modulus (1), yield strength (2) and relative deformation (3) at compressing of nanocomposites' samples

Regarding the FB, it has been found that in case of the filling degree of 0.5 wt.% there is a certain decrease, and in case of a further increase in filler concentration within the compositions (1.5 and 3.0 wt.%) there is a growth of such indices as elastic modulus and yield strength at compression. The concentration dependence of relative deformation reaches the maximum when the content of FB makes 1.5 wt.%, Fig. 4.

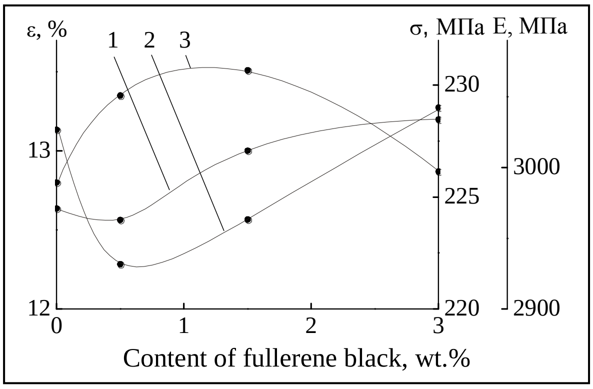

Fig. 4. Effect of fullerene black content on the value of elasticity modulus (1), yield strength (2) and relative deformation (3) at compressing of nanocomposites' samples

Nanocomposites samples' destruction has got a somewhat different nature from that of the initial polymer's destruction. Phenylone C-2 and nanocomposite containing 0.5 wt.% of FB shows plastical destruction, while the other nanocomposites show both plastical and brittle fracture, Fig. 5.

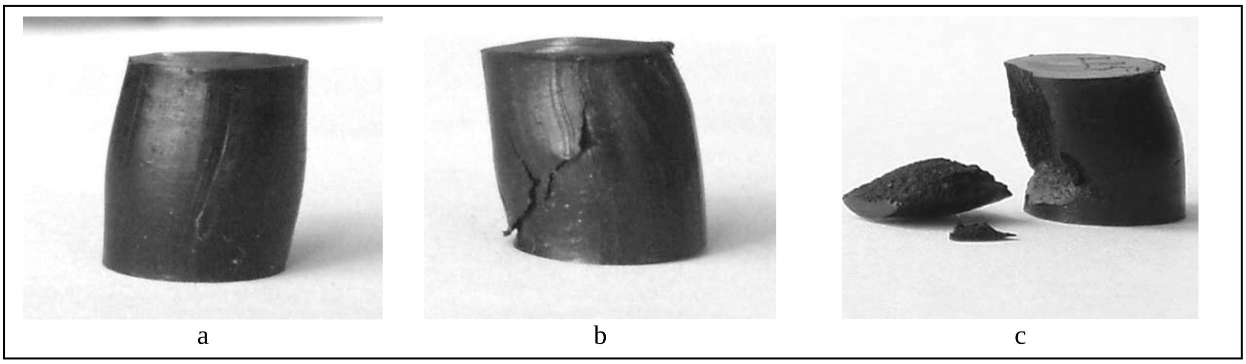

Fig. 5. The nature of composite samples' destruction: a - plastical fracture; b, c - brittle fracture

When the content of the filler makes 1.5 wt. %, the samples show brittle fracture in 20 % of cases. In this case inclined cracks are oriented towards the sample axis at an angle of about 45 °, i.e. parallel to the platforms, where the greatest shear stresses act $\sigma_{max} = \sigma / 2$ (Larkov, 1963). This allows to conclude that such samples will be the best to resist shear. The further increase in the filler content up to 3.0 wt.% increases the inclination angle, while deteriorating shear resistance and, moreover, leads to increased fragility of samples (up to 30 % of cases).

It has been found that the elastic modulus and yield strength for all the developed fullerene-containing PCM within the filling range of 0.5-3.0 wt.% change symbatically to the share of phenylone macromolecules that have moved to marginal layers, which is explained by the effect of interstructural interaction when the dispersed filler's particles are located on interfaces of overmolecular structures in the areas of defects and affect the flexibility of the polymer macromolecules. (Burya, et al. 1998)

The microhardness (H_μ) values of all the composites mostly remain at the level of the initial phenylone C-2. Some disadvantages of these compositions include the reduction of shock viscosity (a_n), Table 1.

Table 1. Properties of fullerene-containing composites based on phenylone

Indices	Content of filler, wt.%			
	0	0.5	1.5	3.0
1	2	3	4	5
phenylone C-2 + fullerene C_{60}				
σ_m, MPa	228	213	215	233
E, MPa	2971	3017	3068	3279
ε, %	12.8	13.96	13,96	11.54
H_μ, MPa	320	327	332	289
a_n, kJ/m^2	43.24	13.22	12,65	12.14
phenylone C-2 + fullerene soot				
σ_m, MPa	228	224	229	231
E, MPa	2971	2988	3111	3081
ε, %	12.8	14.63	15,16	14.11
H_μ, MPa	320	332	329	296
a_n, kJ/m^2	43.24	7.36	3,36	3.25
phenylone C-2 + fullerene black				
σ_m, MPa	228	222	224	229
E, MPa	2971	2963	3012	3034
ε, %	12.8	13.35	13,51	12.87
H_μ, MPa	320	333	312	290
a_n, kJ/m^2	43.24	6.69	4,24	4.14

4. Conclusions

The results of investigating strength properties of the composite materials have allowed to reveal that due to the most perfect structural organization of phenylone C-2 in case of the affect of a filler in the amount of 1.5 wt.%., such composite materials possess the optimum correlation of the elastic modulus, yield point and plasticity.

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7th International Multidisciplinary Symposium

„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Microcontroller System For Monitoring A Wind Generator

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Abstract

The price of electricity produced using aerogeneratoars is steadily decreasing, reaching a minimum. Harnessing this potential energy has a fundamental component, data collection about aerogenerator, for processing and optimization of production process of energy. In the system proposed by me, the costs are low and the benefits are manifold. The project can be expanded and improved, and can generate statistics on monthly or annual average wind speed in the area using an anemometer and an analogue input of the microcontroller. Data taken fot be saved and archived for a thorough study of the potential of wind in the area. Electricity charged can be totaled on different time intervals, such as weeks, months, or years.

Keywords: optimization,transport data,energy;

1. Introduction

It will consider a wind generator single phase power. Using a microcontroller ATMEGA 328 mounted on a plate ARDUINO it will retrieve the following sizes: the speed of the generator ; electrical voltage at the terminals of the generator power,; generator charge amperage through the circuit.Four sizes will be displayed on a LCD display-serial at the same time will be sent to a computer for processing and display of graphic-type values of the specified quantities. All sizes will be sent to a web server to be accessed with a fixed or mobile device (smartphone, Tablet) using an INTERNET connection. System consisting of generator, microcontroller and display device is connected to a computer through a USB port, which will ensure at the same time and power supply microcontroller Board. There are also variant operation with individual power to a voltage source. For electrical power cut of electric generator, be sure to use a variable load. Discount rate of electrical quantities taken over by microcontroller, can be variable, and then in the system devised by me was set at one second. Type display system (LCD) was chosen for the way work independently when the microcontroller Board is supplied separately and the system operates independently of a computer. Data transmission in the internet network in the way freelance work can be done with an ETHERNET card, but this case will not be presented in detail, leaving this aspect to be the subject of study for an expansion of the project's facilities.

2. General Electric scheme

The Figure 1. presents the electric diagram realised with Express PCB.

Electrical diagram single-phase generator connected differs to the rectifier. Filtering is performed with an electrolytic capacitor and stabilization with a LM 7805. The characteristics of this circuit can be seen in the annexes. To determine the value of the electric voltage in different points of the electrical circuit, use a voltage divider for each point. Elected to this method because the currents flowing through the circuit have low values and hence the electrical losses through low-value resistors of the electrical resistance will be negligible. There are four points of the circuit to determine the electrical voltage value. These points, A0, A1, A2, A3, will connect to the analog inputs of the plate Arduino. On the basis of differences in the intensities voltage currents flowing through the two main sides of the circuit. So, knowing the value of resistor R3 and the voltage at its terminals, determine amperage by connecting side of the generator and battery. Similarly proceed with flowing R5 and the side that makes the connection between battery and

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electric consumers. The circuit will retrieve a LM7805 voltage will be between 4, 8V and 5, 2V, so you'll have a powerful linear feature.

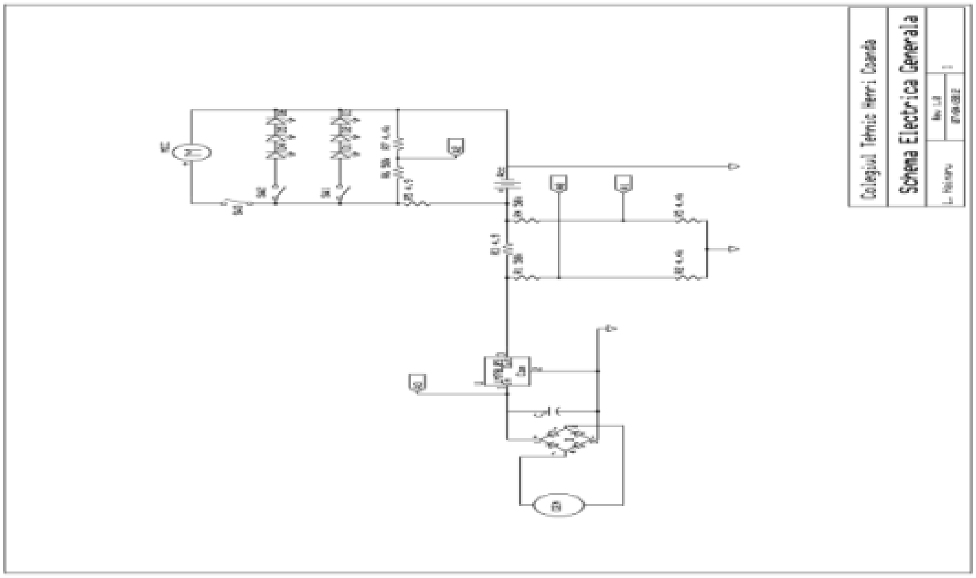

Figure 1

To be able to see changes in electrical voltage as a function of the speed of the generator, we considered it opportune to blood collection and before stabilizing circuit, this tension will be applied to the Arduino board enters into A3. For a good view of the electrical generator power cut, electrical consumers will connect in three steps as follows:

In the first stage, closing the first circuit breaker, will connect the three LEDs. In the second step, closing the second switch, it will connect three LEDs. In the third stage, will connect the DC-power. The tree will be variable and will allow the cutting power of variation upon the generator.

Voltage Dividers are used to protect the analog inputs of the microcontroller. The maximum voltage that can be applied to an analogue input is 5V. Using the voltage divider, the voltage value applied to analog, entry is given by the formula:

(1)

$$U_{out} = \frac{U_{in} \cdot R_2}{R_1 + R_2}$$

Where the meaning of the measurand is the following: electrical voltage Uout-at the outlet voltage divider; Electrical voltage UIN-at the entrance of the voltage divider; R1, R2 are the two resistors in the voltage divider;

In this formula, one can see that the value of the voltage applied to the terminals of the electric plate Arduino depends on the ratio of Electrical resistors R1 and R2. They were chosen to decrease the voltage to about 1/8 of the voltage at the output circuit LM7805. Resolution that expresses the value of analog input size is 10 bits. Therefore, the smallest variation in voltage that can be detected by the microcontroller, is given by the following formula*:*

(2)

$$U_{\min.} = \frac{5V}{1024} = 0{,}004V$$

So the lowest voltage that can be applied to the analog inputs of the microcontroller's is 4 mV. Because determining the current intensity is based on the measuring of the difference in voltages low-value resistors terminals of electric resistance, from the experimental determination of the voltage drop on the resistors, I measured the voltage difference of 1 .25V, this amount being sufficient to determine the value of the intensity of the current through the circuit. Current intensity calculation is done by the microcontroller. In the same way will be calculated and charged electric power, making it the product of voltage and current.

3. Determination of revolution and wind generator

To determine the running speed of the generator will use the Arduino board and two components will be mounted on one side and the other propeller rotor supported by e: an LED that emits in the infrared spectrum and a fototranzistor. Electrical Schematic is as follows:

Led infrared emission is connected on 13 of the digital entry microcontroller. Fototranzistorul is powered at 5V through a resistor to limit the current through it. Numeric entry 2 a microcontroller is connected directly to the collector of the transistor. Principle of determining the running speed is as follows: propeller with seven blades, so seven interruptions during a period, is positioned between the LED and fototranzistor. When positioned in between the two is a palette, the transistor is locked and when between fototranzistor and LED a slot is found, fototranzistorul is found in tunneling. It follows that in order to determine a rotation,fototranzistorul must have seven cycles of lock-conduction.

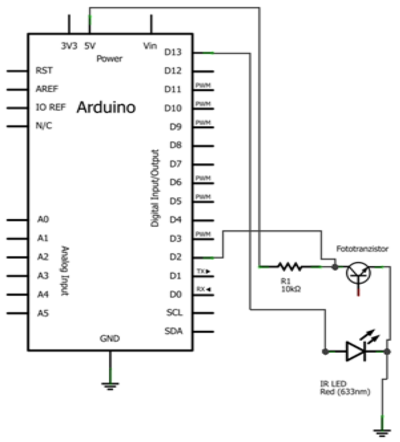

Figure 2

The sequence of the program written to calculate the running speed is shown below. It was written to convey the data so the device type serial LCD display as well as the computer's serial port, when the card is connected to a PC.

4. The algorithm of calculating the running speed

```
#include <Software Serial.h> //se include librăria necesară transmiterii către portul serial al PC
#include <SparkFunSerLCD.h> // se include librăria necesară funcționării LCD
SparkFunSerLCDled(7,2,16); // numărul pinilor de conectare a LCD pe placa Arduino
intledPin = 13;              // se declară pinul de conectare a led-ului IR
volatile byte rpmcount;
unsignedint rpm;
unsigned long timeold;
voidrpm_fun() // se definește funcțiarpm_fun
 {
   //La fiecarerotație, această funcție este rulată de opt ori
   //calculează RPM
   //actualizează numărătoarea
rpmcount++;
 }
void setup()
 {
Serial.begin(9600); // inițializez transmisia pe portul serial al PC
led.setup(); // inițializezafișajul LCD și pentru asta folosesc librăria declarată la început
delay(1000); // decalaj de o secundă
led.at(1,1,"RPM: "); // poziționez cursorul pe prima linie a afişajului şi scriu RPM:
   //Interuperea O, se regăsește pe pinul digital 2, acolo unde este montat fototranzistorul
   //Când tensiunea scade de la valoarea maximă la minimă, starea de schimbă din HIGH în LOW
attachInterrupt(0, rpm_fun, FALLING);
   //Declar pinul 13 ca ieșire şi alimentez led-ul
pinMode(ledPin, OUTPUT);
digitalWrite(ledPin, HIGH);
rpmcount = 0;  //inițial valorile variabilelor sunt zero
rpm = 0;
timeold = 0;
 }
void loop()
```

```
 {
   // Actualizează RPM la fiecare secundă
  delay(1000);
   // Procesul nu se întrerupe atunci când se calculează
  detachInterrupt(2);
   //rpm se calculează după formula 60*1000/(millis() - timeold)*rpmcount dacă întreruperea
  //este egală cu unu la o singură rotație.Pentrucă elicea are şapte întreruperi, se va calcula după
   //formula cu 60/7=8.57*1000/(millis() - timeold)*rpmcount
  rpm = 8.57*1000/(millis() - timeold)*rpmcount;
  timeold = millis();
  rpmcount = 0;
   //Afișează rezultatul pe LCD și trimite-l și pe serial
  Serial.println(rpm);
  led.at(1,6,"     ");
  led.at(1,6,rpm);
   //Restartează procesul de întreruperi
  attachInterrupt(2, rpm_fun, FALLING);
  }
```

This sequence can be determined very high engine speeds and updating data on the LCD can be done at a desired time interval, we chose one second by default. The LCD device allows customization of data display mode, using different effects. In the program notes how RPM for a propeller with seven blades, can adapt to different propellers with more or fewer blades.

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7th International Multidisciplinary Symposium

„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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The potential of wind in the area

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Abstract

In the system proposed by us, the costs are low and the benefits are manifold. The project can be expanded and improved, and can generate statistics on monthly or annual average wind speed in the area using an anemometer and an analogue input of the microcontroller. Data taken fot be saved and archived for a thorough study of the potential of wind in the area. Electricity charged can be totaled on different time intervals, such as weeks, months, or years. . In 2005, bringing a worldwide total of approximately 58000 empowerment MW.

Keywords: optimization,transport data,energy;

1. Introduction

The energy of stream of air moving at veloricitylinear shall be determined by using the kinetic energy formula:

$$E = m\frac{v^2}{2} \tag{1}$$

m – is the mass of air in motion and is given by the formula:

$$m=\rho V=\rho S v \tag{2}$$

ρ – represents the air density and V is the volume, which runs through an area some, in a unit time. Air flow, power expressed in Watts will be given by:

$$P = \frac{\rho}{2} S v^3 \tag{3}$$

For normal atmospheric pressure and temperature of 15 0 C, the air density is 1, 225Kg/m ^ 3, and for variations of 100 m, the variation of density is not more than 5%. The rated speed of the wind turbines, modern high-output ranges between 12 m/s and m/s. due to the low density of the air, to capture more energy, you have increased the area of the propeller. A modern turbine with power of 1500kW, will have a rotor diameter of 60 m.

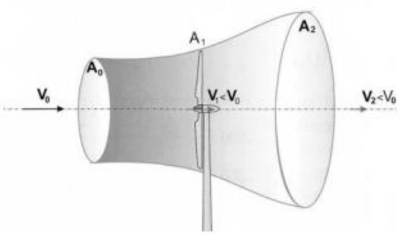

Figure 1

From his expression Betz limit it follows that an ideal wind turbine can extract from a wind power not exceeding 59,3%. Starting from this premise, it is found that the effectiveness of the conversion of the airflow into mechanical energy will be less than optimal value if the turbine Rotor: has a number of large, paddle or if the rotor rotates with a

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very high speed, and each blade moves in a distorted due to airflow from the front blade. Turbine rotor has a number of small paddle, or a very small angular velocity and flow of air passing through the rotor area without having to interact with it. From these two premises, it follows that in order to obtain a maximum conversion efficiency, speed of the wind to be correlated with the rotational speed of the rotor. It will introduce the dimensionless parameter λ, the rapidity of the turbine. This parameter represents the ratio of the linear speed of the blade and wind speed:

$$\lambda = \frac{V1}{V2} = \frac{\varpi R}{V2} \tag{4}$$

V1 – the speed of a point on the length of the circle described by the tip of a pale

ϖ – is rotational speed

R- the radius of the propeller

V2 – wind speed

Operational characteristics of wind generator coordinates HP (factor Betz) and λ (speed), it can be said that the three turbine blades has the highest efficiency and the factor of efficiency of turbine blades with 12-18 is less than 3-factor turbine blades and shall not exceed 0.35.

2. Fixed speed wind

Principle scheme of a fixed speed wind is as follows:

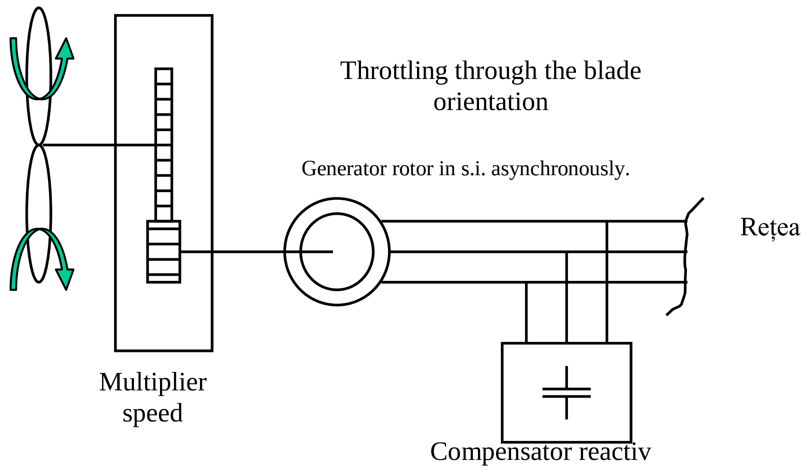

Figure 2

This type of implementation involves the operation of the two schemes: the autonomous Regime, when fueling tasks in isolation. The generator is either a synchronous machine with permanent magnets or an asynchronous machine with cage rotor, fitted with devices for securing the reactive energy. Network operation arrangements, when the machine rotation speed is constant, for stable operation. This speed is required by network supplied frequency. Imposition of a steady, significantly restricts the scope of application areas for this type of installation.

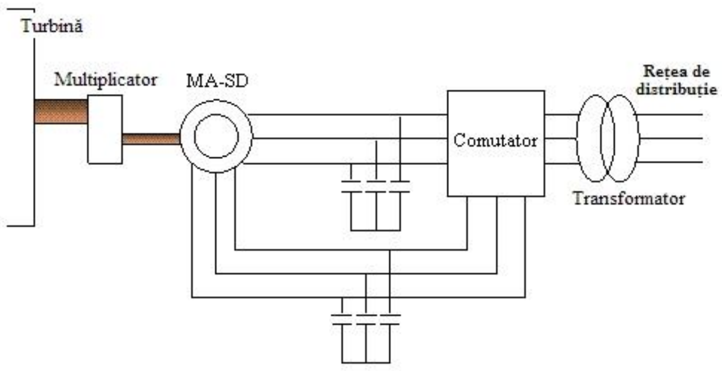

Figure 3

When the asynchronous generator is used, it is either squirrel cage rotor winding with either. When the rotor is wound, the asynchronous generator powered double appears. Another possible configuration is an asynchronous generator with a variable number of pairs of poles. This schema includes the possibility of functioning of eolienei with two speeds. Stator has two types of windings, which determines a variable number of pairs of Poles, so two fields. Winding power, but with the large number of poles for use in wind speeds. Winding power with small number of pairs of Poles, used for high speeds of wind. Such a system diagram is shown in the following figure

The following figure presents an aerogenerator and speed adjustment system of the power input and the offset.

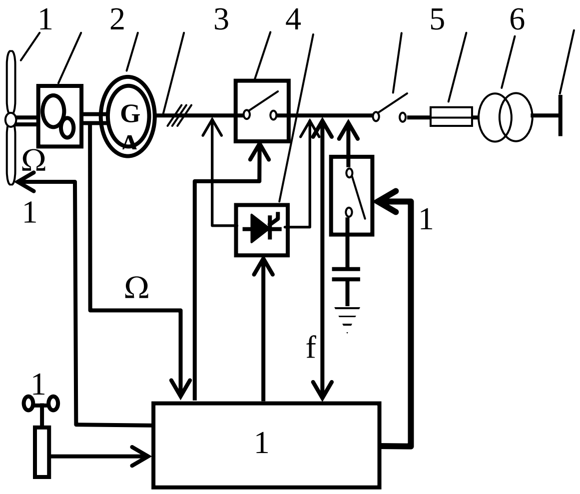

Figure 4.- 1-wind sensor; 2-kinematic transmission; 3-induction generator with cage rotor; 4-electrical connection; 5-switch; 6-thyristor system; 7-separator; 8-fuses; 9- who raises voltage transformer; 10-control unit and command; 11-anemometer; 12-regulating power subsystem; 13-the energy subsystem reactive (power capacitors); 14-distribution of electricity.

3. The V90 3MW Aerogenerator from company VESTAS from Denmark

This variant underwent substantial improvement relative to previous models, both in terms of performance as well as reducing maintenance costs. As also emerges from the name, this aerogenerator has an installed power of 3Mw and can be controlled remotely using a microcontroller and a SCADA system. It is made of special materials, the latest generation of what are used in the aviation industry. Equipped with a cooling system and high voltage transformer poyiţionate inside the basket. For modern aerogeneratoarele are at your disposal. smart positioning systems. A section through the mounted platform, can be seen in the following figure

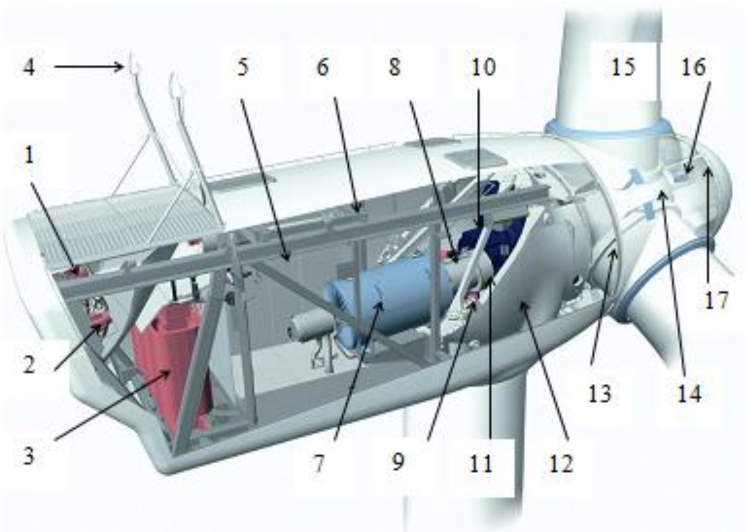

Figure 5.- 1-oil cooler; 2-water cooling system of the generator; 3-turn tor high voltage; 4-speed sensor wind ul-trasonic; 5-VMP-Top regulator with converter; 6-spare parts for cranes; 7-asynchronous generator OptiSpeed; 8-disc coupling; 9-yaw mechanism camps; 10-Reducer; 11-mechanical brake; 12-socket for accessories; 13-blade camps; 14-blade hub; 15-Pale; 16-cylinder pitch control; 17-control guideline basket.

The main characteristics of the aerogenerator V90-3.0 MW are: rotor diameter-90 m; the area swept propeller-6362 m2; the nominal speed of the impeller-16.1 rotations/min; normal operating range-8,6-18.4 rotations/min; number of propellers-3; the Tower's height 80-105 m; wind speed coupling-4 m/s; rated wind speed to 15 m/s; wind velocity decoupling-25 m/s; asynchronous generator with OptiSpeed control 50 Hz; power adjustment of Pitch/type OptiSleep; microprocessor-based control with the possibility of remote control-type SCADA.

Conclusions

The price of electricity produced using aerogeneratoarelor is steadily decreasing, reaching a minimum. Harnessing this potential energy has a fundamental component, data collection about aerogenerator, for processing and optimization of production process of energy. In the system proposed by me, the costs are low and the benefits are manifold. The project can be expanded and improved, and can generate statistics on monthly or annual average wind speed in the area using an anemometer and an analogue input of the microcontroller. Data taken fot be saved and archived for a thorough study of the potential of wind in the area. Electricity charged can be totaled on different time intervals, such as weeks, months, or years.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH"

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Optimizing energy characteristics

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Abstract

To verify the results obtained through the methodology of analytical calculation based on experimental tests of laboratory were undertaken experimental research in conditions career at E-Lupoaia demolition 04 1300 type SRs in step II of sterile (grey blackish clay). Given the random nature of the process of cutting the scratchy material, represented by the grey clay quarry Lupoaia, constant deviation is relatively small, acceptable conditions in anyway lignite quarries. This supports the contention that the methodology of calculation used is usable in the study of cutting systems-load of classic low-rotor. Improving the system of cutting the rotor loading backhoes involves the use of methodologies for calculating well-grounded and the results obtained on the basis of experimental tests in laboratory and in SITU

Keywords: transport optimization

1. Experimental studies on optimization required

Based on the research and design work undertaken, were manufactured by S.C. UREX S.A. Rovinari a set of teeth for a complete demolition of the rotor to E-04 type SRs 1300 Lupoaia career. Experimentation with new types of teeth occurred in September 2015 and was done under the same conditions as the research undertaken to verify the results obtained by analytically computing methodology based on experimental laboratory tests, carried out in March 2015 on the same rung of sterile (dull blackish clay), same excavator and roughly the same structure of the front.

Fig. 1. Bucket with teeth in our front

For comparison of synthetic running regime if the excavator teeth begotten, design and produce in the context of this paper, with the situation of using the existing teeth, will be used like index performance power consumption at the excavation. Specific energy consumption at the excavation can be determined with the relation:

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$$E_s = \frac{P_i \cdot T}{3600 V_a}, \text{ [kWh/m}^3\text{]} \quad (1)$$

Where : Pi represents average strength active registered at cutting a complete shavings, kW;
T – measured during excavation , s;
Va – a complete volume of chips , m^3.
A comprehensive volume on the same slice chips shall be determined by the relationship:

$$V_a = H \cdot h_m \cdot L_H, \quad \text{m}^3 \quad (2)$$

where the thickness of the chip's average is calculated from the relationship (May 27), and the distance traveled by a Cup to a full swivel LH .

Table 1.The data used for comparison

Nr. crt.	Swivel effect	Test no.	The width of the block B, m	Cutting height H, m	Swivel RADIUS Rp, m	Maximum thickness of -wool Board ho, m	During excavation T, s	Slewing speed vp, m/s
1.	right	16	66	1,8	41,68	0,6	168	0,54
2.	left	17	66	1,8	41,68	0,6	168	0,54
3.	right	19	66	1,8	41,68	0,7	174	0,53
4.	left	22	66	1,8	41,68	0,7	174	0,53
5.	right	23	66	1,8	41,68	0,8	178	0,51
6.	left	24	66	1,8	41,68	0,8	178	0,51
7.	right	25	70	3,5	41,68	0,6	428	0,23
8.	left	26	70	3,5	41,68	0,6	428	0,23
9.	right	28	70	3,5	41,68	0,7	434	0,222
10.	left	29	70	3,5	41,68	0,7	434	0,222
11.	right	30	70	3,5	41,68	0,8	438	0,22
12.	left	31	70	3,5	41,68	0,8	438	0,22

Table 1. Measurand in experimenting new teeth

Nr. crt.	Swivel effect	Test no.	The width of the block B, m	Cutting height H, m	Swivel RADIUS Rp, m	Maximum thickness of -wool Board ho, m	During excavation T, s	Slewing speed vp, m/s
1	right	41	76	4	41,68	0,6	371	0,285
2	left	42	76	4	41,68	0,6	418	0,253
3	right	43	76	4	41,68	0,7	410	0,258
4	left	44	76	4	41,68	0,7	729	0,145
5	right	45	76	4	41,68	0,8	652	0,162
6	left	46	76	4	41,68	0,8	724	0,146

Substituting yields:

$$E_s = \frac{P_i \cdot T}{3600 \cdot H \cdot h_m \cdot L_H}, \quad \text{[kWh/m}^3\text{]} \quad (3)$$

Taking into account the data in table 3 for measurements and recordings made in the Lupoaia career Haroon SRs 1300 equipped with existing teeth, resulting:

$$E_s = \frac{P_i \cdot T}{491.732 h_o}, \quad \text{[kWh/m}^3\text{]} \quad (4)$$

Using this relationship and corresponding data excavating height H = 3.5 m of table 1 shows the specific energy consumption for each test, as shown in table 3.

Table 3. Measurand and based on existing teeth

Nr. crt.	Nr. încercării	Timpul măsurat T, s	Maximum thickness of -wool Board Ho, m	Registered average power Pi, kW	Specific energy consumption Es, kWh/m3
1	25	428	0,6	298	0,435
2	26	428	0,6	422	0,609
3	29	434	0,7	303	0,378
4	30	438	0,8	337	0,377
5	31	438	0,8	313	0,345

Specific energy consumption of the environment resulting from the arithmetic mean of the values calculated on the basis of the measured data, whereas the share of tests carried out was pleased about. In this case:

$$E_{smed} = 0{,}429 \quad [\mathrm{kWh/m^3}] \tag{5}$$

Similarly, for the data presented in table 4 for measurements and records made under conditions similar to demolition SRs equipped with 1300 new teeth, it appears the expression calculation:

$$E_s = \frac{P_i \cdot T}{783.576 \cdot h_o}, \quad [\mathrm{kWh/m^3}] \tag{6}$$

Using the relationship (5) yields the data in table 4.

Table 4. Results and calculated sizes for new teeth

No. crt.	Test no.	Time measured T, s	Maximum thickness of -wool Board Ho, m	Registered average power Pi, kW	Specific energy consumption Es, kWh/m3
1	41	371	0,6	221	0,173
2	42	418	0,6	199	0,177
3	43	410	0,7	302	0,224
4	44	729	0,7	343	0,451
5	45	652	0,8	265	0,270
6	46	724	0,8	401	0,462

Specific energy consumption average in this case is Es med = 0,292 kWh/m3.

Analyzing the data obtained, resulting in a reduction of the specific energy consumption by 32% compared to using existing teeth.

One can notice that the experimental tests with existing teeth were made after a number of hours when they had a relatively small degree of wear, and experiment with new teeth were made immediately after fitting the rotor, so with sharp teeth able.

However it can approximate that a reduction of the specific energy consumption occurs at least 20 ... 25%, which confirms the wisdom on one hand values calculated from the results of laboratory experiments, and on the other hand the fact that the shape and geometric parameters you teeth have been thus begotten, respectively elected as to lead to a great work of cutting system bootstrap backhoes rotor.

2. Conclusions

Improving the process of excavation reserves, if we take into account the benefits from new and constructive geometric solutions regarding the placement of the teeth on the cups, and the cups. In addition, the depth study of the phenomenon of wear of the teeth and the cups would in a whole stage possibilities of improvement of cutting system-loading, including from the point of view of sustainability, winners and the impeller.

The results of his research in the field of lignite and deployment using the teeth of excavator, in conjunction with those of the research concerning the excavation parameters in front of work, ensures increased efficiency cutting system-low rotor loading in general with the Customizing for the particular case of Motru basin.

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Optimal configurations for industrial robot

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Abstract

Accuracy of odometer measurements for the determination of fixed position is the indirect result of kinematic design of the vehicle. Due to the close relationship between kinematic model and positioning accuracy, consider the first cinematic design before attempting to improve accuracy. For this reason, in the following we present some of the most popular cinematic schemes. In the second part of this work we will treat a few methods of reducing errors in the recently developed, odometer for some of these schemes.

Keywords: transport,optimization;

1. Theoretical aspects

1.1. Pushbutton switches

Figure 1 illustrates a typical differential drive mobile platform LabMate, manufactured by the TRC. In this scheme of differential encoderele are mounted on the two motors to count the rotations of the wheel. The robot can perform simple position recognition using mathematical equations, computes the relative position of the vehicle at the momentary position start.

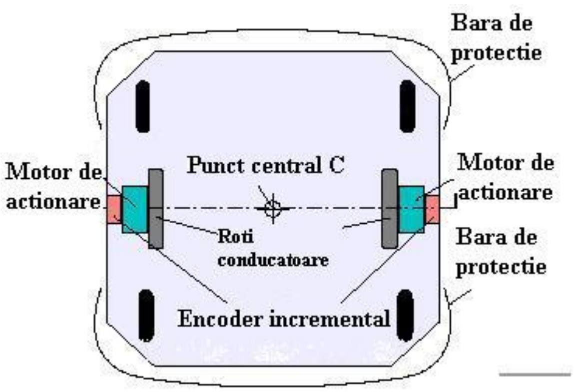

Figure 1 Typical scheme of a differential drive mobile robot (view)

Order will be the subject, we present equations odometer. Assuming that the desired interval in the left wheel and the transducer at the right shows the impulse increments NL, respectives NR. We consider that:

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$$c_m = \pi \cdot D_n / n \cdot C_e \quad (1)$$

Where :
cm – conversion factor which encodes linear displacement transducer in the impulses of the wheel;
Dn – diametrul nominal al roţii (in mm);
Ce -resolution of the transducer (in pulses/rotation);
n – gear ratio of the gears of the engine (where the transducer is located) and the wheel drive.

We can calculate the distance travelled by the incremental wheels left and right , ΔUL,i and ΔUR,i, According to the relationship:

$$\Delta U_{L/R,i} = c_m N_{L/R,i} \quad (1')$$

and incremental linear displacement of the Centre of gravity , ΔUI:

$$\Delta Ui = (\Delta UR - \Delta UL)/2 \quad (2)$$

Next, we compute the incremental change in the orientation of the robot:

$$\Delta\square i = (\Delta UR - \Delta UL)/b \quad (3)$$

where b is the length of the front and rear wheels, measured as the distance between the two points of contact between the wheel and the floor. New orientation relative to the robot may be deducted from:

$$\theta i = \theta i\text{-}1+\Delta\theta i \quad (4)$$

and the relative position of the center of gravity is:

$$xi=xi\text{-}1+\Delta Ui\cos\theta i \quad (4a)$$
$$yi=yi\text{-}1+\Delta Ui\sin\theta i, \quad (4b)$$

where xi, yi are the relative positions of center point c at the moment i.

1.2. Tricycle press

Actuator configuration tricycle (fig. 16) involving a single driven wheel (front) and two wheels at the rear, passive (or vice versa) is quite common in construction applications due to the simplicity of the AGV. In terms of measurements, use a odometer sensor angle of direction, recognition of the position is equivalent to a vehicle driven by Ackerman, where imaginary steering wheel replaces the Central wheel. In the meantime, if odometria the differential rear deck is used to determine the direction of movement, the solution is the same configuration with differential drive. A problem associated with the influence of tricycle is that the Centre of gravity of the vehicle tends to move off of the front wheel from crossing a surface inclined, causing a loss of traction. As if driving scheme Ackerman, some

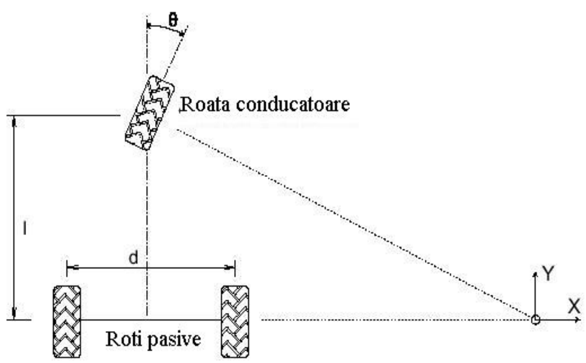

Figure 2 Influence of tricycle configuration involves a directional wheel and two wheels, and can generate information on the distance travelled directly from a steering angle sensor, or indirectly via the on-board odometer malfunction and differential induction of offset errors are possible when acting direction while the platform did not move

1.3. Ackerman's Leadership

Used almost exclusively in the automotive industry, is intended to ensure that Ackerman turning the wheel towards the Interior with a slightly sharper angle than the outside wheel in cornering, thus eliminating earthfalls tire induced surface geometry. As shown in Fig. 2, the axes of the two extended front wheels intersect in a common point on the axis of the shaft from the rear. The plane determined by the points drawn from the center of each wheel in the direction of walking is, in this case, a set of concentric arcs around this central point of rotation, P1, and (ignoring any centrifugal acceleration) all instant speed vectors will be tangenţi to these arcs. Such leading geometry can satisfy the equation Ackerman:

$$ctg\theta_i - ctg\theta_0 = d/l \qquad (5)$$

where :

θ_i -relative angle of the steering wheel;

θ_0 -relative angle of the steering wheel;

l – the distance between the centres of the front and rear wheels;

d – the distance between the left and right wheel.

For ease of calculations, the angle of the steering of the vehicle can be seen as an angle associated with a central wheel located in the reference point P2, as in fig. below. θ_{SA} can be expressed by means of steering angle either inside the outside (θ_i or θ_o):

$$ctg\,\theta_{SA} = \frac{d}{2l} + ctg\,\theta_i \qquad (6)$$

sau, alternativ,

$$ctg\,\theta_{SA} = ctg\,\theta_o - \frac{d}{2l} \qquad (7)$$

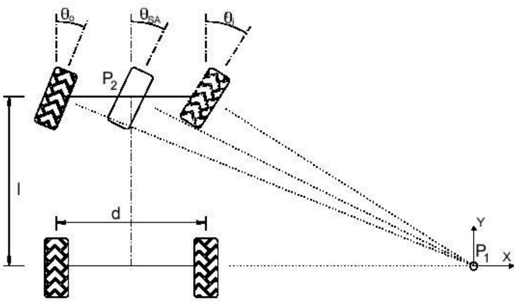

Fig. 3: In Ackerman's leadership has extensive, digvijay all wheels is intersecting in a point Común.

Method of driving odometric offer a solution Ackerman with a pretty good accuracy, making it the choice for autonomous vehicles. This implementation involves the use of a gasoline or diesel engine mated to a manual or automatic transmission with all-wheel drive through a transfer, differential, and a host of cable joints. The representative example is the prototype HMMWV from USMC Tele-Operated Vehicle (TOV) Program. From the perspective of a military operation and safety component reliability, it recommends. Significant problems of the interface can be encountered, however, in adapting the existing vehicles, intended for humans to be able to be operated by remote control or by computer.

1.4. Synchronous operation

Mechanical synchronization can be accomplished in various ways, most commonly using a chain or belt drive gear box. Carnegie Mellon University has implemented an electronic version of sync on one of the robots series Rover's own engines, gearing up for each of the three wheels.

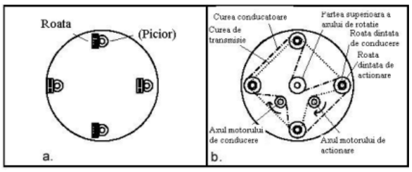

Fig. 4 : Synchronous drive configuration with 4 wheels: a) view from the bottom; b) vue de dessus.

Configurations using chain or belt drive suffers degradation of accuracy due to unequal distribution, leadership of which vary based on load and direction of rotation. In conclusion, the strâmtarea distribution chain or strap to reduce the game, individual wheels must be realiniate. These problems are eliminated by using a fully enclosed transmission, which also reduces the noise or the scattering of particles, the latter being very important in applications for clean rooms.

To prevent these problems, the robot uses Cybermotion Navmaster configuration with K2A transmission, as shown in Fig. 5. and 6. When the robot is trained in a turn, the wheel rotates in the direction involved corresponding to minimize wear and tear on the floor and tires, power consumption and slipping. It is observed that for a proper compensation, coupling, gear wheel shaft must be located after the shaft of it. The equation that governs the minimum method is slipping:

$$\frac{A}{B} = \frac{r'}{r} \qquad (8)$$

Where :

A – the number of teeth on the ring gear wheel shaft tapered leader;
B – the number of teeth of conical toothed wheel wheel axle;
r' – offset of the wheel axis swivel ;
r – the radius of the wheel

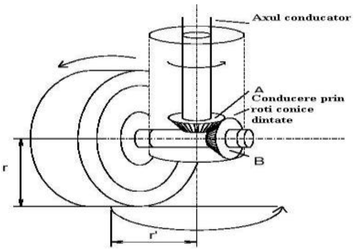

Fig. 5: Compensate for slipping in a cornering is achieved using wheels for bevel gear transmission, to the three wheels of robot K2A Navmaster.

A shortcoming of this method is manifested through the lower lateral stability, when a wheel is rotated under the vehicle. Cybermotion has improved variant K3A, scheme of realization of solving this problem (even with a shorter distance between front and rear wheels), incorporating a montage with double wheels at each leg. Double wheels positioned in opposite directions of pivot leg in turn, and good stability is maintained in this instance of the movement outside of the wheel. Odometer for synchronous actuators make calculations are relatively simple; the direction of movement of the vehicle is derived from the size of the transducer angular direction, while heading for the purposes of movement arises from:

$$D = \frac{2\pi N}{C_e} R_e \qquad (9)$$

Where :

D = the movement of the vehicle along the path;
N = pulses of transducer on the motor shaft;
C_e = conjunction with the impulses of the wheel's rotation is complete;
R_e = the effective radius of the wheel;

Fig. 6 a) model Cybermotion b) Model Denning Se K2A.

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Optimal tensioning effort of belt

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Abstract

In order to stretch labor value quantification based on load torque and operating conditions we recommend using appropriate methodologies to ensure on the one hand the determination of the proper value and labor, on the other hand to establish the place of location of the expanse used conveyor. In order to stretch labor value quantification based on load torque and operating conditions we recommend using appropriate methodologies to ensure on the one hand the determination of the proper value and labor, on the other hand to establish the place of location of the expanse used conveyor.

Keywords: transport optimization; belt conveyor

1. Optimization by mathematical calculation

Fundamentally, a belt conveyor can be considered to cause a translating one dimensional movement. It spans distances through a combination of intermediate supports and the tension in the belt. The tension is a combination of that needed to make the flexible belt reasonably straight, that needed to overcome the resis tance to movement, and other tensions necessary for various components to work consistently.

All three have wide interdependencies with the conveyor path and the material handled which combine to make the accurate prediction of tension very difficult as it varies around the conveyance and return circuits. Nevertheless, belt tension is a primary influence on the cost and function of virtually all belt conveyors and is a key design parameter.

Accurately predicting the tension is therefore a key objective when developing a conveyor in order to optimize investment and operating efficiencies.

Tension forces in the belt have a decisive role in proper operation of belt conveyor and strength of the belt. On the other hand, the effective tightening of the belt depends on the total resistance of movement of the belt or the type and capacity of the transported material, and from the mass of the belt and route conditions.

The selection of quality belt conveyor for a particular plant is based on the maximum force of tension. From the governing equations below equations it is clear that the ability of the pulley to move the belt will increase if the angle of wrap is increased around the pulley or coefficient of friction is increased.

In practice single pulley drive are usually limited to an arc of contact of about 230º (exceptionally 240º) when using a snub pulley behind the drive pulley. Improved coefficient of friction may be obtained by suitably lagging the drive pulley surface.

In this paper are realized calculations of weights of loads in rubber belt of conveyor which at the same time are done according to tension force of belt that relates with the force of rope of pulleys. We have done the calculations of forces during the tension of system with tow and four pulleys, these calculations have its technical and economical importance because is know the duration of belt and tension rope and enable to know the time of replacement of belts and their operation and maintenance.

When distributed drive power is applied to a belt conveyor system, the system designer gains the opportunity to control and to reduce the tension in the belt.

The most important result of this ability to influence the belt tension is that it enables the system designer to reduce the belt’s strength requirements.

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The reduction in belt strength allows:
• A lighter and cheaper belt construction and support structure.
• The possibility to standardise system components. As the system length and power requirements increase the same type of belt can still be used by adding more drive stations.
• An increase in layout flexibility. With the lighter belt construction the belt can negotiate tighter turns and the smaller drive units occupy less space.

The actual reduction of the required belt strength does, however, depend on the application because the conveyor belt has a double function; firstly, the belt has to be strong and stiff enough to support a specified volume of bulk solid material without exceeding sag limits and secondly it has to be strong enough to transfer the required drive forces. As the belt length and power requirements increase, the potential benefits to be gained from the application of a distributed drive system also become larger.

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2. Determination of the necessary tension of belt

It is known that in order to avoid slippage of the belt in full operation it is recommended that the calculations to be made wear 20…30% traction force, which can be passed on to the drum. This attrition of thrust in the calculations take into account by the coefficient kf, according to the relationship:

$$K_f S_i = S_d e^{\mu\theta}, \quad [N] \tag{1}$$

where: Si the effort represents the first winding drum drive, N;

S_d – the ongoing effort of the last drum drive, N;
μ - coefficient of friction between the belt and drum drive;
θ - the total angle of coiling of the belt on drums, rad engines.

Taking into account the fact that the theoretical maximum winding effort Taking into account the fact that the theoretical maximum winding effort Si max is:

$$S_{i\max} = S_d \cdot e^{\mu\theta}, \quad [N] \tag{2}$$

where θ a represents the angle of sliding of the tape on the drum, the resulting value of the coefficient represents the angle of sliding of the tape on the drum, the resulting value of the coefficient kf thus:

$$k_f = \frac{S_{i\max}}{S_i} = \frac{e^{\mu\theta}}{e^{\mu\theta_a}} \tag{3}$$

In order to determine the value of the angle a for a specific reserve coefficient kf relationship (4) is hereby amended as follows:

$$k_f e^{\mu\theta_a} = e^{\mu\theta} \tag{4}$$

Apply logarithm to equality (4) yields

$$\theta_a = \theta - \ln k_f^{\frac{1}{\mu}} \tag{5}$$

Or:

$$\theta_r = \ln k_f^{\frac{1}{\mu}} \tag{6}$$

Applying relationships (6) and (7) for an angle conveyors θ = 440o, reserve coefficient kf = 1,3, friction coefficient de μ = 0,3, It follows θa = 390o and θr = 50o, where θr = θ - θa and represents the angle of repose and relatively narrow-belt between drum. In order to determine the optimum effort stretching of the tape will resume the relationship (1), i.e.:

$$k_f S_i = S_d e^{\mu\theta}, \text{ [N]} \tag{7}$$

where the total angle of the belt's winding drum drive is: where the total angle of the belt's winding drum drive is:

$$\theta = \theta_1 + \theta_2, \text{ [rad]} \tag{8}$$

where θ1 and θ2 represent the angles of coiling, in order, the two drums. represent the angles of coiling, in order, the two drums.

Relationship (1) you can write and form: Relationship (1) you can write and form:

$$S_d = \frac{k_f S_i}{e^{\mu\theta}}, \text{ [N]} \tag{9}$$

or

$$S_i = S_d \frac{e^{\mu\theta}}{k_f}, \text{ [N]} \tag{10}$$

Taking into account the fact that the effort is:

$$W_o = S_i - S_d, \text{ [N]} \tag{11}$$

yields:

$$W_o = S_d \frac{e^{\mu\theta} - k_f}{k_f} \tag{12}$$

Or

$$W_o = S_i \frac{e^{\mu\theta} - k_f}{e^{\mu\theta}} \tag{13}$$

From relationships (12) and (13) the resulting expressions and winding effort underway, depending on traction effort, as follows:

$$S_i = \frac{W_o e^{\mu\theta}}{e^{\mu\theta} - k_f}, \text{ [N]} \tag{14}$$

respectively:

$$S_d = \frac{W_o f_f}{e^{\mu\theta} - k_f}, \text{ [N]} \tag{15}$$

On the other hand thrust in the outskirts of drum drive power arises from the relation:

$$W_o = \frac{1000 P_m \eta}{v \cdot k_r}, \text{ [N]} \tag{16}$$

where: $\eta = \eta_r - \eta_{tm}$ represents the total yield of action groups. represents the total yield of action groups.

Pm – power input of the load, kW;

v – transport speed , m/s;

kr- backup power coefficient.

Replacing Wo in the relationship (16) into (14) and (15) yields

$$S_i = \frac{1000P_m \cdot \eta e^{\mu\theta}}{vk_r\left(e^{\mu\theta} - k_f\right)}, \quad [N] \tag{17}$$

And

$$S_d = \frac{1000P_m \cdot \eta k_f}{vk_r\left(e^{\mu\theta} - k_f\right)}, \quad [N] \tag{18}$$

Maximum thrust Wmax What can be developed on the outskirts of drums of actuator Motors corresponds to the amount of engine power at the torque of upheaval Mr and shall be determined by the relationship::

$$W_{max} = \frac{1000P_m \eta \lambda_1}{v \cdot k_r}, \quad N \tag{19}$$

Where: λ 1 represents the coefficient of overload of the motor and can be determined with the relation: represents the coefficient of overload of the motor and can be determined with the relation:

$$\lambda_1 = \frac{M_r}{M_N} \tag{20}$$

Where MN is the torque of the engine (engine) , Nm.

For the case of an overload or stalling of the tread, sliding between it and any action should be excluded even if the engines stop under load. In this situation the force transmitted by the friction between the drum and the belt must be higher or at least equal to that of the propulsion engines developed at the torque of the capsize.

Noting with Si max and Sd max the effort of the winding in the appropriate venue, the thrust force Wmax, for the above correlation must be satisfied the inequalities:

$$S_{i\,max} \geq \frac{1000P_m \cdot \eta\lambda_1 e^{\mu\theta}}{vk_r\left(e^{\mu\theta} - k_f\right)}, \quad [N] \tag{21}$$

$$S_{d\,max} \geq \frac{1000p_m \cdot \eta_1 k_f}{vk_r\left(e^{\mu\theta} - k_f\right)}, \quad [N] \tag{22}$$

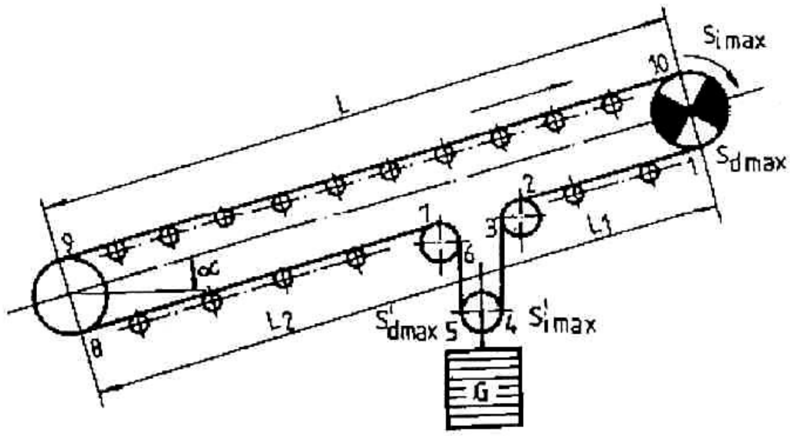

Fig. 1. Simplified scheme of a belt conveyor

If you consider a scheme which has the principle shown in Figure 3 and note with S'i max and S'd max efforts from the point of wrapping belt or the deployment of the board of stretching and F1-4 resistant forces moving portion of the belt 1-2-3-4, and with F5-10 same for portion 5-6-7-8-9-10, then we have:

$$S'_{i\max} = S_{d\max} + F_{1-4} \tag{23}$$

and

$$S'_{d\max} = S_{i\max} - F_{5-10} \tag{24}$$

Neglecting the local resistance forces and noting the tension drum Fir optimal initial effort stretching can write: efforts from the point of coiling, namely ongoing board and with

$$F_{ir} = S'_{i\max} \cong S'_{i\max} = S_{d\max} + F_{1-4} = S_{i\max} - F_{5-10} \tag{25}$$

Substituting this into the relationship (25) at his limit values Sdmax the relationship (22) and specifying the amount of forces resisting on the 1-4 yields:

$$F_{ir} = \frac{1000 P_m \eta \lambda_1 k_f}{v k_r \left(e^{\mu\theta} - k_f\right)} + \left(q_b + q''_r\right) L_1 \omega \cos\alpha - q_b L_1 \sin\alpha, \quad [N] \tag{26}$$

Whereas the possibility of locking or overload over rational limits during the operation of conveyer tape are unlikely, or for other reasons (overuse of the tread, low durability of the belts and especially joints) is waived when determining the optimum tensile force after blocking criterion, then the optimal effort stretching is determined from the condition of a home, excluding wheel slip. In this case the optimal initial stretch effort to tread will be given by the relationship:

$$F_{ip} = \frac{1000 P_m \eta \lambda_2 k_f}{v k_r \left(e^{\mu\theta} - k_f\right)} + \left(q_b + q''_r\right) L_1 \omega \cos\alpha - q_b L_1 \sin\alpha, \quad [N] \tag{27}$$

Where λ_2 overload coefficient represents the engine at startup and can be determined with the relation:

$$\lambda_2 = \frac{M_p}{M_N}, \tag{28}$$

Where Mp represents the starting torque represents the starting torque, Nm.

The diagram is constructed for horizontal motor driven conveyor with a coefficient overload $\lambda_1 = 2{,}2$ and a return on influence $\eta = 0{,}85$. Values read from the chart corresponding to a power of the actuator motor 1 .5kW.

The corresponding values of a conveyor with engine power (engines) of the Pm kW, using relations:

$$F_{ir_2} = F_{ir_1} \cdot P_m, \quad [N] \tag{29}$$

$$S_{\max} = S_{\max 1} \cdot P_m, \quad [N] \tag{30}$$

$$S_{\max N} = \frac{S_{\max}}{\lambda_1} = \frac{S_{\max 1} \cdot P_m}{\lambda_1}, \quad [N] \tag{31}$$

$$F_r = k_s S_{\max N} = \frac{k_s}{\lambda_1} S_{\max}, \quad [N] \tag{32}$$

Where : Fir1 It represents the effort of spreading out the optimal initial unit (corresponding to the installed power of 1 kW), N;

Smax1 – maximum load per unit amounts of the torque of the capsize, N;

SmaxN – maximum load of the corresponding nominal moment, N.

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Determining the Center of Gravity

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Abstract:

The paper addresses an important and timely issue in the area of improving and modernizing methods and equipment to ensure the efficient operation of the machinery for the extraction of high-capacity by improving the functioning of the time, concerned by increasing usability. The drafting of the paper were undertaken both in actual conditions research of quarries in Oltenia, in general and of quarries in the Stall, in particular, as well as in specialized technical literature in the field, from which it resulted that the weighing operations, methodologies for the determination of the Centre of gravity and the counterweight size and stability tests shall be performed on the machine working open pit mines (rotor excavator, stacker etc.) for a long time with the aid of means and methods which have become classics that can be upgraded and improved so that the balance, stability, functioning condition to improve and to increase the performance of the ruling mainly machinery and technological system in general.

Keywords: transport,optimization,mecanics;

1. Possibilities for determining the center of gravity with the methods of resistive electrical tensiometry

Bucket wheel excavators used in open pit mines rest on the ground through three mechanisms of crawler movement. Excavator weight is supported by the group of three mechanisms with paver loaded via supports spherical A, B and C (fig. 1, 2 and 3), which form in the horizontal plane, an equilateral triangle (fig. 4). Center of the circle circumscribed and inscribed on the vertical axis of rotation in the horizontal plane of the superstructure. Through these supports shall be transmitted to the pressures on the crawlers and forth upon the ground.


Fig. 1. The support A


Fig. 2. The support B


Fig. 3. The support C

Rotating on the upper deck are the mechanisms of action, the working body with related equipment and conveyors with transfer tape material deployed. Knowing the values of dangerous deflections RA, RB and RC, measured in supports A, B and C, can be measured by weight upper deck rotating projection position of center of gravity of the upper deck in the plane of the triangle ABC. Each of the reactions RA, RB, RC have two components namely: static components:

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$$R_{s_A} = \frac{G \cdot c}{a}$$

$$R_{s_B} = \frac{G}{2}\left(1 - \frac{c}{a}\right) \tag{1}$$

$$R_{s_C} = \frac{G}{2}\left(1 - \frac{c}{a}\right)$$

their amount shall be:

$$R_{s_A} + R_{s_B} + R_{s_C} = G \tag{2}$$

$$R_A + R_B + R_C = G \tag{3}$$

in the same way (see Figure 4):

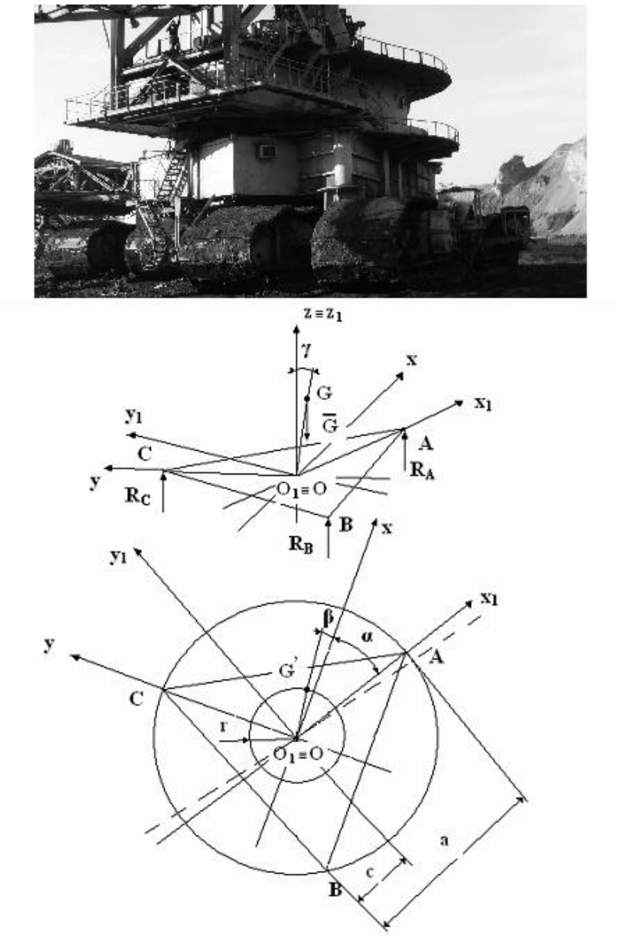

Fig. 4. Construction scheme and abutments on groups of support

dynamic components of the three reactions, are functions dependent on the angle of the α position of the arm (fig. 4):

$$R_{v_A} = \frac{G \cdot r}{a}\cos(\alpha + \beta)$$

$$R_{v} = \frac{G \cdot r}{a}\cos\left(\alpha + \beta + 120^{\circ}\right) \tag{4}$$

$$R_{v_C} = \frac{G \cdot r}{a} \cos\left(120^\circ - \alpha - \beta\right)$$

In figures 15 and 16 is shown how variation of dangerous deflections and variable components for a unit value weight G.

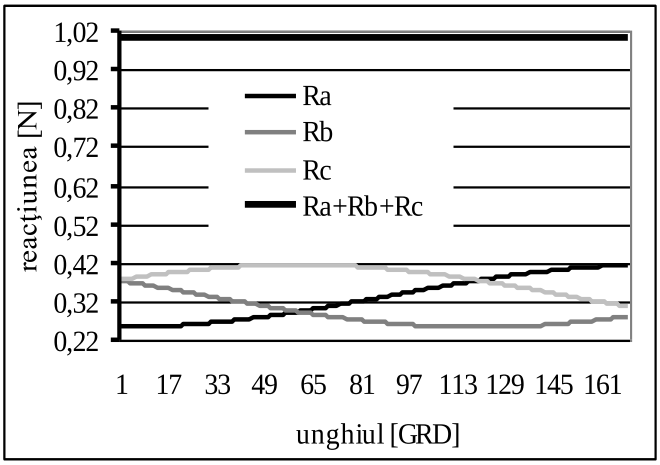

Fig. 5. Reactions and their function of position angle

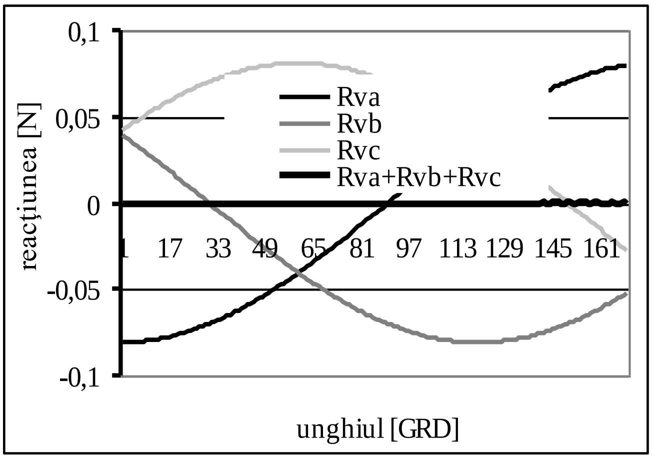

Fig. 6. Dynamic components and their function of position angle

If the arm position is defined by the angle ϕ variable change is involved:

$$\alpha = 180^\circ - \left(\phi + \phi_0\right) \tag{5}$$

from where,

$$R_{v_A} = -\frac{G \cdot r}{a} \cos\left(\phi + \phi_0 - \beta\right)$$

$$R_{v_B} = -\frac{G \cdot r}{a} \cos\left(\phi + \phi_0 - \beta - 120^\circ\right) \tag{6}$$

$$R_{v_C} = -\frac{G \cdot r}{a} \cos\left(\phi + \phi_0 - \beta + 120^\circ\right)$$

How these components are forms a harmonic signal sensor located in support (for example) will be proportional form:

$$u_{v_A} = k_A \cdot R_{v_A} \tag{7}$$

where kA is a constant of the sensor calibration. In this case the sensor was achieved through a montage of tensiometric transducers (TER), a pseudo-sensor (fig. 17).

Mounting is accomplished through four TER-ins T11, T12, T21 and T22, located on connecting beam (Figure 7) between pairs of travel of crawler mechanism in the vicinity of support under the action of load.RA, Thanks to reacţiunii, on the beam develops a triangular distribution moments încovoietoare me, that take into account the location of TER in order obţineri a maximum signal, stable and not be disrupted by the parasitic effects.

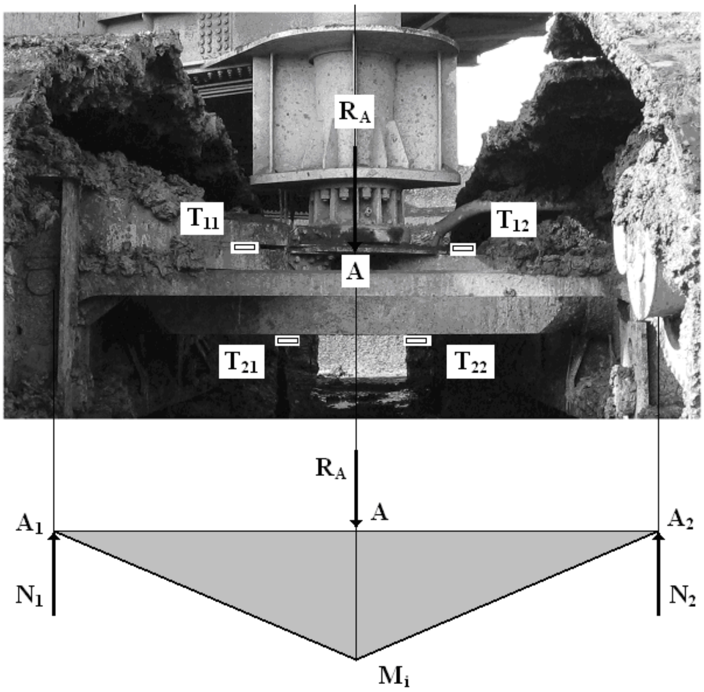

Fig. 7. Steel beam connection

To determine the position of the Centre of gravity of the rotating upper deck (the mass imbalance of excavator) is sufficient for a single signal processing sensor located in the neighborhood support on the beam. To verify the accuracy of the method is carried out a second and third sensor on the neighborhood supports B and C respectively.

Signals uw(ϕ), (W = A, B, C) recorded from the three sensors from support A (W = A), from support B (W = B) or support C (W = C), will have to respect the General form

$$u_w(\phi) = u_{w0} + k_w R_{v_W} = u_{w0} + u_{w_X} \cos\phi + u_{w_y} \sin\phi \tag{8}$$

where u_{w0} is a constant, unknown, resulting from imbalance,

$$\begin{aligned} u_{W_X} &= -k_A \frac{G \cdot r}{a} \cos(\phi_0 - \beta);\ u_{W_y} = k_A \frac{G \cdot r}{a} \sin(\phi_0 - \beta)\ \text{pentru}\ W = A \\ u_{W_X} &= -k_B \frac{G \cdot r}{a} \cos(\phi_0 - \beta - 120^\circ);\ u_{W_y} = k_A \frac{G \cdot r}{a} \sin(\phi_0 - \beta - 120^\circ)\ \text{pentru}\ W = B \end{aligned} \tag{9}$$

k_A and k_B calibration constants being two pseudosensors.

Equation (8) has three unknowns uw0, u_{wx} and u_{wy} which can be determined by the formation, from this, the system of linear equations as follows:

$$u_{w_0} + u_{w_X} \cos\phi_i + u_{w_y} \sin\phi_i = u_w(\phi) \tag{10}$$

where u(ϕ_i)is the value of the signal recorded at n angular positions ,ϕ_i = 1, 2, 3, …, n

System (10) is resolved by regressive method of least squares, defining a function error quadratic form, which must be minimized:

$$E = \sum_{i=1}^{n}\left(u_{w_X}\cos\phi_i + u_{w_y}\sin\phi_i + u_{w_0} - u_w(i)\right)^2 \to \min \tag{11}$$

which in turn requires

$$\frac{\partial E}{\partial u_{w_X}} = 0 \; ; \quad \frac{\partial E}{\partial u_{w_y}} = 0 \; ; \quad \frac{\partial E}{\partial u_{w_0}} = 0 \; . \tag{12}$$

This will result in a full linear system of three equations with three unknowns, which transposed in matrix form become :

$$[D]\{u\} = \{Z\} \tag{13}$$

unde:

$$[D] = \begin{bmatrix} \sum_{i=1}^{n}(\cos\phi_i)^2 & \sum_{i=1}^{n}\cos\phi_i\cdot\sin\phi_i & \sum_{i=1}^{n}\cos\phi_i \\ \sum_{i=1}^{n}\cos\phi_i\cdot\sin\phi_i & \sum_{i=1}^{n}(\sin\phi_i)^2 & \sum_{i=1}^{n}\sin\phi_i \\ \sum_{i=1}^{n}\cos\phi_i & \sum_{i=1}^{n}\sin\phi_i & n \end{bmatrix}; \quad \{u\} = \begin{Bmatrix} u_{w_x} \\ u_{w_y} \\ u_{w_0} \end{Bmatrix}; \quad \{Z\} = \sum_{i=1}^{n} u_w(i)\begin{Bmatrix} \cos\phi_i \\ \sin\phi_i \\ 1 \end{Bmatrix} \tag{14}$$

The values of the unknowns uwx, uwy and uw0 are the elements of the vector column

$$\{u\} = [D]^{-1}\{Z\} \tag{15}$$

Having known the values of signals ux, uy You can determine from the peak amplitudes of signals, values:

$$u_{rA} = \sqrt{u_{Ax}^2 + u_{Ay}^2} = k_A\frac{G\cdot r}{a}$$
$$u_{rB} = \sqrt{u_{Bx}^2 + u_{By}^2} = k_B\frac{G\cdot r}{a} \tag{16}$$

which are proportional to the radius of the circular trajectory Tr Center of mass (G) of the superstructure, the rotating arm in the horizontal plane. The phase position vector

$$\vec{r} = \overrightarrow{OG}$$

of the center of mass axis Ox arm is determined from (9) through the relationship

$$\beta = -arctg\left(-\frac{u_{Ay}}{u_{Ax}}\right) + \phi_0 \tag{17}$$

by taking the signal from of the pseudo supporter sensor uA or with

$$\beta = -arctg\left(-\frac{u_{By}}{u_{Bx}}\right) + \phi_0 - 120^\circ \tag{18}$$

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Differentiation of functions of several variables

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Abstract

The notion of the derivative of a function generalizes to functions of several variables. Below we discuss the concept in the two variable case.

Keywords: optimization; energy; transport

1. General Considerations

Given a function f: $R^2 \to R$, the partial derivative of f with respect to the variable x at the point (a, b) is defined as follows:

$$\frac{\partial f}{\partial x}(a,b) = \lim_{n\to 0}\frac{f(a+h,b)-f(a,b)}{h} \tag{1}$$

Similarly, the partial derivative of f with respect to the variable y at the point (a, b) is defined as:

$$\frac{\partial f}{\partial y}(a,b) = \lim_{n\to 0}\frac{f(a,b+h)-f(a,b)}{h} \tag{2}$$

Generally speaking, we can define the partial derivative with respect to any variable for a function of n variables. Given the function f: $R^n \to R$, the partial derivative of f with respect to the variable x (i = 1, 2,…, n) at the point $(a_1, a_2, \dots, a_n)$ is defined as follows:

$$\frac{\partial f}{\partial x_1}(a_1, a_2, \dots, a_n) = \lim_{n\to 0}\frac{f(a_1, a_2, \dots, a_1+h, \dots a_n)-f(a_1, a_2, \dots, a_n)}{h} \tag{3}$$

The function f is differentiable if all partial derivatives with respect to x_i (i = 1, 2,..., n) exist and are continuous. All differentiable functions are continuous, and if a function is not continuous, it cannot be differentiable.

2. Partial derivatives

The function f is differentiable if all partial derivatives with respect to x_i (i = 1, 2,..., n) exist and are continuous. All differentiable functions are continuous, and if a function is not continuous, it cannot be differentiable.

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The directional derivative of the function f with respect to the vector $v=(v_1,v_2,\dots,v_n)$ is defined as the following scalar product :

$$(Df)v = \left(\frac{\partial f}{\partial x_1}, \frac{\partial f}{\partial x_2}, \dots, \frac{\partial f}{\partial x_n}\right) \cdot (v_1, v_2, \dots, v_n) = (\Delta f) \cdot v \qquad (4)$$

$$\Delta f = \left(\frac{\partial f}{\partial x_1}, \frac{\partial f}{\partial x_2}, \dots, \frac{\partial f}{\partial x_n}\right)$$

is called the gradient vector of f.

The directional derivative of the function f with respect to the vector $v=(dx_1,dx_2,\dots,dx_n)$ is called the total differential of f. Its value is:

$$Df = \left(\frac{\partial f}{\partial x_1} d_{x_1} + \frac{\partial f}{\partial x_2} d_{x_2} + \dots + \frac{\partial f}{\partial x_n} d_{x_n}\right) \qquad (5)$$

3. Aplication

O Find and classify the extreme points of the function
$f(x,y) = 120x^3 - 30x^4 + 18x^5 + 5x^6 + 30xy^2$.
We begin by finding the possible extreme points. To do so, we equate each of the partial derivatives of the function with respect to each of its variables to zero (i.e. the components of the gradient vector of *f*) and solve the resulting system in three variables:

```
>> syms x y
f = -120 * x ^ 3-30 * x ^ 4 + 18 * x ^ 5 + 5 * x ^ 6 + 30 * x * y ^ 2

f =

5*x^6 + 18*x^5 - 30*x^4 - 120*x^3 + 30*x*y^2

>> [x y] = solve (diff(f,x), diff(f,y), x, y)

x =

 0
 2
-2
-3


y =

0
0
0
0
```

So the possible extreme points are: (– 2,0), (2,0), (0,0) and (– 3,0).
We will analyze what kind of extreme points these are. To do this, we calculate the Hessian matrix and express it as a function of *x* and *y*.

```
>> clear all
syms x y
f = -120*x^3-30*x^4+18*x^5+5*x^6+30*x*y^2

>> H = simplify([diff(f,x,2),diff(diff(f,x),y);diff(diff(f,y),x),diff(f,y,2)])
```

```
>> det(subs(H,{x,y},{0,0}))

ans =  0
```

The origin turns out to be a degenerate point, as the determinant of the Hessian matrix is zero at (0,0).
We will now look at the point (- 2,0).

```
>> det(subs(H,{x,y},{-2,0}))

ans =  57600

>> eig(subs(H,{x,y},{-2,0}))

ans =

  -480
  -120
```

The Hessian matrix at the point (- 2,0) has non-zero determinant, and is also negative definite, because all its eigenvalues are negative. Therefore, the point (- 2,0) is a maximum of the function.
We will now analyze the point (2,0).

```
>> det(subs(H,{x,y},{2,0}))

ans =

      288000

>> eig(subs(H,{x,y},{2,0}))

ans =

         120
        2400
```

The Hessian matrix at the point (2,0) has non-zero determinant, and is furthermore positive definite, because all its eigenvalues are positive. Therefore, the point (2,0) is a minimum of the function.
We will now analyze the point (- 3,0).

```
>> det(subs(H,{x,y},{-3,0}))

ans =
     -243000

>> eig(subs(H,{x,y},{-3,0}))

ans =
        -180
        1350
```

The Hessian matrix at the point (– 3,0) has non-zero determinant, and, in addition, is neither positive definite nor negative, because it has both positive and negative eigenvalues. Therefore, the point (– 3,0) is a saddle point of the function.

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The Role of Internet of Things as a Key Technology Enabling the Fourth Industrial Revolution

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Abstract

This paper is an attempt to analyze the role of Internet of Things (IoT) as one of the most important elements of the fourth industrial revolution. First, historical aspects connected with the phases of the industrial revolutions are presented and the key factors causing entering industrial revolution into its fourth phase are discussed. Next, the notion of the Internet of Things is presented and the most important elements of the architecture of IoT systems are described. The core part of the paper is focused on the most important opportunities offered by the Internet of Things. Also the most significant challenges emerging in the context of IoT solutions are discussed.

Keywords: IoT; Industry 4.0; new business processes; redesign of business processes

1. Introduction

Modern economy enters a new phase of profound transformations known as the fourth industrial revolution. There are at least three elements indicating that this in fact takes place Schwab, 2016. The first is the velocity of the changes. In contrast to previous phases of the industrial revolution, the fourth phase does not evolve linearly but exponentially Brynjolfsson and McAfee, 2014. The second element is the systems impact. All systems operating in countries, companies or industries, as well as the society as a whole are subjected to the transformation process. The third factor is the breadth and depth of transformations. They take place in the context of the digital revolution and are based on multiple technologies, the use of which leads to profound changes in the paradigms underlying the functioning of the economy, business, society as a whole as well as individuals Schwab, 2016. These are referred to as disruptive technologies, and the Internet of Things is one of them Bisson et at., 2013. This technology, which assumes a ubiquitous combination of people, objects, and machines, is also the essence of the vision of operation of the industrial sector in the context of the fourth industrial revolution referred to as Industry 4.0 Geissbauer et al., 2014; Geissbauer et al., 2016; Schwab, 2016.

The purpose of this paper is to analyze the role of the Internet of Things as one of the key elements of the fourth industrial revolution. And attempt was made in this context to identify the most important opportunities and challenges for the companies with the development of this technology.

2. The fourth industrial revolution and the most important factors stimulating its development

Changes taking place in today’s economy and its profound transformation processes are the next wave of great changes taking place in the history of human civilization. The wave which has introduced industrial phase to humanity started around 1760. It was mainly related to the use of a steam engine in the mechanical production systems. The end of the nineteenth century is the beginning of the second industrial revolution related to mass production systems and assembly lines based on electricity. The third phase of the industrial revolution, referred to as a computer or digital revolution, begins in the 60s of the twentieth century. It is associated with the emergence of mainframes, PCs and the

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Internet. The economy began entering the period of the fourth industrial revolution at the beginning of the second decade of the 21st century, when there were more and more capabilities to create cyber–physical systems, i.e. systems integrating the physical and virtual worlds Industrie 4.0 Working Group, 2013; Schwab, 2016.

There are many technological drivers of the fourth industrial revolution. According to Schwab, we can divide them into three groups, i.e. physical, biological, and digital. The first includes technology megatreds, such as autonomous vehicles, 3D printing, advanced robotics systems or new materials. The advancements in biology include genetic research, synthetic biology, the use of 3D technology in medicine (*bioprinting*) or new ways of monitoring health and physical activity. Digital factors include such technologies as *blockchain*, technology platforms enabling the development of the on-demand economy and the Internet of Things, which is one of the key bridges between physical and virtual world Schwab, 2016; Tapscott and Tapscott, 2016. The latter technology is also the basis for the creation and implementation of Industry 4.0. It is understood as an end-to-end digitalization of all physical resources and their integration into digital eco-systems created with value chains partners PWC, 2016.

3. Internet of Things and the main elements of the IoT systems architecture

Despite the growing number of publications and research on the Internet of Things, there is no single comprehensive definition. According to Porter and Heppelmann, the phrase "Internet of Things" was created in order to "reflect a situation in which there is a growing number of smart, connected products and highlight the new opportunities they may bring about" Heppelmann and Porter, 2014. Dobbs et al describe this concept in much more detail. Namely, they identify the Internet of Things as "physical sensors and actuators embedded machines and other objects that have been used for data collection, remote monitoring, decision-making, and optimization processes in all areas from production through infrastructure to health care" Dobbs et al., 2015.

However, the typical Internet of Things system consists of similar components regardless of the adopted definition. The simplest version of its architecture can be presented in a way such as the one shown in Fig. 1. It consists of various types of sensors (S1–Sn) gathering data and transmitting them through various transmission channels (persistent connections, WiFi, cellular or Bluetooth) to a gateway. After the initial data processing or without this process, it transmits them to the processing system, i.e., the analytics cloud. In this case, the connection is ensured through the use of a permanent connection, LAN or WiFi Perera, 2015.

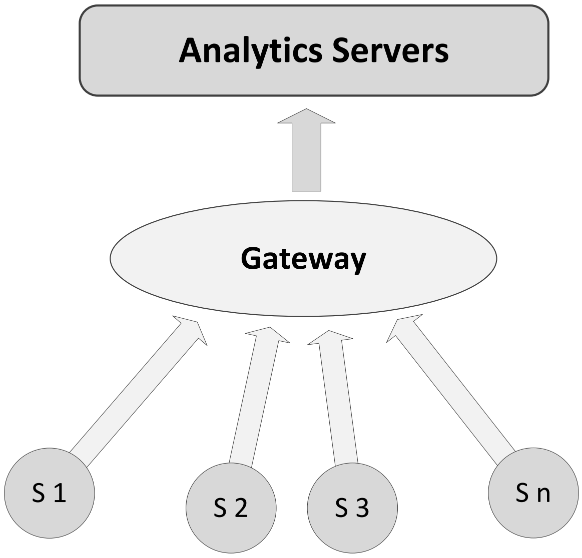

Fig. 1. The basic components of the IoT system architecture (source: based on Perera, 2015)

Alas, we have to note that it is not possible to create the technological infrastructure of the IoT system without the use of a number of leading technologies, which in itself carry an enormous transformation potential. This applies to cloud computing, big data tools and mobile solutions Aharon et al., 2015; Burkitt, 2014; Deichmann et al., 2015; Heppelmann and Porter, 2014; Heppelmann and Porter, 2015; ITU, 2015; KPMG, 2015; Olszak, 2014; Wielki; 2015.

4. Opportunities and benefits related to the use of the Internet of Things by enterprises

The possibilities related to the use of smart connected products, which allow the creation of value in Internet of Things solutions result from four basic functionalities. These are: monitoring, control, optimization, and autonomy. The first ones are sensors built into smart products that enable to monitor:

- Its health, operation, and use.
- External environment.

In turn, software contained both in the product itself and in the infrastructure layer offers even more possibilities. Namely, it enables to remotely control the product and its functions and personalization of its operation on a scale which previously was not possible to achieve. Monitoring capabilities and the resulting wide data stream combined with the control opportunities offered by smart products allows the organizations to optimize their performance in an extremely wide range. This applies to aspects such as the significant improvement in the operation of the product itself or its predictive diagnostics and repair. The three functionality types discussed above allow the smart products to achieve an unprecedented degree of autonomy Heppelmann and Porter, 2014.

These four functionalities offered by smart combined products provide business organizations with two basic types of opportunities:

- Transformation of business processes.
- Enabling new business models.

When it comes to the reconstruction of business processes, there are a number of related opportunities which differ depending on the settings to which they apply. These are, e.g. changes in the design of domestic appliances in the home setting. Namely, the process is based on the analysis of usage-based design. In the retail setting, the key application areas of the Internet of Things solutions are: check-out automation, goods layout optimization or individualization of promotional activities in stores. On the other hand, in the office setting, the IoT applications include: organizational redesign and the monitoring of employees or the use of augmented reality for training purposes. Regarding the transformation of business processes in the factories, the key issues include: optimization of operations and the related improvement in productivity, optimization of the use of equipment and supplies, predictive maintenance, the maintenance of equipment, and the occupational safety and health. Another setting which enables a deep reconstruction of business processes is related to non-standard production worksites, such as oil and gas or construction sites. In this case, the most important capabilities are similar to the previous case, with additional IoT enabled R&D activities. When it comes to the setting associated with the various types of vehicles, the key areas of IoT-based solutions include: repair and condition-based maintenance, equipment design based on an analysis of their usage or pre-sales analytics. Vehicles are also related to the capabilities of reconstruction of logistics processes. This applies to things such as real-time routing, the use of connected navigations or the use of transport monitoring systems Aharon et al., 2015.

Regarding the opportunities associated with the implementation of new business models, we can identify ten basic types in this context. These include:

- Business models based on “anything-as-a-service” concept.
- Business models based on the use of new forms of outsourcing.
- Business models based solely on the data and their use.
- Business models based on additional services related to the physical product offered to customers.
- Business models based on smart products which are sources of added value for the customer.
- Business models based on behavioral profiling.
- Hybrid business models.
- Business models based on offering IoT platforms.
- Business models based on offering comprehensive IoT infrastructure solutions.
- Business models based on offering extended services.

The model being the product-as-a-service is the “mainstream” in the first group. Its development is related to more and more widely observed processes of migration from the customer buying the product to the one in which the manufacturer retains ownership of it, and the customer uses it, paying for its real use. The development of functionalities related to intelligent, connected products provides big opportunities in this area. Rolls Royce, which offers their engines to airlines in the “power-by-the-hour” model, is one of the companies pioneering in this field. In this model, the airlines pay for the real engine use time, instead of incurring a one-off cost of its purchase and additional costs of maintenance and repair. Xerox also employs such a model by monitoring the actual use of their photocopiers via the installed sensors Heppelmann and Porter 2015.

The development of smart systems also allows for the implementation of business models based on offering new forms of outsourcing. Another such example is Pacific Control company operating in Dubai. It offers the remote monitoring of buildings, airports, and hotels based on the Internet of Things The Economist, 2010.

For the third category, the development of smart connected devices enables to collect vast amounts of different types of data that can be used to create business models based on their usage. Skyhook Wireless company, which offers specific information acquired based on geolocation data they collect, is an example of this approach. They can include information such as which local bars will be the most popular on a specific day and time, how many people will go near the billboard at a given date and a specific time, or what is the density of people in a specific urban area on a given day and time. The company uses anonymous geolocation data collected from mobile users of its services in every major American city during the past twenty four months to carry out this analysis The Economist, 2010; Mims, 2010.

The development of the Internet of Things also enables to implement business models based on providing customers with additional services related to the physical product they purchased and use. Caterpillar company is one example of this approach. Specialized teams advise customers on how to optimize the deployment of equipment, when a smaller number of machines suffices and how to achieve better fuel efficiency through the stock of machines based on analysis of data collected from each their machine used on the construction site Heppelmann and Porter, 2015. Heidelberger Druckmaschinen, a manufacturer of printing presses offers a similar type of service based on over a thousand sensors installed in them The Economist, 2010.

Another group is business models based on providing customers with smart products which are sources of additional benefits to them. Play Pure Drive is an example of such a solution. In this case, Babolat company has transformed a traditional product into a smart one which provides players with the opportunity to improve their technique by the use of a dedicated application, a tennis racket equipped with appropriate sensors and a system enabling the connection to the smartphone. Clothing manufacturer Ralpf Lauren made a similar move by offering smart PoloTech Shirt. It collects all parameters including pulse, the intensity of the movement, calories burned, and many others with built-in sensors in real-time during exercise and transmits them to a smartphone or smartwatch Heppelmann and Porter 2014.

Another group of business models are those based on behavioral profiling. The system for establishing insurance rates based on monitoring of the driving behavior through the suitable telemetry device mounted in the vehicle is an example of this type of solution. The American insurance company Progressive offers this solution under the name of Snapshot Burkitt, 2014. Coverbox uses a similar system on the British market The Economist, 2010.

Hybrid business models are a compromise between the models of product-as-a-service and traditional purchase of products by customers. They connect sales with e.g. different types of service contracts based on the monitoring of the device operations.

Another group is business models based on offering IoT platforms to the users. Apple HomeKit is an example of such a solution. It controls various home devices from different manufacturers through the smartphone application. HealthKit platform, which enables the integration of devices for monitoring people’s health and activity, is another example of a solution by the same company Burkitt, 2014.

The next group of business models is those based on providing comprehensive IoT infrastructure solutions. ThingWorx platform is one of well-known examples of this approach. It provides comprehensive services for the creation of Internet of Things solutions ThingWorx, 2016.

The last group is business models based on the provision of extended services. This forward-looking category includes solutions based on the use of data and information collected by the providers of various IoT services and providing their own services based on them. Operations of insurance companies working on solutions which include creating their own portfolio based on cooperation with companies offering various types of IoT systems designed to monitor health and physical activity are an example of this approach Burkitt, 2014.

5. The most important challenges, impediments, and limitations related the use of the Internet of Things by enterprises

There is a whole range of different kinds of impediments and limitations related to the Internet of Things, and the scale and diversity of IoT ecosystems is significant because they are complex solutions based on various technologies.

There are three key areas in the technical context related to the creation of IoT ecosystems, which could both limit and stimulate their development. They concern Aharon et al. 2015:

- Technology, both in terms of hardware and software necessary for the creation of the Internet of Things infrastructure.
- Security.
- Interoperability.

At the same time, one can indicate a whole range of non-technical challenges. Value in the Internet of Things systems is mainly created on the basis of acquired, transmitted, processed, and analyzed data, the related issues are one of the key aspects that can be impediments to the development of this concept or stimulate its development Heppelmann and Porter, 2014. The most important ones relate to various legal issues. Undoubtedly, one of the key such challenges related to data are those concerning intellectual property, and the ownership of collected data is one of the most important aspects in this area. Legal challenges also apply to a number of other issues related to privacy and confidentiality. They relate to such issues as: data protection, sharing and methods of their use, data storage and access location or the applicability of the law relating to data protection.

Also, behavioral impediments may play an essential role in the development of systems based on the Internet of Things concept. They are related to things such as consumer attitudes in the context of acceptance, or lack thereof, of specific IoT solutions due to e.g. trust towards them Duggan and Rainie, 2016. Another area is noteworthy that could be important to the development of Internet of Things, which is structural changes in various sectors (e.g. transport industry in the context of autonomous vehicles) Aharon et al., 2015.

At the same time it should be noted that the impediments or challenges that could turn into stimulators exist at different levels, i.e.:

- Global – e.g. the global price trends of IoT infrastructure components, global standards, (e.g. in "cloud" solutions for Big Data systems [ITU 2015]).
- Regional – e.g. EU standards and regulations on various aspects of the Internet of Things.
- National – e.g. standards and regulations in the markets of individual countries.
- Sector – e.g. industry regulations and standards.

A whole series of challenges will also occur at the level of individual organizations.

6. Conclusions

Organizations in today's economic reality are on the verge of profound changes in their operations. They are related to a quick progress in information technology and the economy entering the fourth phase of the industrial revolution. More opportunities to create systems integrating physical and virtual worlds are one of its key differentiators, and the Internet of Things is the underlying technology.

This gives the companies a number of unprecedented opportunities Bauer et al., 2014. As in the previous phases of the Internet evolution they concern two fundamental issues when it comes to value creation processes Wielki, 2010. They are the implementation of new business models and deep reconstruction of business processes they carry out. As a result, it enables to implement the vision of Industry 4.0.

In this new situation, each enterprise has to run a deep analysis of how the Internet of Things is a part of their operations and the processes of digital transformation and decide on a strategy for IoT use. There are a lot of opportunities in this area Aharon et al., 2015; Burkitt, 2014.

It is necessary to create the vision of one's own activity in this context. When creating it, the organization also has to take into account a number of factors (e.g. the current state of technology development, experience and capabilities in the development and implementation of solutions based on the Internet of Things concept or the challenges it will have to face) and plan the necessary activities and changes both internally and externally. As the changes are very dynamic, and at the same time they involve long-term consequences, the choice of appropriate and well-thought course of actions in relation to IoT is an extremely critical decision for any organization from the point of view of both future competitive position and further development.

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Enclave Economy – an Irreversible Economic Phenomenon for Romania

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Abstract

Within this paper, we have approached the theme of enclaves from economic and social perspective. Seen as a process due not only to immigrants who tend to settle down in larger urban centers, with large and heterogeneous population, but also due to the migration from the countryside to urban areas, economic enclaves have long-term effects. In this context, we have have highlighted the main causes which have an influence on the regional enclave phenomenon as well as the multiple effects such a complex phenomenon may have on national economy and obviously on a country's population. We have completed the work by presenting the GDP as the main indicator of the intensity of the enclave process and the discrepancies recorded by developing regions as a result of regional gaps. The paper tackles several aspects of the enclave process since a clear delimitation of economic enclaves cannot be made without dealing with its social aspects, as well; therefore, we have made a classification of enclaves, the broadest one including the regions where enclaves can be found. It is obvious that the reduction of the negative effects of this phenomenon is the responsibility of the State and its institutions whose mission is to implement plans and strategies in the field of regionalization; therefore, we concluded the paper with the presentation of the portfolio of targets needed to be achieved for a balanced regional development.

Keywords: economic enclave, social enclave, GDP, economic development

1. Introduction

According to the Explanatory Dictionary of the Romanian Language, an enclave represents a small territory with less population, located near the border between the two States, within one state, but belonging to the other. Thus, from administrative point of view an enclave is a state or an administrative-territorial entity surrounded by the national territory of another State.

The terms enclave/exclave, having along the years eminently geopolitical significances, have crossed over during the last years. Steck (2000) or Claval (2001), if we exemplify only two noticeable references in the area, included it to the vocabulary of social geography, of transportation and territory planning, referring, as a matter of fact, to a certain isolation of a phenomenon, human group or territory, in relation to a neighbouring ensemble (Puscasu, 2011).

As a result, the evolution of the term enclave, namely enclavisation, has resulted in amendments to the original meaning, so that currently there can be identified several types of enclaves, according to the phenomenon or process it represents:

- **Social enclaves** refer to lots of people who, through certain common interests constitute a group which is increasingly isolated due to various reasons. The most common social enclaves are *ethnic enclaves* and *religious enclaves*. Ethnic enclaves are generally made up of immigrants who arrive in certain States, and in some cities to seek jobs that are paid better than in the country of origin. They have the natural tendency to settle down in geographic areas populated with individuals from the same country of origin thus forming ethnic enclaves within cities (Mionel, 2010). Ethnic enclaves often interfere with religious enclaves in the case of extremist religions or when the ideology of that religion does not allow effective communication with the rest of the community;
- **Economic enclaves** have their origin in elements of enclave economy. Enclave economy is a term created by French sociologist G. Balandier and was used by sociologist Chirot D. to present the process of delayed modernization

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of the less developed societies (Chirot, 1989). Chirot showed for the first time that it can enhance the heteroclite character of the cities not only due to immigrants who tend to settle down in large urban centers, with a large and heterogeneous population, where the income level is higher than in other provincial regions (Bădescu, 2005). It is obvious that, over time, it has been demonstrated that enclaves of this kind are influenced not only by immigrants. They are replaced in many countries by the rural population who tends to move to urban areas. This phenomenon leads to some **societal enclaves** (the interference of economic enclaves and social ones) that will confine the world of native rural people to an underdeveloped economy with a traditional culture dominated by a suburb or a slum culture as regional characteristic.

2. Causes and effects of enclave economy in Romania

Even if during communism the enclave phenomenon was almost non-existent, creating mono-industrial areas of strategic importance for the national economy, heavily subsidized by the public budget was the first step towards the enclave economy that we are witnessing today. Thus, among the most obvious causes of this economic phenomenon are:

- *Inefficiency to implement strategies*. Even though during the period 1990-2000, there was not a coherent and realistic strategy for economic development, much less a balanced regional development, some specific plans or strategies were laid down later on but their implementation and their effects were adverse and below the level of the objectives proposed. The most telling proof of this ineffective policy is the fact that in the early 1990s the GDP of Bucharest-Ilfov region contributed with 14.22% of national GDP, while today the share nearly doubled, namely 28%, thus balanced regional development could not be achieved in this area. On the contrary, Bucharest-Ilfov region has developed the largest economic enclave in the country;
- *Small urban settlements have not assumed the role to maintain competitiveness of adjacent rural areas*. Small towns could play an essential role in the development of surrounding rural areas, through direct access to production and by casting the effects of development on adjacent areas. Moreover, these settlements have suffered a decrease in economic activities so that the influence upon surrounding rural areas changed negatively, as for example industrial firms that would process the agricultural raw material reduced their activity or were closed down;
- *Demographic changes*. The reduction of births, the increasing number of residents who have moved into major urban settlements or have emigrated to other European countries and the ageing of population are the most important social factors with a direct effect on economic and social enclaves.

Even if, at European level, the phenomenon of economic enclaves has expanded, its effects are multiple and from the economic point of view they are obvious. Among the negative effects, the following are worth mentioning:

- *Emphasizing urban agglomeration for certain urban centers*. Depopulation of rural areas and of some mono-industrial urban areas amid increasing urban congestion that tends to be suffocating in certain areas, such as Bucharest-Ilfov can be strongly delimited. In terms of population density, there are very large differences between the Bucharest-Ilfov region that has reached a density of 1239.2 inhabitants/km^2 and other seven regions where the density average is of 70 inhabitants/ km^2;
- *Increase of the economic imbalance among regions*. Romania is developing at completely different speeds even though the goal of creating development regions was to ensure a balanced development of Romanian regions, an objective which was established by the National Development Plan for the period 2007-2013. Even if the goal was not achieved, the need to pursue it was resumed when implementing the National Strategy for Regional Development for the period 2014-2020, elaborated by the Ministry of Regional Development and Public Administration.

Enclaves have *positive effects* as well. The process of urbanization is a normal one; all high-income countries that had experienced rapid economic growth have gone through a very rapid process of urbanization. There is a solid relationship between urbanization and income per capita. Almost all countries that have achieved a degree of urbanization of at least 50% have gone through a process of economic urbanization and, in the long run, the effects on adjacent areas were positive even though the level of urbanization reached 70-80%. Urban environment plays a major role in increasing economic competitiveness through their ability to innovate and create new economic opportunities due to which the trend at European level is to concentrate economic activities in large cities and in the capital, so that the largest part of the GDP should be accumulated here.

The most obvious consequence of this enclave phenomenon represents a layering of economic criteria, as follows: *poles of economic growth*, such as Bucharest-Ilfov, Timis-Arad and Constanta where business registers an ascending trend; *areas with potential and moderate development*, such as Brasov, Cluj, Arges and Galati; *counties with stagnant or descending development trend* such as Vaslui, Botoşani, Olt, Mehedinti, Ialomiţa, Giurgiu, Calarasi, Harghita, Covasna, Sălaj; *mono-industrial regions* where industrial production is a rather illusory, trade is affected by low income of the population, and the prospects of attracting investors are impeded by the lack of administrative measures intended to provide facilities for those who want to set up production sites, regardless of the field of activity.

Between areas with economic enclaves, we can mention Bucharest-Ilfov, which records 16.7% of the urban population and 9.4% of the population of the country. In 85.6% of the other 320 cities and municipalities, there is a population with direct production access to a rural area with less than 50 thousand inhabitants, which represents 18.1% of the country's population. (Cluj region with 377,213 inhabitans; Iași region with 357,192 inhabitants; Timișoara – Arad region has a population of 333,613 inhabitants; other areas: Constanța with 319,168 inhabitants, Craiova with 307,022 inhabitants, Galați with 305,805 inhabitants, Brașov with 291,195 inhabitants, Ploiești with 234,969 inhabitants and Oradea with 223,237 inhabitants).

3. GDP - indicator for measuring the intensity of the enclave phenomenon

The most important comparison indicator of the level of economic development is the Gross Domestic Product. Thus, by comparing regions of Europe based on the NUTS classification and, according to EUROSTAT data, one can find that 15 regions in Romania, Bulgaria and Poland are among the poorest in the European Union (EU), with a GDP per capita measured in purchasing power standards below 50% of the European average. In Romania, the Bucharest-Ilfov area is the only region in Romania that exceeds the European average by 29%, followed by the Western and Central regions, Southwest Oltenia, with 41% of the average, South-Muntenia (43%), Northwest (48%) and the poorest region is the Northeast, where the GDP per capita represents about one third of the European average.

At national level, the value of GDP by regions ranges between 60 and 70 billion lei; a significantly higher level can be registered in South-Muntenia, ranking second after the Bucharest-Ilfov which is the top leader with a value of 25% of GDP; that is the equivalent of the GDP of the two regions, as shown in the table below.

Table 1. Value of GDP by regions in the period 2012-2017 [bill lei]

Region	2012	2013	2014	2015	2016	2017
North-East	63.9	67.6	71.1	74.6	78.7	83.1
South-East	62.8	66.1	69.5	73.2	77.3	81.6
South-Muntenia	73.4	79.1	83.3	87.4	92.3	97.5
South-West Oltenia	47.8	52.3	55.1	58.0	61.2	64.7
West	59.9	63.9	67.2	70.5	74.3	78.5
North-West	62.6	66.7	70.1	73.7	77.7	82.1
Center	67.5	72.6	76.5	80.4	84.7	89.6
București-Ilfov	148.8	156.4	165	173.6	183.2	193.6
Total per economy	587.5	625.6	658.6	692.2	730.3	771.6

Source: The National Commission for Prognosis, Projection of the main social and economic indicators along the territories by 2018

This discrepancy will be maintained, as it is mentioned in the projections of the National Commission for Prognisis and Bucharest municipality could register an economic growth of 4.3% in 2017 and 2018, while GDP/capita will grow to 22,215 euros in 2016, to 23,895 euros in 2017 and to 25,675 euros in 2018. As for other regions, there are also predictions regarding development; however, the same gaps between Bucharest - Ilfov and the rest of the country will be maintained.

In terms of GDP/capita, table 2 reveals a huge gap between the capital city and other regions, particularly the North-East region where predictions for a period of more than 10 years, respectively, for 2008-2013 and a forecast for 2019, show a continuation of the proportion below 60%, as opposed to other regions which are at least 10% better positioned.

The same gaps remain, even as regards the average net income, where Bucharest-Ilfov area shall be maintained during period under review to 150%, as opposed to other regions where there is a tendency to decrease, the largest bias being in South-West Oltenia region with 9.9%, the North-East region with 7.9%, the South-East region with 8% and South Muntenia region with 2.8%. According to estimates by the National Commission for Prognosis, those wage gaps will maintain and even enhance the power of economic enclaves, bearing in mind that the net average income for the year 2016 will exceed 2,000 lei per month in counties like Timis, Cluj and Bucharest-Ilfov area obviously, while the smallest salaries will be paid by employers in Harghita county - 1,317 lei.

Table 2. Share of regional gaps in 2014 [%]; Each area in realation to the West region, occurying the second place from the point of view of economic development

Region	Gross Domestic Product per capita			Net average income		
	2008	2013	2019	2008	2013	2019
NORTH - EAST	55.1	60.0	59.3	95.7	88.5	88.0
SOUTH - EAST	70.9	86.3	86.4	98.6	92.6	90.6
SOUTH MUNTENIA	72.9	75.6	75.1	101.1	98.1	98.3
SOUTH – VEST OLTENIA	66.6	70.8	72.1	104.4	96.0	94.5
NORTH - WEST	80.5	83.2	83.6	92.7	89.9	92.7
CENTER	85.2	90.0	90.2	95.3	93.4	93.2
BUCURESTI - ILFOV	229.7	225.2	219.3	150.0	151.8	150.0

Source: The National Commission for Prognosis, Projection of the main social and economic indicators along the territories by 2018

4. Conclusion

The basic aim of regional development policies is to reduce territorial disparities, achieving a balance between the levels of economic and social development of different areas. A goal of regional policy, specific to this period, is to facilitate sectorial and structural adjustments, supporting the restructuring processes and economic recovery, rebuilding and stimulating the competitive capacity of regions, supporting the processes of European integration. Most countries, including the economically developed ones, are experiencing regional disparities and, therefore, they apply regional development strategies and policies.

The process of reducing the discrepancies between developed areas and those lagging behind is long lasting and it is carried out with small steps. Even if economic growth rates are higher in areas with a low level of development, the economies of developed regions are not stagnating; on the contrary they register an uptrend thus reducing the intensity gaps. For this reason, the reduction of territorial disparities should be kept but must represent an essential component of the post-accession Strategy.

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Considerations about the nature of the expenditure cost components of human capital formation

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Abstract

History shows us that, over time, training and education have had, mainly, the mission to develop the society and the socio-economic relationships. Human resources development is based largely on the initial and continuing training of persons. Human capital formation takes place not only in the initial compulsory education or in the continuing training, but also in the non-formal education, as well as in self-education. Initial training causes investments to recover by themselves, without the need of going through the entire professional path, to the faculty, because they enjoy the economic benefits of education. Economic entities focus, most of the time, on training costs and do not quantify the benefits; consequently, we find out that training is not perceived as an investment in human capital. The cost of investment in education can be regarded as a public good since they consider that it only partially fulfils the characteristics related to public goods. This research has a dual approach, combining quantitative and qualitative elements and achieving the analysis of correlations between the effects and the efforts recorded in the issues of costs of human capital formation. The first section presents conceptual clarifications on the development of human resources by the initial and ongoing training of people. In the second section we performed radiography of public expenditure on education as % of GDP and their influence on the costs of human capital formation. The third section presents the main conclusions as a result of carrying out this work.

Keywords:Cost, human capital, expenditure, GDP, education, training.

1. Introduction

Over the time, training and education have had as main objectives the development of the society and of the socio-economic relationships. This must be regarded upon as a necessity belonging to a past that keeps diverging from more and more, even though, if perceived as reality, it continues to persist nowadays, too. Education and training, in the context of the targets established in Lisbon in 2000 and during the Summit of Barcelona in 2007, as well as of the Treaty of European Union Functioning adopted in Lisbon in December, 2007, outlined common objectives for education and training in Europe, and they also had as a strategic objective, by 2010, to have become the most competitive and dynamic economy in the world, based upon knowledge, and capable of sustainable economic growth, generating new jobs, better ones, and characterized by an increased social cohesion.

The mentioned demarches have continued through the adoption of the 2020 Europe, the fundamental strategy of the EU, devoted to the economic and employment growth. In the field of education and training, the objectives, tools and procedures for the co-operation at the EU level are summarized in the strategic context of 2020 Education and Training (EF), which is valid until 2020. By a mid-term evaluation of the 2020 EF in 2015, the situation has been amended so as to reflect the importance of Education and Training to the labor market and to promote fundamental values and active citizenship, a change also reflected in the following ***priority areas*** (Măcriș & Ciurea, 2013):

- *Relevant and quality skills and competencies, with a focus on the results of learning in oder to increase the ability of vocational insertion and to stimulate innovation and active citizenship;*
- *Education favorable to inclusion, equality, non-discrimination and promotion of civic competencies;*
- *Open and innovative Education and Vocational Training, including a maximum capitalization of digital technology;*
- *Consistent support for trainers;*
- *Transparency and recognition of skills and qualifications in order to facilitate learning and labor force mobility;*

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- *Sustainable investments, performance and efficiency of educational and vocational training systems.*

Human resources development is based, to a large extent, on the initial and continuing training of people. Economic entities concentrate, most of the time, on the costs of the vocational training without quantifying the benefits. Consequently, we realize that vocational training is not perceived as an investment in human capital (Dima & Man, 2013). Since ancient times, society has admitted the role of education and its benefits. The system of initial vocational training includes gymnasium, secondary school and after highschool, the latter being considered as initial vocational training just for the graduates of the theoretical branch of highschool. At the same time, it lays the theoretical and practical foundations to exercise a profession or a group of professions, as well as the attitudinal and motivational foundations for all social categories.

The initial training causes investments to recover by themselves, without having to go through the entire professional path, up to college, because they enjoy the economic benefits of Education (Măcriş & Man, 2012). It is demonstrated that the next superior level of Education offers higher chances of employment. In economic terms, with regards to income, a person with a higher level of education will get higher income, too. Most often, parents understand that elaborate education creates greater opportunities to achieve a career, to obtain higher income and a considerable financial security.

The cost of investment in Education cand be seen as a public good, since it is considered that it partially meets the attributes related to public goods (Măcriş & Man, 2014). Thus, we highlight the feature of non-exclusiveness, especially when it comes to mandatory State education where, from a theoretical point of view, no one is deprived of the right to educate, going through the different levels of the compulsory system of vocational training. We also emphasize that no one has exclusiveness in exercising this right.

2. Radiography of public expenditure on Education in total gross domestic product

Human capital formation takes place not only in the initial mandatory Education or in the continuing vocational training programs, but also in non-formal Education and in self-education.

The indicator of public expenditure for Education, as a percentage of GDP, highlights the proportion out of the annual national financial achievement allocated by the Government to specialty services within a financial year. This indicator reflects the importance placed on Education in comparison with other public services provided by the State. At the same time, the allocations specific to the levels of education reflect the priority granted to a certain level. Although it is the highest since 1989, the percentage of GDP allocated to Education in 2008 was at the level specified in the current Law of National Education (6%). As one can notice from the data presented in table 1, the reduction of public expenses on Education, as percentage of GDP, was of 58% (2.5%) in 2013 and of 40% (3.7%) in 2015. Romania is found at the bottom of the EU ranking regarding the expenses on Education, being so far away from the desideratum of 6% of GDP, set by the National Law of Education. Noteworthy is that the trend of getting closer to the European average, which continued during the period of economic growth in the years 2000 – 2008, has been reversed starting with 2009, and the removal from the average value of the European Union has been emphasizing ever since.

Therefore, despite the financial difficulties, the decrease of the percentage from GDP allocated to Education in Romania is totally atypical and cannot be explained just in terms of constraints generated by the economic crisis. The latest data collected at European level in 2012 shows that Romania was the last with regards to Education funding. Despite the fact that our country went through a financial crisis, a phenomen otherwise experienced by all states on the continent and beyond, a significant number of states, which had recorded a regress on the percentage of GDP registered in the national budget, did not operate budgetary cuts that big as those in Romania. In addition, the economic growth during 2012 – 2015, promoted by the Romanian Government, was not reflected in the Education budget. Unfortunately, we note with concern that even nowadays, the Romanian political class shows no maturity regarding the responsibility for the issues in Education. All reports made draw attention to the direct link between the level of public investment in Education and that of the population's participation to Education and training, Romania continues to be, from this point of view, also, after other member States of the European Union, as it can be noticed from the information presented in table 2.

Table1. The situation of public expenditure on Education as % of GDP for Romania over the period 2006 – 2015

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
% of GDP	4.3	5.3	6	4.2	3.5	3.1	2.6	2.5	3.2	3.7

Source: Fragments from Reports of the Ministry of Education and Scientific Research

With regards to ***the share of public expenses on funding Education in GDP,*** one notices that the average recorded in the 28th area of the European Union is around 5,2% in 2006 and 4,9% in 2012, while the average of the analyzed period is of 5,2%. The analysis of the level of expenditure for Education in relation to GDP indicates the general aspects of financing, representing an important indicator of the macro-economic policies for all countries. In the table below, the situation with these expenses is presented as follows:

Table 2. The situation of public expenses in Education as % of the GDP over the period 2006 – 2012

Country	% of GDP							
	2006	2007	2008	2009	2010	2011	2012	Period average 2006-2012
EU-28	**5,2**	**4,9**	**5,1**	**5,4**	**5,4**	**5,3**	**4,9**	**5,2**
Denmark	8,0	7,8	7,7	8,7	8,6	8,6	8,7	**8,3**
Iceland	7,5	7,4	7,6	7,8	-	-	7,8	**7,7**
Sweden	6,7	6,6	6,8	7,3	7,0	6,8	7,0	**6,9**
Norway	6,5	6,7	6,4	7,3	6,9	6,5	6,9	**6,7**
Finland	6,2	5,9	6,1	6,8	6,9	6,8	6,8	**6,5**
Malta	-	6,2	5,7	5,3	6,7	8,0	6,8	**6,5**
Belgium	6,6	6,0	6,4	6,6	6,0	6,5	6,6	**6,4**
Ireland	4,7	4,9	5,7	6,4	6,4	6,1	6,5	**5,9**
The Netherlands	5,3	5,3	5,5	6,0	6,0	5,9	6,0	**5,8**
Austria	5,4	5,3	5,5	6,0	5,9	5,8	6,0	**5,7**
Portugal	5,1	5,1	4,9	5,8	5,6	5,3	5,8	**5,4**
Great Britain	5,5	5,3	5,3	5,6	6,1	6,0	5,6	**5,6**
Slovenia	5,6	5,2	5,2	5,7	5,7	5,7	5,5	**5,5**
Poland	5,3	4,9	5,1	5,1	5,2	4,9	5,2	**5,1**
Germany	4,4	4,5	4,6	5,1	5,1	5,0	5,1	**4,9**
Hungary	5,4	5,3	5,1	5,1	4,9	4,7	4,9	**5,0**
Estonia	-	4,7	5,6	6,0	5,7	5,2	4,8	**5,3**
Spain	4,2	4,3	4,6	5,0	5,0	4,8	4,4	**4,6**
Bulgaria	4,0	3,9	4,4	4,6	4,1	3,8	3,6	**4,0**
Latvia	3,3	5,1	5,7	5,6	5,0	5,0	3,2	**4,5**
Lithuania	-	4,6	4,9	5,6	5,4	5,2	-	**5,1**
Slovakia	3,7	3,6	3,6	4,1	4,2	4,1	3,1	**3,1**
Romania	4,3	4,2	6	4,2	3,5	3,1	2,6	**2,6**
Luxembourg	-	3,1	-	-	-	-	3,9	**3,6**
Greece	-	-	-	-	-	-	-	-
OECD	**5,2**	**4,9**	**5,1**	**5,3**	**5,5**	**5,2**	**5,0**	**5,1**
Other countries	-	-	-	-	-	-	-	-
Switzerland	5,3	5,0	5,1	5,4	5,0	5,0	5,4	**5,2**
United States	5,6	5.5	5.5	5.4	5.6	5,2	5.6	**5.5**
Brasil	5,0	5,1	5,4	5,6	5,8	5,7	5,8	**5,5**
South Africa	5,3	5,2	5,1	5,5	6,0	5,7	6,0	**5,6**
India	3,1	..	..	3,2	3,3	3,7	3,3	**3,3**
Koreea	4,2	4,2	4,8	5,0	-	-	5,0	**4,7**
Canada	-	4,9	4,8	5,0	5,5	5,2	5,5	**5,2**
New Zeeland	6,0	6,0	5,6	6,4	7,2	7	7,2	**6,6**
China	3,8	3,5	3,3	4,4	3,5	3,4	3,4	**3,7**

Source: Available data extracted from: http://data.worldbank.org/indicator, OECD (2016), Eurydice 2016, Eurostat.

Although, by adopting the Europe 2020 Strategy, the EU State Members agreed upon the fact that one of the major priorities resides in obtaining high quality Education, which should represent the foundation for a smart, lasting economic growth, favourable to social inclusion, for all citizens, this goal is not transposed in the funding policy, in the medium and long-term (Man et al., 2011). The issue of financing in Education is not only a punctual problem, but it concerns a country's ability of development.

From the analysis of the data presented in table 2, the situation of public expenditure in Education, in relation with the GDP as compared to the European average of the analyzed period 2006 – 2012, determines us to group these countries into ***two categories:***

- *the first category where we find the countries with values above the European average (5,2%),* that is: Denmark (8,3%), Iceland (7,7%), Sweden (6,9%), Norway (6,7%), Finland and Malta (6,5%), Belgium (6,4%), Ireland (5,9%), the Netherlands (5,8%), Austria (5,7%), Great Britain (5,6%), Slovenia (5,5%), Portugal (6,4%) and Estonia (5,3%);
- *the second category where we find the countries with values below the European average (5,2%),* respectively:

Poland (5,1%), Lithuania (5,1%), Hungary (5,0%), Germany (4,9%), Spain (4,6%), Latvia (4,5%), Bulgaria (4,0%), Slovakia (3,1%), Romania (2,6%).

We also have to mention that the OECD Member States are close to the European average and countries such as: New Zeeland, Switzerland, the USA, Brasil, South Africa and Canada place themselves even a bit over the European average. We haven't had data available for all years for countries like Lithuania, Estonia, Luxembourg and Greece.

The increase of expenses on Education up to 6% of the GDP is not an end to itself, but a tool for achieving the ambitious objectives of the Europe 2020 Strategy and of the key goals. If the expenses on Education increased gradually till the aforementioned level, then the economic growth would be achieved till the level of the 2016 - 2025 period. The experience of the States with economies and participation rates similar to that of Romania (such as Latvia and Hungary), but which invest more in Education (almost 6% of the GDP), demonstrates that Romania could increase the average of the schooling level with an year by 2025, so that the investments in the early years of Education should stimulate economic growth and equity. International studies show that the investment in early Education represents the intervention area with the greatest benefits, the EU data still indicating its sub-funding in Romania. The development of human capital can also present numerous benefits, such as improved health, decreased crime and dependency on welfare benefits. In the figure below, the percentage of the GDP allocated to Education by States in 2012 is presented in a graph.

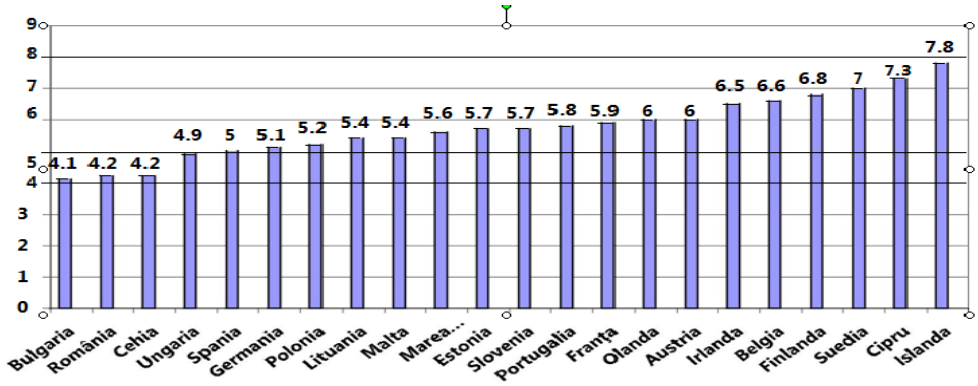

Fig.1. The percentage of GDP allocated to each State for Education in 2012 (Source: World Bank)

The strategy and the budget of Education have to be consistent with a broader plan of **economic development in order to encourage the private sector to create jobs and recruit staff in a non-discriminating manner.** This plan should set targets for industry and services, supported by a more consistent human capital (Măcriș & Ioanăș, 2015). The Education and Training System has to reflect the needs of the labor market. Thus, in achieving the budgets of the education institutions, and especially of the pre-university ones, they have to take into account **the pupil/standard cost**, which is based on the expenses with the staff, the materials and services, as well as the professional development, according to the following schedule:

BASIC INDICATORS	**Type of the cost**	**Financed by**
Number of pupils	***PUPIL/STANDARD COST***	***STATE BUDGET***
Number of classrooms		
Teaching norm/guidelines		
4. Physical consumption (with the personnel, the materials, the textbooks, etc.)		
ADDITIONAL INDICATORS	***CORRECTION COEFFICIENTS OF THE PUPIL/STANDARD COST***	***COUNTY COUNCIL BUDGET (local budget adjustments based on the correction factors by county equalization funds)***
A. Indicators depending on the characteristics of the education institution		
Education Institution:		
Type		
12. Level of Education		
1.3. Branch		
1.4 Specialization		
2. Teaching staff characteristics:		
2.1. Average wage level		
2.2. Teaching degree		

2.3. Seniority tranche		***LOCALCOUNTY COUNCIL BUDGET***
2.4. Professional development		
3. Urban or rural environment		
4. The degree of isolation and density of school population		
5. Other specific indicators (type of heating, the presence of some school facilities, the status of the material basis, historical monuments)		
6. Curriculum protection		
B. Indicators dependant on the characteristics of school population and/or localities		
Pupils with additional educational needs:		
No. of pupils belonging to minorities		
No. of pupils with additional educational needs		
No. of pupils with learning disabilities		
No. of pupils belonging to disadvantaged groups		
Pupils with special needs		
Unemployment rate		
The degree of poverty		
The rate of social protection beneficiaries		
Average income/inhabitant		

Fig.2. *Schematic diagram of the budget of educational institutions*

The State budget, that is the sums deducted from VAT, performs basic funding (F_b), which comprises *personnel costs, scholarships, goods and services.* In order to complete the sum of basic funding, sums from the Local Council Budget are allocated, too, that is funds for *expenses on materials, services, as well as for professional development.*

The amounts *relating to* ***complementary funding (Fc)*** are distributed from the Local Council Budget for *consolidations, essential repairs, investments, subsidies for boarding and school cafeterias, expenses for organizing assessments, simulations and national exams of students, scholarships, transport, commuting, compulsory medical examination, school contests and educational, cultural and artistic activities, sports and tourism,* representing a completion to the basic funding. The two forms above-presented form the complete funding ($F_{complete}$) of Education and starts from the following relationship:

$$F_{complete}=F_b+F_c \qquad (1)$$

Additional financing is achieved from several sources, from the Ministry of Education and Scientific Research, from the County Council, local councils, from the citizens through voluntary contributions, funds from economic entities, etc. We express our opinion that not only the employers have to be convinced of these benefits. The investment in the health and education of our children produces benefits throughout life. James J. Heckman, Nobel laureate, argues that, when it comes to the learning process, investment in early childhood brings benefits on the medium and long term, greter benefits than in any other period of life. Although world's governments are more and more involved in increasing the percentage of GDP allocated to early Education, they do not put this fundamental demand for the development of mankind on the first place.

3. Conclusions

Within public expenses, the ones on Education play an important social and economic role because, from the resources allocated by the State, people attending schools and those who use skilled labor force in society are the ones benefiting from these resources. Taking over a part of the social spending, the State exempts economic entities from the financial effort necessary to form skilled people and highly qualified specialists. Therefore, the modernization of Education is achieved in accordance with the requirements of different stages of the economic and social development, of equalizing the conditions of training and education of the members of the society, with the resources allocated, reason why it is necessary that public spending on Education increase yearly.

Costs analysis, especially of unit ones (on a specific indicator) and of the component elements allow the assessment of the education system depending on the way the various factors of production are reunited (teaching staff, auxiliary force, goods and services, etc), opportunities of the economy, financial advantages and disadvantages of the new methods and working techniques, etc. Consequently, it represents an essential tool for planning to assess the productivity of the system and to forsee possible expenses (Grabara et al., 2013). Sometimes, the unit costs can be higher for different reasons: either the Education system is of quality or, on the contrary, it hasn't been adapted to the social and economic conditions. Generally, we support the idea according to which any improvement of Education requires an increase of the amounts allocated. Undoubtedly, the incomes of those working in this sector must increase so as to recruit the teaching staff easier and to allow the purchase of strictly necessary materials, but very often, we need a better organization of the administration, of the educational methods, an efficient use of the spaces which allow the development of Education without an excesive increase of costs.

In literature they often use the term of expenses for education and that of cost of education, there are quantitative and qualitative differences between them. From a quantitative perspective, the expenses for Education are higher than the costs, because they include both the costs to ensure the optimal operation of the educational process and the costs for the educational action, while in terms of quality-structural, the expenses for education are represented by the funds allocated, while the cost represents the real expenses consumed, diminished with the income made by specialized institutions. In budgetary terms, the expenses represent the planned level of the funds for Education, while the cost represents the actual consumption of the funds, according to the budgetary execution (cash payments).

Thus, we conclude that one must use the term of expenditure in the process of substantiation of the neccesary money for Education, and the term of cost in the process of analysis, in the records of the funds used. Even though there are differences between the terms of cost and expenditure, at educational level, it is important that, where appropriate, they include, correctly, the elements they consist of so that they could be used in the economic analysis, whose application in Education is extremely useful and represents certain particularities as compared to other sectors of the economy. Therefore, the actual cost of training cannot be obtained by multiplying each year of study with the duration of the cycle; the additional cost which involves actual losses has to be taken into consideration. On the other hand, unlike the cost of production of a merchandise which lies in the responsibility of an economic entity, the cost of Education is partially supported by the individual benefiting from various forms of education. Despite the fact that Education is free, the individual has to perform different expenses, sometimes there may be no gain for him/her especially when the individual is at the age when he can carry out an activity. It is therefore compulsory that this cost of opportunity be taken into consideration by the State in its general policy, although it may compromise the production targets in the situation of the lack of labor force.

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The need to use benchmarking in performance analysis of human resources in the public sector

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Abstract

Due to global competition and rapid economic and social changes, the environment, in which public sector entities work, is changing and this raises serious challenges regarding their position on the market, their reputation and even their existence. In order to progress, and sometimes even to survive, these have to be up to date with the latest trends, to adopt changes and to update their practices. Benchmarking is an effective tool to achieve improved performance through continuous monitoring and comparison with similar entities enjoying success. Consequently, in order to be successful, the process of bench-marking has to identify the best practices and determine the way these practices could be adopted by other institutions as well. Human resources in the public sector have to admit that their role is to create value and to provide bench-marking with those tools to obtain value, by measuring the difference between opportunities and strategic plans set out by the management. Through this paper, we intend to analyze the conceptual aspects and the stages of carrying out a bench-marking project, whose knowledge will largely contribute to a substantial improvement of the human resources management in public sector institutions.

Keywords: Benchmarking, performance analysis, human resources, public sector .

1. Introduction

The human being is the richest resource within an entity, and its performance is born out of the human resource coordination. Education plays a vital role in the formation and maintenance of human capital and in determining the human's chance from an economic point of view. Nowadays, in Romania the problem of accomplishing the objective "investments in human capital" (Scurtu, 2006) is becoming more and more urgent. This requires the completion of some stages, not only the conceptual ones, but also of mentality. The first stage is that of understanding that without a rapid and profound progress in the educational system, we will have neither an economic growth, nor an increase of the living standards, no matter how many funds the European Union or any other international financial institution would allocate us. The second stage is to change the mentality of management within the Ministry of National Education and Scientific Research, in the way of a real re-organization and reform of the entire system of education. The third is the change of mentality, the citizens of the country, the businessmen, the parents, the children, they all have to understand that the investment in education is the most important objective for the future. Human capital formation and maintenance remains a global responsibility for all individuals and governments.

Although people are "*the measure of all things",* their importance is not appreciated at their true value (Suciu, 2008). In conclusion, *the more you invest in human capital, the more it promises better economic performances,* both from the point of view of the individual, of the employer and of the society, in general.

The human resources efficiency is expressed by a set of rates established by reporting the results obtained to the available human resources. These rates allow value judgments on the use of human capital through comparisons in time and space towards certain values considered as normal (Charles & Bennewort, 2008). The calculation formula of the efficiency of human resources is given by the ratio between the results obtained and the human resources available. Therefore, the results obtained in the public sector can be represented by revenues and reflected into the account of patrimonial outcome, and the human resources available are expressed in number of employees, in number of days worked, in number of hours worked, salary costs.

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Human resources efficiency can be correlated with labor productivity (Munteanu, 2014). We consider efficiency as the value expression of productivity, expressing the ratio between the volume gained and consumption, quantitatively. We can conclude by emphasizing the fact that, within an economy based on transactions, these elements form the skeleton of a solid system of information and decision making on human capital.

2. Approaches of conceptual nature on benchmarking

The practical application of the latest theories regarding the mitigation of global crisis and the use of a wide range of instruments means, most of the time, the difference between collapse and success, between profitability and inefficiency, between economic performance and bankruptcy. *Benchmarking* is one of the latest instruments that are at hand for a successful management. If used to its full potential, in a proper environment, correlated directly with the market circumstances, it can be the cornerstone in the future positive development of the entity in discussion.

The study of literature determines us to appreciate that there is still no universally accepted unit definition, but, to a certain sense, they all converge to the same meaning. Thus, benchmarking has been lately defined as:

- *"an ongoing process of performance evaluation [...] probably, the only way to longer stay 'on a role', among the best"* (Camp, 1998);
- *"a tool for learning about how to improve activity, processes and management",(*Ahmed & Rafiq, 1998);
- *"a process of evaluation and application of best practices which improve quality"* (Kulmala, 2003);
- *"an information system which enables an enterprise to display their development strateg*y" (Niculescu & Lavalette, 1999);
- *"a way of identifying potential improvements, in efficiency and effectiveness, of current operations and strategy by comparing the company's performance with the performance of others"* (Costa, 2008);
- "*a way to utilize the expertise of others in order to avoid reinventing the wheel*" (Michelin & Wilson, 2007);
- "*a useful technique to determine the competitive advantages and to learn about products, services and own operations by comparison with the best*" (Herme & Achard, 2007).

From the definitions presented above, it results that *the entity that performs benchmarking aims at achieving on overrun of competition by measuring the distance that separates them and by establishing the necessary measures to mobilize the energies for performances' increase. Benchmarking involves the identification of entities considered as leaders in the control of their own intangible assets and the determination of the level to which certain criteria are met, by comparing their own outcomes with the results of those leaders, benchmarking aims at quality, performance, the path to excellence, seeks a transfer of the ways of management and actions that are meant to visibly improve the management of the entity (*Vorhies & Morgan, 2005).

The human capital of a country cannot be easily measured. It is impossible to make a list of the skills of a population overall, at macro-economic level, and which later to evaluate in terms of their relevance on the labor market. What is actually possible is to compare *the structure of the qualifications of the population* of the respective countries based on *formal education (*Măcriş & Man, 2012).

The UNESCO classification of the education systems serves as the starting point for the human resources *indicator.* The indicator offers a comparative perspective of the human capital in several countries. Due to the fact that this indicator focuses on the formal qualification (initial education), further qualification won't be taken into consideration. The countries included in the comparative analysis are: Bulgaria, Estonia, Croatia, Latvia, Lithuania, Romania, Slovakia, the Czech Republic, Hungary, Poland. The higher the value of the human resources indicator, the more qualified the population is in terms of formal qualification. The HR indicator can register values between 100 - which means that the formal education of the resident population is not above the compulsory level of schooling - and 300 - which means that the entire resident population has a university degree or any other similar qualification.

In an international comparison, Romania ranks the last place among Central and East European countries. Estonia ranks the first place, with the highest value (201) of the HR indicator, followed by the Czech Republic, Lithuania and Latvia. The third group consists of Slovenia, Austria, Slovakia and Poland. The maximum difference between the countries with the highest and the lowest indicators is of 37 points. This data show that there are significant differences among countries. Consequently, the human capital in these countries is also very different. This method may be explained, in theory, but it is difficult to be put into practice. If well managed, a benchmarking project can be of real help for an entity because it forces the participants to closely look at their own processes and to ask themselves questions regarding the activity carried out.

Benchmarking partners have to be chosen carefully because two organizations/institutions are never identical. It is remarkable how different entities are at a close level when they are involved in the same business and this determines the participants to examine the general (universal) areas of operations, which can later increase *or decrease the power of exercise* (Serge, 2009).

The participants of the above-mentioned method are not, for different reasons, open or honest to one another during the exercise. The information derived from the process have to be taken into consideration and measured carefully in accordance with the confirmed evidence. Not all should be considered as absolute truth since this could mislead the entity, which may have an itinerary full of obstacles and failures (Parrado & Loeffler, 2013). It is worth highlighting that some of the protesters of the method suggest that bench-marking serves to conducting the entity to an average level, and not to be the leader of the reference area. This may have coverage in some businesses, but they ignore the fact that entities can learn from one another (Vanderborght, 2007).

By definition, benchmarking makes an entity to turn its attention from the internal to the external environment so as to compare their own performances with those of the best entities. A common question would be that related to why an entity should be involved in benchmarking (Pell, 2007). The simplest answer would be that by adopting this procedure, the entity remains in competition. The institutionalized bench-marking determines the entity to better know the environment of the competition and the requirements of their own clients.

Some entities have no real chances of success because they are not up to date with the changes happening in the industry, and they rely, especially, upon unverified or insufficient information, plus the weak managerial training (Platen & Heath, 2006).

Consequently, ***benchmarking*** *is a process of organizational change directed towards continuous improvement, towards correcting shortcomings and finding the best practices to lead the entity to a higher level of performance.* It provides the changing of processes and working methods at the level of an entity by using the data obtained from research, thus increasing its efficiency. At the same time, it understands how other entities set their levels of performance and reach them by a continuous process of modeling.

The purpose of *benchmarking* is to realize how other entities measure their performances, structures and the processes they use. *Benchmarking* is the method by which we can look in the exterior (outside the entity) or from the exterior to the interior of the entity in order to find, introduce and increase performance.

The main feature of the bench-marking process is to establish credible objectives and to aim at a continuous improvement of the employees' performance (human capital). Thus, at the origin of any *bench-marking* approach there are more objectives, as follows: meeting customer's satisfaction; improving performances by establishing efficient and credible objectives; discovering best methods and practices; evaluating their strength and weaknesses to increase performances; facilitating a conduct for change.

3. The content of the stages of a Benchmarking Process to analyze the performances of the human resources in the public sector

Benchmarking is a basic component of the human resources audit which translates into an internal analysis of their functions at the level of a public institution, including the performances made at higher hierarchical levels. Human resources audit starts with the evaluation of effectiveness on fields of activity, followed by the benchmarking of activities carried out in order to go on with the improvement. The human resources of an entity have to be aware of their role, that of creating value. Benchmarking **provides** the necessary **tools** to obtain value by measuring the gap between opportunities and the strategic plans set out by the management. Any benchmarking project aims at achieving the following ***objectives:***

- *Establishing a connection between the efforts of achievement and the strategic plans of the institution;*
- *Gathering internal information necessary to carry out the program;*
- *Identifying internal opportunities;*
- *Focusing on particular aspects, which haven't been valued yet.*

Carrying out a benchmarking project implies going over **four important stages**:

- ✓ ***Planning***

The first stage in a bench-marking project aims at **planning.** Considering that benchmarking implies the comparison of the public institution's performances with that of the leader on the market - the institution with the greatest representation for the public sector - it is compulsory that an internal analysis of human resources should be made, especially **of the success factors and of the weak points of the entity in the human resources field**. This scan can be achieved through the specific activities of the HR management, namely: recruitment and selection; jobs analysis and design; reward; training and career development; relationships with employees; working conditions, at the level of the entire human ensemble. This last indicator is of particular importance because, based on it, the top management sets how the human resources field operates and this can determine **the competitive advantage** over the competition, as well as the shortcomings in comparison with a powerful entity in the field. Most of the time, this internal analysis is required when a decrease in efficiency and effectiveness is noticed. This is why it is in the best interest of any entity, be it a public institution or a company from the private sector, to continuously or periodically perform **an audit of human resources** at the level of all activities and then later see its effects.

As a stage of the bench-marking project, **planning** establishes **the implications of the business plan of the organization in direct connection wit the human resources,** it allows the identification of the problems which can affect the objectives set or with implications on the other functions of the organization. At the same time, planning has the role to transform *organizational objectives into objectives of personnel,* which may ensure the foundation of a strategic planning in accordance with the needs of human resources. Another strategy aims at *revising the process of* *strategic planning* of the organization in order to identify new directions of involvement of the top management and of the department of human resources, with the purpose *of correcting the shortcomings in the domain of reference*.

The role of planning in identifying the internal opportunities of benchmarking consists in highlighting the requirements of human resources on three distinct levels, namely: that of *current operations,* where an analysis of the entire database of the institution is necessary, in order *to discover* whether there are any *limits or constraints in implementing the policies, practices and procedures in the field. At the departments level,* they intend to make some *interviews with the representative managers* in order *to get to know and retain* viable, valuable ideas on *the implementation of policies in the human resources field, on the whole, and the implementation of practices and procedures* according to the specifics of each department. At *senior department level by checking* the way the activity of strategic planning is reflected upon human resources. Conducting a bench-marking project consists in *interviewing the key managers* of the entity in order to find out *their opinions* regarding the way *planning influences the implementation of policies, practices and procedures in the human resources field.*

Benchmarking, as we mentioned, aims at finding *some alternatives (solutions) to eliminate the deficiencies* which the entity faces in the human resources domain. One direction refers to the comparison of their situation with that of other entities so as to come up with ideas meant to fill in the gaps and to ensure competitive advantage. Another direction would be that of an ***internal analysis of human resources*** in order to identify some particular aspects which characterize them, to monitor progress, to improve activity, to develop and implement new programs and practices for increasing the efficiency and effectiveness of the field.

Focusing on the particular aspects, on the results and on the measurement requires a rigorous analysis of the human resources available at each institution when it identifies challenges and opportunities. It is an important process which requires time and the results obtained from analysis are to be quantified and interpreted. Based on the results obtained, the senior management of the entity will formulate proposals and solutions to reduce shortcomings and to improve the activity in the respective field.

At the level of each activity in the human resources field, a localization of malfunctions and opportunities is necessary, and also a concrete analysis of the findings in order to establish the cause - effect relationship. A list of possible explanations (reasons) is also necessary and useful, explanations that lie at the basis of the malfunctions/opportunities appearance and the connection between them. They will determine the consequences of solving shortcomings, the size of benefits, without omitting the degree of control that the senior management of the entity disposes of. In the end, they will retain the results and major consequences of the research in the human resources field and the impact of the measurements adopted on the well functioning of the institution.

The analysis carried out will enable true knowledge of the human resources situation and the adoption of some measures to improve the activity in the future. The data and information resulted from research has to be real, certain, viable, and the results obtained have to be quantifiable and construable in terms of costs, time and benefits. It should not be forgotten that during the analysis they must set the level of competence of the controller, as well as the level of performance to be reached in the next period.

✓ ***Research***

The main *sources of data and information* necessary to draw up a bench-marking project are: libraries, the internet, professional associations, publications, analysis studies, consulting firms, chambers of commerce, the primary documents of the organization, etc. The purpose of *identifying the sources of data and information* necessary for the project is to allow *meaningful comparisons* between those provided by the institution, at the level the analysis is conducted, and those supplied by external sources. A full and viable analysis has to start from using the above mentioned sources of date. In identifying the necessary factors for the adoption of the right program, an important role accrues to the research focusing on the issues specific to human resources; nevertheless, the other sectors of the organization shouldn't be omitted. The data and information used in the benchmarking project have to be *relevant and useful after their processing*.

The documentation regarding the problems/opportunities arising from research begins by gathering the internal information, in conjunction with the external data so that they can be compared with those of other similar institutions. In case the measures adopted on the situation in question don't give the expected results, then it is necessary that the partners or benchmarking entities should be contacted. The companies that provide consulting services in the human resources field are to identify the existing gaps over other benchmarking projects with similar issues and *to come up with solutions, not just recommendations,* so as to produce visible changes.

✓ ***Analysis***

Conducting a benchmarking project involves not only providing standard solutions. They are based on the real situation of the entity, on the analysis of activities, processes, practices and methods used in the field of human resources. After analyzing the failures and opportunities arisen in the human resources domain, the analysts suggest a set of ***questions*** that will include:

- *When did the latest changes occur in the human resources domain?*
- *Could these be considered causes of the issues and malfunctions arisen?*
- *What are the quantitative and qualitative dimensions of the problems?*

• *Are the used data and information significant and measurable? What about the results obtained after having processed them?*
• *What are the major differences between the situation of the researched organization and other institutions?*
• *What are the changes to be undertaken in the human resources domain so as to improve the existing situation?*
• *Can the solutions proposed be applied on the organization under research?*

The answers to these questions are ***the premises*** for formulating proposals and developing the action plans to improve the situation. It is highly imperative that the analysis of the entity's situation be rigorous and fall into a certain ***time limit***. The longer the analysis takes, the more the probability that some changes, internal and external, arise in the human resources domain, at the entity's level, which makes it difficult for the situation to redress. Actually, reconsidering the data and the changes occurred leads to new solutions in conducting bench-marking, ***the priorities*** are going to be observed. Their modification can generate an interruption of the project and its recommencement from scratch. The increase in the analysis duration, without presenting the solutions, can also lead to a decrease in the reliability of the process.

✓ ***Implementation***

The last phase of bench-marking refers to the implementation of the solutions suggested in order to improve the performances obtained by the public institution at the human resources level. Turning this into action must result into visible changes which should allow the increase of efficiency and effectiveness in the respective domain.

The four phases of the benchmarking as presented above aim, on the whole, at ***performance increase***. If in the first phase, the main objective is that of identifying the strengths and weaknesses of the entity in the human resources field, in the second stage, the opportunities of achieving a benchmarking project are to be known, and the third phase allows comparisons with similar situations of other entities, based on the data and information gathered. The last stage is, in fact, a synthesis of the previous stages and consists in ***applying the solutions suggested, followed by a thorough monitoring of the progress registered***.

The practical application of the solutions resulted after applying the program will have as ***final objective:***

- *Communicating the results, proposals and solutions of the senior management of the entity;*
- *Emphasizing the strengths;*
- *Identifying the opportunities to increase performance;*
- *Obtaining the support from the management of the entity to implement the solutions proposed after having identified the shortcomings;*
- *Developing other objectives, as a result of applying new solutions;*
- *Monitoring the progress made;*
- *Updating the changes made at the level of the entity in the human resources domain and achieving bench-marking in a period of time between two-three years.*

The above presented determine us *to consider that benchmarking doesn't limit to just performing some comparisons between the public institution analyzed and other entities, but it aims at overcoming the parameters of efficiency of the entities competing, in the area of reference, having as final objective the achievement of excellence.*

4. Conclusions

Considering the current economic conditions, the conclusion is clear and obvious: the investments in human capital, at macro- and micro-economic level, are becoming more and more profitable. The investment profitability in human capital is based on individual value, depending on the length at work, the quality of work and the contribution over a period of time. The current research is oriented towards the investigation of modern means of evaluating the production capacity of human resources and the amplitude of its variation in time. Specialists study the global and individual value of the service to quantify human contribution to the enrichment of the society which, in its turn, measures the stream of revenue produced by the human resource. Due to the inaccurate character of the notion "increase of the services delivered", some economic analysts, such as E. Marques (1980), assimilates the growth of these services with a part of the added-value, which leads to the evaluation of the society and, hence, of the part associated to human resources. The constitutive elements of economic performance are, at the same time, technical, human and organizational. The performance of human resources cannot be reduced to mere productivity in a developed conceptual framework that does not consist in the hypotheses of simplicity and the stability of markets.

The development of human resources in a knowledge-based society and of all institutions acting on this line represents a crucial factor that lies at the basis of competitiveness. Benchmarking and the orientation towards the best practice represents the corresponding technology for the management of a sector which, at a large extent, is not governed by the force of the market. The examples of best practice serve for setting objectives and creating the necessary enthusiasm to improve performances. The bench-marking in the public sector has long-term effects and stimulates lifelong learning in institutions of this kind. Thus, the services offered by public institutions fall under the conditions which influence business development and have to be targeted for the best practice with regards to their efficiency and quality, as well as to customer satisfaction. Consequently, the public sector has to be acknowledged and encouraged to utilize benchmarking as a current policy, to capitalize knowledge and the existing models in Europe.

In this sense, we can certainly state that benchmarking does not only focus on comparing costs or measuring performances between the entity under study and the competing entities, but it focuses on understanding the methods and comparing basic processes so as to elaborate and present constructive and applicable ideas, necessary to management improvement. In fact, benchmarking aims at identifying shortcomings, followed by the development of new projects which, once implemented, can substantially improve the management of human resources.

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Banking crises: theoretical concepts and determinant factors

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Abstract

Banking crisis is a form of financial crisis. It can manifest itself at the local, regional, national and global level. The problem of determining banking crisis involves disclosure of its concepts and selection criteria of banking crisis can be called on the basis of which the situation in banking sector. In their absence, and it can not possible to analyze the actual banking crises. In this article will be examined theoretical concepts and determinant factors of banking crisis.

Keywords: banking crisis, bank, banking system, factor

Introduction. According Wikipedia, “a banking crisis is a financial crisis that affects banking activity. Banking crises include bank runs, which affect single banks; banking panics, which affect many banks; and systemic banking crises, in which a country experiences a large number of defaults and financial institutions and corporations face great difficulties repaying contracts.” (*List of…*, n.d.)

A banking crisis is marked by bank runs that lead to the demise of financial institutions, or by the demise of a financial institution that starts a string of similar demises.

Studies show that banking crises occurred early in the eighteenth century and their number is growing trend (Fig 1).

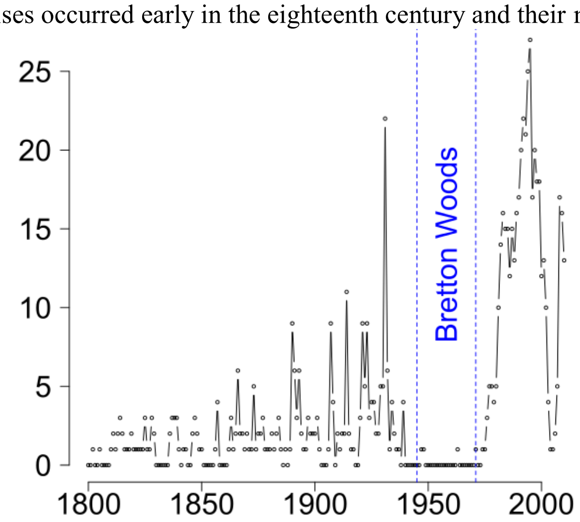

Fig. 1. List of banking crises Source: (*List of…*, n.d.)

Thus, in the eighteenth century it occurred for major banking crisis, in the nineteenth century their number reached 12 and in the twentieth century there have been 17 famous banking crises.

The most remarkable of the XXI century banking crises were:

- 2002 - Uruguay banking crisis
- 2003 - Myanmar Banking Crisis
- starting in 2007- subprime mortgage crisis in the U.S.
- 2008 - United Kingdom bank rescue package
- 2009 - United Kingdom bank rescue package

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- 2008 - 2009 - Belgian financial crisis
- 2008 - 2012 - Icelandic financial crisis
- 2008–2009 - Russian financial crisis
- 2008–2009 - Ukrainian financial crisis
- 2008–2012 - Spanish financial crisis
- 2008–2011 - Irish banking crisis
- 2009 – 2010 - Venezuelan banking crisis
- 2012 - 2013 - Cypriot financial crisis.

Defining banking crisis. The problem of determining banking crisis involves the disclosure of its concepts and the selection criteria. The literature contains many definitions of this notion:

- Banking crisis is the failure of the banking system, which means the bank's inability to comply with terms of entered into contract with investors, due to defaults of bank's borrowers, of contract with bank or as a result of impairment of bank assets (Rudy, 2003);
- Banking crisis is represents recurrent violations of monetary system balance, expressed as a mass withdrawal of deposits and sharp reduction of commercial bank loans, growth of financial bankruptcies, pursuit of cash and gold, a significant increase in the rate of interest (Onosova, 2008), (Tolstolesova, 2016);
- Banking crisis is the failure of the banking system to perform its core functions of accumulation and mobilization of temporarily free funds, provision of credit, settlement and payment transactions in the country's economy. (*Современные…,* n.d.);
- Banking crisis usually refers to a situation in a general "market adjustment" when faith in banking institutions falls, and people start trying to move their money to other places for safe keeping. (*Banking crisis (a),* n.d.);
- Banking crisis is a situation in which the supply of money is outpaced by the demand for money. This means that liquidity is quickly evaporated because available money is withdrawn from banks, forcing banks either to sell other investments to make up for the shortfall or to collapse. (*Banking crisis (b),* n.d.);
- Banking crises (banking crises, based on the effect of "dominoes", in which the accumulation of bad assets in a limited number of banks and their ability to pay termination leads to a banking panic, to a run, a sharp decline in lending by banks to each other, etc., and - against the background of growing distrust of the crisis - started mass suspension of payments by banks followed the collapse of the payment system and financial markets). (Mirkin).

Charles Calomiris affirms: "When defining banking crises it is important to distinguish between two different aspects of banking crises – waves of bank insolvency (episodes in which bank losses result in many failed banks), and banking panics (moments in which the banking system as a whole suffers from sudden, large withdrawals of deposits)." (Calomiris, 2009)

Examined notion is often linked to bank run (bank panic), which is treated by Rational wiki as "a serieis of unexpected cash withdrawals caused by a sudden decline in depositor confidence or fear that the bank will be closed by the chartering agency, i.e. many depositors withdraw cash almost simultaneously. Since the cash reserve a bank keeps on hand is only a small fraction of its deposits, a large number of withdrawals in a short period of time can deplete available cash and force the bank to close and possibly go out of business. (*Banking crisis*, n.d.)

Bank for International Settlements has identified what signs can identify banking crises (Onosova, 2008):

- If banking problem assets represent more than 2% of GDP;
- The amount of money needed to rescue the banking system is more than 2% of GDP;
- The nationalization of the banking sector has acquired a mass character, frozen bank deposits and government introduces the so-called "bank holidays";
- The country's central bank guarantees payment to population of all bank deposits, not providing their material guarantees.

Specialists of the International Monetary Fund believes that banking crisis occurs, if at least one of the following conditions is present (Onosova, 2008):

- The ratio of uncollectible assets to total assets of banking system exceeds 10%;
- Costs for public authorities to support troubled banks amounted to at least 2% of GDP;
- Carried out the nationalization of troubled banks;
- Emergency measures have been taken by banks, such as the freezing of deposits, suspension of work;
- Public authorities have undertaken a number of bodies created by the guaranteed return of lost deposits.

Forms and types of banking crisis. Some researchers prefer to highlight a number of forms of manifestation of banking crises (Onosova, 2008), (Obmeliuhina, 2010).

The first form - latent crisis (bank distress), which is a situation where a significant part of banking institutions is untenable, but continues to operate.

The second form - this is an *open form of the banking crisis*. In other words - the bank bankruptcy, which even before the Great Depression was preceded by banking panic, expressed in massive withdrawals of deposits from banks (bank runs). By the way, in present time "raids" on depositors banks have become a rarity - mainly due to the deposit insurance system and the various forms of explicit and implicit guarantees from public authorities. So, now crisis transition from hidden to open form is largely determined by the specifics of the institutional and legal framework of the country and measures by the central bank and other regulators in relation to troubled banks.

The third form - a systemic banking crisis, which is the failure of most of the banking system. Insolvency refers to inability of bank to fulfill conditions of contract with investors due to default of borrowers or as a result of impairment of bank assets. The open form of crisis is reflected in the failure of termination of banks issuing deposits on demand of investors. Payments termination on deposits by a large number of banks is the most obvious manifestation of open systemic crisis.

The fourth form of the banking crisis is the most harmless - it's a *partial* or *local banking crisis*, when the crisis covers a certain sector of banking system or individual regions within the country.

Also, researcher Onosova divided banking crises in two types. (Onosova, 2008)

The first type is a crisis, acting at microeconomic level - irrespective of extent of budget expenditure. Examples - crises in United States, Sweden (1990-1993 gg.), Finland (1991-1994 gg.) and France (1984-1991 gg.) (1991-1998 gg.). In these cases, bankruptcy of a limited number of banks did not extend to entire financial system and caused large-scale macro-economic downturn.

The second type of banking crises is associated with much more devastating consequences for a country which becomes a victim. This type of crisis is mainly distributed at the macroeconomic level. Very often, in this case, is recollected the experience of Chile's 1981-1984, which was originally a banking crisis caused a decline in the 13% of GDP (in 1982-1983.). There the overwhelming part of the banking sector was nationalized, but in the end government spending on its restructuring has not yet been fully compensated.

Based on the scale of crisis, exist following types (Hodachnik, 2001):

- *Local* - happens to individual banks and their groups (on territorial or branch principle);
- *National* – affects with their action one country;
- *Regional* - arises and develops in several countries of region;
- *Global* banking crisis.

Some sources are divided banking crises into *local* and *systemic*.

According to experts of the World Bank, "a systemic banking crisis occurs when many banks in a country are in serious solvency or liquidity problems at the same time - either because there are all hit by the same outside shock or because failure in one bank or a group of banks spreads to other banks in the system. More specifically, a systemic banking crisis is a situation when a country's corporate and financial sectors experience a large number of defaults and financial institutions and corporations face great difficulties repaying contracts on time. As a result, non-performing loans increase sharply and all or most of the aggregate banking system capital is exhausted. This situation may be accompanied by depressed asset prices (such as equity and real estate prices) on the heels of run-ups before the crisis, sharp increases in real interest rates, and a slowdown or reversal in capital flows. In some cases, the crisis is triggered by depositor runs on banks, though in most cases it is a general realization that systemically important financial institutions are in distress."

It should be noted that between crises arising on a particular levels on scale, there are certain relationship. The crisis in individual, in particular systemically important, banks can cause a national banking crisis. Problems in one country can provoke instability in another, cover region or contribute to development of the global crisis. It is necessary to take into account that banking system is an integral part of the economy as a whole and its problems can be both a cause and a consequence of wide crisis.

Based on causes of their origin, the typology of banking crises can be represented as follows: (Obmeliuhina, 2009):

- *Conjunctural (current, local) crises* of solvency and liquidity arising from conjunctural fight for market share;
- *Debt (loans, financial) crises* appear together with the high dependence of banks in banking system by groups of shareholders, clients, related to the riskiness of loan and investment portfolio, and in general with the diversification of assets;
- *Organic (moral, corporate) crises* are caused by participation of banks in redistribution of property, lobbying political and economic interests of the owners of the bank, holding company;
- *Structural (systemic) crises* arising from unresolved macroeconomic problems, wrong monetary policy, financial instability of individual economic agents.

Causes (factors) of banking crises occurrence. Researchers Ermakov and Frolova (2010) examined causes of banking crises and introduced a system of three groups of factors which should be considered together.

- *Institutional factors:*
  - Unsatisfactory condition of supervision of banking systems and their regulation;
  - Unsatisfactory state of regulatory and legal framework governing of banking activities;
  - Unsatisfactory state of bank statements;
  - Absence of necessary conditions for the development of banking supervision;
  - Delayed and inadequate response to failure of banks.
- *Microeconomic factors:*

– Poor quality of current bank management, defining features of corporate governance and reaction of commercial banks to adverse changes in the economic environment;
– Unreasonably high level of credit expansion during prolonged economic boom, which usually serves as a triggering factor for banking crises;
– Predominance of non-market motivation in issuing loans, lending affiliates, focus on a single borrower;
– Human factor (moral hazard, interest of the bank's management in bringing it to bankruptcy).
- *Macroeconomic factors:*
– Unsatisfactory or unstable state of the national economy;
– Political instability in the country;
– High inflation and lack of adequate measures for its regulation;
– Unsystematic sharp fluctuations of commodity prices, prices of banking assets, interest rates on loans and deposits;
– Foreign policy factors, including the problem of external debt, international obligations, etc.
– Negative effects of the stabilization policy, market reforms.

A set of macroeconomic, microeconomic and institutional factors causing banking crises manifested in specific forms of crisis the bank's status, such as (Ermakov, Frolova, 2010):

- Decrease value of the bank's assets;
- Sharp outflow of funds of depositors and creditors and, as a result, reduction in funding (inflow of investment assets);
- Drop in the cost of providing collateral overdue credit;
- Lack of balance of the bank's assets and liabilities by maturity and currency;
- A large proportion of bad loans and poor quality of loan portfolio;
- Occurrence of serious damage caused to the bank fraud and various illegal actions.

Conclusions. Banking crisis is a situation where a country enters more banks unable to meet its payment obligations in short term (liquidity crisis) or bank liabilities are lower than the bank's assets result in (bank insolvency). It is a specific form of financial crisis. Banking crises can take different forms, and to move from one to another, and the most serious of which is systemic banking crisis in global expression. Triggering banking crisis occurs under impact of factors institutional, microeconomic and macroeconomic nature. Forms and factors knowledge is important to avert banking crisis and taking adequate anti-crisis measures.

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Comparative Study on the Accounting of Client Credits in Romania and the Republic of Moldova

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Abstract

The aim of this paper is to present the similarities and the differences identified in the way of applying accountancy at the crediting institutions in Romania and in the Republic of Moldova, in general, and to highlight their particularities in point of client crediting accountancy. At the basis of this study there were questions concerning the structure of the Chart of Accounts and then concerning the function of the accounts, which has led the authors to focus on the client operations category, actually on the way credits are granted to clients, which determined investigations that were realized both on the level of several crediting institutions in Romania, and on the level of some crediting institutions in the Republic of Moldova. Based on the data obtained, a detailed analysis has been realized regarding the accomplishment of the aim proposed by the authors, since the Chart of Accounts applicable to the crediting institutions in Romania includes accounts symbolized based on the decimal system, grouped on classes; on groups; on synthetic accounts of first degree; on synthetic accounts of second degree; on synthetic accounts of third degree, whereas the Chart of Accounts applicable to the Banks of the Republic of Moldova includes a highlighting of the accounts on classes and groups for which a four-digit numerical notation system is used. At the same time, by the study realized are brought to light the stages of the crediting operations and their reflection in the accounting of the crediting institutions in Romania and in the Republic of Moldova. The paper ends with the authors' conclusions on the specificity of the way client credits are granted and on the way the stages of this process are reflected in accountancy on the level of each country.

Keywords: crediting accountancy; long term loans; comparability; crediting institutions; economic operations;

1. Introduction

Both in Romania and in the Republic of Moldova the specific Chart of Accounts for crediting institutions, the structure and the function of accounts and their usage are based on orders of the Romanian National Bank and on specific laws containing also the methodological norms for the application of law provisions, and on accounting regulations, in accordance with European directives, applicable to crediting institutions.

In Romania, the Chart of Accounts for crediting institutions takes into account the general framework of the General Chart of Accounts and the characteristics of the activity, containing the accounts system symbolized on the decimal system, grouped according to a classification system, while in the Republic of Moldova the highlighting of the groups of accounts on classes is based on the hierarchical principle of classification on classes and groups. This system uses a four-digit numerical notation system,

In Table 1 we present the similarities and the differences identified in the way the accounts are structured in the Chart of Accounts, on classes and groups, belonging to the two countries.

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Table 1. Similarities and differences concerning the structuring of the Chart of Accounts in both countries

Romania	**Republic of Moldova**
Similarities	
According to the legal regulations, specific for each country, the crediting institutions' accountancy has a few common provisions that should be applied doubtlessly, such as – filling up the papers right at the moment when the action is taking place, chronologically and systematically organized; registration of patrimonial operations; patrimony inventory; balance sheet and statistical reports elaboration; delivery, publication and keeping of information referring to patrimonial situation and outcomes of crediting institutions; other payables, according to the legal norms in force; commitment of responsibility of the persons who elaborated, certified and approved the financial reports. Application of the same accounting principles in both countries, that reflect the true image of the patrimony and, respectively, of the specific financial reports for the crediting institutions, as follows: prudentiality principle, permanent usage of methods principle, continuity of activity principle, independence of the yearly exercise principle, intangibility principle, non-compensation principle, nominalism principle, supremacy of relation over appearance, regularity, authenticity, and true image keeping principle, signifiant importance treshhold principle.	
Differences	
In Romania, for the banking system, two Charts of Accounts are operating, one used by the National Bank of Romania, and the other one specific of the banking companies.The accounts are symbolized on the basis of the decimal system and are structured as follows: -on classes, corresponding to the first digit in the account symbol; -on groups, corresponding to the first digits in the accounts symbol; -on syntethic accounts of first level, corresponding to the first digits in the account symbol; -on syntethic accounts of second level, corresponding to the first four digits in the account symbol; -on syntethic accounts of third level, corresponding to the first five digits from account's symbol. Usually, with certain exceptions, the syntethic accounts of first level are not functional, being developed on syntethic accounts of second level, some of them being further developed on syntethic accounts of third level. The Chart of Accounts for banking entities consists in the following classes of accounts: First class: "Treasury operations and interbanking operations"; Second class: "Customer operations"; Third class: "Stocks and shares operations and various operations"; Fourth class: "Permanent capital"; Fifth class: "Equity capital, appropriates and provisions"; Sixth class: "Expenses"; Seventh class: "Incomes"; Nineth class: "Operations not included in the balance sheet". The Chart of Accounts specific for the information system of all the banks residing in Romania, with certain exceptions for the National Bank of Romania, is structured on nine account classes, the first seven of them being included in the balance sheet, the eighth class being structured on accounts for mandate operations performed by the bank for the State treasury, and in the nineth class there are the accounts representing operations not included in the balance sheet. The accounting registration on accounts from the Chart of Accounts is performed using the double-entry method, i..e. a way of registration and representation of economic operations, that is presentation in value and simultaneously in the debit of an account and in the credit of an account, another account of the same value. The accounts belonging to the nineth class of the Chart of Accounts do not need double-entry, but for methodological uniformization, there were established certain rules as for the other accounts, the account 999 named "Countertrade".being used for this purpose, which has double function.	In the Republic of Moldova, the banking system is structured as follows: -on groups – corresponding to the first two digits from the account's symbol, the first digit of account's number representing the affiliation to the class of that account; - the second and third digit represents the group of the account that includes accounts with homogenous economic presence; - the fourth digit represents the concrete object of the evidence. The Chart of Accounts from the Republic of Moldova consists of seven classes, among them, the 1 to 5 classes representing balance sheet accounts, and the classes 6 and 7 are not included in the balance sheet. The accounts belonging to the 6th class, named conditional are for the evidence of the obligations dpending on certain circumstances, and the accounts from the 7th class, named memorandum, are for the evidence of important values and documents for bank's activity, or assigned to them. In what concerns the structure, the Chart of Accounts specific to the Republic of Moldova consists of: First class: "Assets"; Second class: "Stocks and shares "; Third class: "Capital and reserve currency"; Fourth class:: "Incomes"; Fifth class: "Expenses"; Sixth class: "Conditional accounts"; Seventh class: "Memorandum accounts". In the Republic of Moldova the registration on the accounts of the first five classes Balance sheet accounts) is using the double-entry method, and for the accounts not included in the balance sheet (conditional and memorandum) is performed using the method of one-entry which represents the way of unilateral presentation of the economic operations.

Both in Romania and in the Republic of Moldova, the responsibility for book- keeping and for the way of conducting the accounting evidence, respectively of registration of the financial-economic operations and also the organization of internal control in the crediting institutions lays in the name of the person who has the responsibility of managing the crediting institution's patrimony. According to the accounting regulations specific for each country, this role supposes the realization of the following aspects mentioned in Table 2:

Table 2. Rules that should be obeyed by the person in charge with the management of the patrimony

In Romania	In the Republic of Moldova
- filling up the papers chronologically and systematically with all the economic operations on the basis of vouchers; - elaboration every day of all the vouchers; - daily registration, or when needed, of the economic operations in the books of accountancy; - performing of the patrimonial inventory according to the regulations and the registration of the results, and if needed, the valorification of it; - observance of the regulations and of the efficiency, economy and performance principles in what cocerbs the way of conducting of the financial reports and transmission of them to the competent institutions and their publishing if it is required ; - organization and development of the specific activities of management accountancy, as it is required; - keeping and archiving of the accountancy documents, on various intervals of time, respectively of the registers and financial reports according to the legal regulations at the moment.	- presentation of the accounting documents, while respecting the accounting policy regarding the accounting law and the accounting standards; - assuring the drafting of the primary accounting documents as correctly and completely as possible, and of the registers about the patroimonial situation of the crediting institutions; - obligation of permanently keeping an account of the entity, since the creation of the entity, until its closure / liquidation; - obligation of carrying out the internal control; -obligation of carrying out the inventory at the end of the financial year; - respect of the legal framework concerning the way financial and statistical reports are drafted; - respect of the rules regarding the way the accounting documents should be preserved and archived, including accounting registers; - organization and adaptation of management accounting according to the specific of the crediting institution - application of the internal procedures on the initiation and reflection in accounting of the operations specific of crediting institutions, according to the legal provisions in force.

2. Literature review

Following the numerous research works undertaken by various specialists and professors in the domain of crediting institutions, in the local and international specialized literature on client credits, an important contribution was brought, nationally, by distinguished professors such as: Ilie Răscolean, Lucia Podoabă, Nicoleta-Maria Ienciu, C-tin Rotaru, Elena Zaharciuc, Aurelia Ştefănescu etc., and internationally, by world-famous professors like J.Antoine, Dehan-Maroye, C.Dendauw, K.Cerrada, Y. De Rougé, M.De Wolf, M. Gatz, A.Sardi etc., whose works lay at the basis of the development and application of several concepts related to the activity of the crediting institutions. We can notice that, the issues related to client credits have been studied by various specialists who have tried in the course of time - to adapt the way of granting credits according to the specific of the crediting institutions, so that this technique and modality of granting has been continually extended and improved, to answer the demands of the most diverse clients, from all the categories, and also the demands of the managers of such institutions.

3. Research methodology

Starting from the research undertaken by various specialists in the domain of the crediting institutions regarding the granting of client credits, we aimed to present the way they are granted in Romania and in the Republic of Moldova, relying on the information provided by the specialized literature in the two countries, and also by the research undertaken in crediting institutions similar as structure and size of Romania and the Republic of Moldova. Consequently, the research projection is based on fundamental-empirical and applicative research.

4. Particularities of the long-term credit accounting granted in the banking system of Romania versus the Republic of Moldova

According to the specialists, both local and international, bank credit represents the economic-financial relation established between a juridical person - called creditor (who grants a certain reimbursable sum of money for which it asks for interest) and a physical or juridical person - called debtor requesting and receiving a loan, for a certain period of time.

Nowadays, bank credit has become a need present in all the activity domains, in order to develop the activity, make the production more efficient, develop personal consumption etc., accomplishing an essential role in the modern market economy.

Crediting is a main activity in the crediting institution, allowing obtaining important revenues from the interests and bank commission pertaining to client credits, which are the best financial business they have.

An important function of the crediting institutions is that concerning the decision to grant a client credit which needs to be supported by the reimbursement capacity both present and future of the respective client. In this context, for the crediting institution it is important to obtain as much information as possible about the potential client, regardless of the credit requested, namely short-, medium- or long-term credit. Their granting relies on the financial structure of the economic entity requesting a loan and especially the financial results obtained during a certain period of time, and also on their forecast for the future years. Long-term credits are granted both in Romania, and in the Republic of Moldova based on the same objectives, criteria, principles, landmarks and granting conditions. The granting of client credits supposes the covering of a complex process, based on the financial-accounting laws and regulations in force, harmonized with the European standards and norms in this domain. Based on the documents requested by the crediting institutions, a crediting folder is constituted, which is regorously analyzed by the credit officer in Romania, who communicates the data regarding the one who requested the credit – be he a natural or juridical person – to the main office of the crediting institutions, asking and communicating information to the National Agency for Fiscal Administration and, respectively, by the credit inspector, head of service or crediting office in the operative unit of the crediting institutions of the Republic of Moldova. In the Romanian system specific of crediting institutions, the analysis of client bonity is carried out along four directions, namely: formal analysis, technical analysis, financial analysis and economic analysis, while in the banking system specific of the Republic of Moldova, the analysis of bonity relies on two directions, namely the analysis of the economic aspects and the analysis of the financial aspects. The analysis of the economic position, and also of the performances of the economic entity has a special importance for the credit institution, in the analysis and classification of the credit portfolio, highlighting by this the capacity of the respective entity to respect and honour its contractual obligations in due time. The conclusion/signing of the credit contract confirms the juridical completion of the credit granting and the meeting of all the demands of the crediting institutions for the whole period of development of the crediting contract, in which are explicitly stipulated elements such as: aim of contract, sum, period of time for which the loan is granted, specific conditions, installments deadline, interest rate, form of insurance of the credit granted, rights and obligations of the contracting parties, list of documents required by the crediting institution and handed over by the person contracting the loan, and description of the control of the crediting institution over the financial situation of the person contracting the loan. The credit reimbursement, on the level of the two countries, relies on the reimbursement of a certain sum of the credit – monthly, and of a sum called interest, paid by the one contracting the loan to the funder in order to use the sum borrowed. In the situation of a delay in the payment of the credits, the one who borrows pays an interest rate increased by a certain percentage calculated for each day of delay.

Next, in Table no.3, we shall present a case study concerning a long-term credit granting for investments in real estate in Romania versus the granting of a long-term credit for the construction of a building in the Republic of Moldova.

Table 3. Accounting statements for the granting of a long-term credit in Romania versus The Republic of Moldova

Accounting statements by the crediting institutions of Romania	**Accounting statements by the crediting institutions of The Republic of Moldova**
1) The commitment to grant the long-term credit is recorded	
903 “Commitments in favour of clients” = 999 “Counterpart”	Credit of account 6101“Bonds for credit granting in the future” - this account is charged, being a conditional account
2) The bank records the granting of the long-term credit respectively for real estate investments, and for the construction of a building	
2061 “Credits for real estate investments” = 2511 “Current accounts”	Debt of account 1443 “Long-term credits granted for the construction of a building” Creditul of account 2224 “Current accounts of juridical persons”
3) Calculation and recording of the interest pertaining to the credit for real estate investments, respectively the building of a contruction	
20671 “Debts attached” = 70217 “Interest from credits for real estate investments”	Debt of account 1737 “Interest calculated for the credits granted for respectively acquiring and constructing a building” Credit of account 4443 “Revenues from interest for long-term credits granted for respectively acquiring and constructing a building”
4) Cashing in the installments pertaining to the credit for respectively real estate investments, and contruction of a building	
2511 “Current accounts” = 2061 “Credits for real estate investments”	Debt of account 2224 “Current accounts of juridical persons”

	Credit of account 1443 “Long-term credits granted for respectively acquiring, and construting a building”
5) Cashing in the interest pertaining to the credit for real estate investments for respectively acquiring and constructing a building, from the current account of the client	
2511 “Current accounts” = 20671 “Debts attached”	Debt of account 2224 “Current accounts of juridical persons” Credit of account 1737 “Interest calculated for credits granted for respectively the acquisition and construction of a building”
6) Recording of the bank commissions called for by the crediting institutions for the crediting operations	
2511 “Current accounts” = 7029 “Commissions”	Debt of account 2224 “Current accounts of juridical persons” Credit of account 4445 “Commissions for service provision in the case of credits granted for the construction of a building”

Both in Romania, and in The Republic of Moldova, in the situation in which the borrower does not reimburse the credit and the pertaining interest, in due time, they pass into category of remaining non-impaired debts and will be recorded in the accounting of the crediting institution as follows:

Table 4. Recording the non-impaired unpaid debts in Romania versus The Republic of Moldova

1) Recording in the category of non-impaired unpaid debts the credit for real estate investments not-reimbursed in due time:	
2811 “Non-impaired unpaid debts” = 2061 “Credits for real estate investments”	In the Republic of Moldova, any delay in the reimbursement of installments is recorded as credit due (remaining credit), for which the bank calculates increased interests, according to the conditions set in the credit contract. The penalities for non-reimbursed credits due and for remaining interest is established and communicated by bank memos. In bank practice, remaining credits fall into the categories: - credits in a state of accumulation; - credits in a state of non-accumulation. Credits in a state of accumulation represent the credit for which all the payments were paid in due time and the credits for which the payment was not made in time up to 60 days and an accumulation of the interest is applied. If the interest for the credit granted is not paid within 60 days by the debtor, the credit passes into the special accounts, whose last digit is 5 “Credits in a state of non-accumulation...”, namely in the accounts: - in the debt of account 1445 “Credits of non-accumulation”; - in the credit of account 1443 “Long-term credits granted for acquiring/constructing a building”
2) Recording in the category of non-impaired unpaid debts the interests pertaining to a credit for real estate investments granted to a client, not cashed in in due time:	
2811”Non-impaired unpaid debts” = 20671 “Attached debts”	
3) Recording of the situation in which remaining debts go over 90 days. They are highlighted in the category of depreciated debts and remaining debts for which forced execution procedures were begun regardless of the number of days of delay, namely:	
2821”Impaired debts” = 2811 “Non-impaired unpaid debts”	
In both countries, the crediting institutions have the obligation, according to the banking norms, to constitute adjustments for the depreciation of the debts from interbanking operations and operations with clients. The reflection of the constitution of adjustments for the depreciation of the debts in the crediting operation (long-term credits for real estate investments - Romania and respectively for building a construction – The Republic of Moldova) in bank accounting is operated as follows:	
6621 “Expenses for adjustments specific of depreciations identified on the = 291 “Adjustments specific of depreciations identified on the	Debt of account 5875 “Expenses for the depreciation of the credits granted for the construction of a building and payments pertaining to it”

individual level”	individual level”	Credit of account 1447 “Counter-account Discounts for losses from the depreciation of the credits awarded for the construction of the building and payments pertaining to them”

5. Conclusions

Following the research undertaken, the authors have noticed that regarding the organization of accounting and the aspect concerning its way of administration, on the level of the two countries, it is very similar, functioning based on the same general accounting principles and pursuing to obtain a faithful image of the patrimony through the prism of the financial statements and the accounting regulations in force specific of the domain under analysis.

An essential difference in the way of operation of the accounting of the credit institutions on the level of the two countries, beside the linguistic one - in the sense that for the same economic terms, different names are used -, consists in the fact that, the Chart of Accounts applicable in Romania is structured into seven classes of accounts and one extra-balance, and in the Republic of Moldova it is structured into respectively five classes and two classes of extra-balance.

Another difference resides in the fact that, at the credit institutions of Romania the reflection in the accounting statements of the economic operations relies on a double-entry while for the crediting institutions of the Republic of Moldova, the economic operations rely both on the double representation principle and on the recording in simple entry for the extra-balance accounts.

Conceptually, the notion of crediting is the same for both countries, except for the credit categories granted to natural and/or juridical persons. While for the crediting institutions in Romania the reflection of the long-term credit granting is realized in double-entry, as one can note from the study realized for the crediting institutions of the Republic of Moldova the reflection in the accounting of the long-term credits in made by simple entry, the recordings being made in the credit of the conditional account 6601 “Bonds for credit granting in the future”, which as the credit is being reimbursed are supplied with the sum granted.

Therefore, long-term credits represent the main loans granted by the local crediting institutions and those of R.Moldova, and their management and monitoring needs to be realized prudently to avoid the measures that have to be taken when the installments and interests pertaining to them are not returned in due time.

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Talent management in organizations

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Abstract

Economic development is always associated with the prospect of social, organizational and technological change. The various spheres of human activity change the way of its functioning, there are new technological solutions and management methods. Organizations have to participate in this process. Changes occur in a very dynamic way and the managers take on new roles, they become responsible for the process of rapid adaptation and implementation of appropriate methods within the organization. They are often strongly coupled with the use of appropriate information, skills and competences of people creating human resources. Talent management becomes a key factor in the success of the twenty-first century's organizations: e-business.
The aim of the article is to present the methods of talent management in organizations. Talent management will become the dominant approach of the coming years, because as a factor in human resource development it will significantly affect the growth of efficiency and competitiveness of the organization. Analysis of the literature shows that talent management is mentioned as one of the most important trends in contemporary management of organizations.

Keywords: organization changes; improvement; talent management.

1. Introduction

The aim of the article is to present the idea of talent management in organizations. Analysis of the literature indicates that talent management is regarded as one of the most important trends in contemporary management of organizations. Talent management will be the dominant approach in the coming years, because as a factor of human resource development it will significantly affect the growth of efficiency and competitiveness of the organization. In the first part concepts related to talent management are explained. The second part presents the results of research: the general assumptions for the implementation of talent management in Polish organizations.

Economic development always involves the introduction of social, organizational and technological changes. Ways of functioning of the various business areas are changing, there are new technical and technological solutions and management methods. Organizations have to participate in this process. Changes occur in a very dynamic way and managers receive new roles in the management process. They become responsible for the process of rapid adaptation and implementation of appropriate methods within the organization. These are often technical and organizational solutions that are tightly coupled with the use of knowledge resources, skills and competences available under the organization of human and intellectual capital. These resources are building a unique potential and value added to the organization. The process of acquiring and developing high-skilled employees becomes particularly important, since they can provide exceptional performance on a competitive market. Talent management is becoming a key factor in the success of the organization of the twenty-first century.

2. Talent Management

Talent management is an approach based on the potential of highly talented and effective employees. The approach presented within the article recognizes that the key to the success of the organization are talented employees and their knowledge resources. They become a source of activities of strategic importance for the organization. The dynamic

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development of this concept occurred in the 90s and was associated with the rapid development of e-economy, when there was a surge in the demand for knowledge workers (Pocztowski, 2016).

The concept of Talent Management appeared along with the wording: "*the war for talent*" (Pocztowski, 2007) in the concept launched in the US back in the 80s. Even then the human resources were treated as an important factor in the development of assets, capital and potential of the company. It was noted that investing in employees' development, forming of a specific structure of employment and personnel constellation, allows the creation of competitive advantage against other organizations (Listwan, 2005).

In practice and theory of management, there is no clear definition of talent management. The term is interpreted differently in the literature. Defining the talent management is dependent on the perspective for the recognition of the term. The first perspective refers to the talent, which is defined as a set of outstanding unidirectional or multidirectional abilities of people (Pocztowski, 2007). You can also refer this concept to employee with a high development potential and outstanding professional competence (Wozniakowski, 2005). The second, general perspective defines talent as a person with special aptitude. It is worth to present the latest interpretation of issues related to talent management in light of research that have been carried out in Poland in the period from July to September of 2006. It was attended by 300 personnel directors of largest companies in Poland ("Rzeczpospolita 500 List"). The research and report: "*Talent Management: Challenges, trends, examples of solutions*" were developed in cooperation of The Conference Board association with House of Skills company.

According to the definition of the research report The Conference Board (2006): "*Talent is a employee, who significantly affects the growth of the company and stands out more than the average in the organization of potential for further development and to exercise higher managerial functions.*"

Regardless of the adopted perspective, it is worth noting that talent becomes the main and the most important resource of the organization. Therefore, there is a need for a specific set of consistent, appropriate actions that will enable talent management (Baron, Armstrong, 2008). This style of management Armstrong (2007) defines as the process of ensuring attracting, retaining, motivating and developing talent to meet the needs of the organization. Listwan (2005) defined the same concept as a set of actions relating to gifted persons, undertaken with the intention of their development and efficiency improvement. As a result, the possibilities of achieving organizational goals are strengthening in this way. Maliszewska (2005) shows that talent management includes search and talent acquisition, determination of training needs, career planning and seting of the appropriate level of remuneration.

This process also includes the elements such as the identification of the most valuable employees while spotting the workers useless for the organization, preparation and implementation of development programs for the best members of the organization.

A particular concern for talent in comparison with other employees, is to attract loyal, strategic workers, willing to permanent cooperation. The organization wanting to exploit the potential of talent should also keep in mind the appointment of their proper place and allocate appropriate tasks (Maliszewska, 2005). Finding role for employee in which he can use his talent, the organization contributes to the development of his specific skills and increases the chance of their practical utilisation.

3. Objective of Talent Management

Economy of the twenty-first century is largely based on knowledge. Knowledge is one of the priority factors of production is tightly linked with the development of information and communication technology, as well as a source of competitiveness of the organizations and a key element for its ability to innovate (Buchelt, 2008). This factor has replaced existing, traditional sources of competitive strategies (Herman, 2006), while knowledge management and ability to raise intellectual capital have set the path in the competitive race among organizations.

Success is mainly made up of people. It is thanks to their skills, talent and the right decisions organizations develop and build its advantage in relation to other market participants, utilising in an appropriate manner the tangible and intangible resources.

Turbulence of environment makes organizations to need employees who can skillfully put into practice their knowledge, integrate around the goals of the organization, will pave a new path of development and are committed to build strong pillars of effective market action. They need creative people, able to initiate and implement changes and innovative projects, people with a vision of the future and the desire to continuously improve their abilities. This means that organizations seeking distinguishing achievements should acquire employees with outstanding talent, with whom they can identify new strategies on a competitive market.

Organizations want to fight for talent and manage them in a conscious and rational way. In this method, an important activity is the ability to acquire high-potential employees and provide them with personal development. For this purpose it is necessary to design training, challenges, interesting tasks, projects and principles of promotion and reward for those very employees. All these activities are reflected in the implementation of the most important objective for the organization. It is the prospect of better performance and the ability to create and design new areas of development for the organization.

In the light of data published from the research report of the Conference Board "Talent Management: Challenges, trends, examples of solutions" (2006), some conclusions in relation to business practice could be made. In general managers notice the positive results of the introduction of talent management in their companies. They perceive the impact of a talented employee to develop the potential of the organization and increase competitiveness. Moreover, they acknowledge that the lack of talented and committed employees means the inability to achieve the ambitious goals. They fear the difficulties associated with the loss, migration and a smaller supply of talent due to changes on the labor market. As a result, there is a growing awareness of managers that keeping talent in the organization becomes a priority in human resource management. The impact of talent on the utilization of other resources available in the organization is noticed. Talents are usually the initiators of new ideas, projects, without which it would be difficult for innovative and creative solutions and dynamic development of the organization. "The main goal is to attract talent to increase the value of human capital in the organization to improve efficiency or to obtain a competitive advantage" (Pauli, 2008).

This objective may be the main reason for the increased interest in above-average individuals of human resources and the cause of intense efforts to attract talented people in the knowledge-based economy (the war for talent). With this attitude a variety of talent management programs tailored to the individual needs of the organization and the specific conditions of the rapidly changing environment will develop in practice (Pocztowski, 2008). As a result, there is the message that "continuous hunt for talent should be a key strategy of the organization" (Mikula, 2001), and talent management will be the dominant trend in the coming years.

According to research conducted by the Conference Board (2006) organizations are willing to use activities in the field of talent management for several key reasons:

- The desire to attract the best employees;
- To prevent a loss of talent;
- The need to build a new management team;
- The need to focus development activities and training on the best employees.

In order to utilize the potential of talented workers, organizations adapt talent management programs to their needs and abilities. These are programs for training, development, promotion, implementation of new challenges and tasks. Larger organizations create a personalized career path or specially designed training and development course, and support the talent by dedicating them additional workshops, coaching, post-graduate studies or business school.

The results of the research report by the Conference Board also determine the effects of the implementation of talent management programs. It turns out that managers of organizations perceive more positive than negative aspects of this process. The positive elements may include (The Conference Board, 2006):

- Building a database of employees with high competence, involved in key projects;
- Securing the future of the organization and preparation of management;
- Greater motivation, commitment to the company and the results of selected talent;
- Reducing the cost of recruitment;
- Greater openness of employees on learning;
- Improved communication and information flow within the organization.

Based on the above research it can be said that talent management increases the possibility of building a competitive advantage. However, also the negative aspects of the programs implemented sould be pointed out. Respondents noted that talent management is associated with high costs and the need to take account of this additional expenditure in the budget. In addition, there is a risk of losing the best employees to the competitors and the possibility of dissatisfaction and leaving of valuable but underrated talent of the organization (The Conference Board, 2006).

4. Conclusion

Talent management is mentioned among the world's most important trends that will influence the policy of human resource development in the coming years. Based on the analysis of literature and research results it can be concluded that, particularly, talented employees are the basis for the functioning of organizations operating in the turbulent environment of the twenty-first century economy. Talent, as a unique resource takes on crucial importance for the organization. Individuals with extraordinary abilities and knowledge - ready for new challenges and committed to the job - they are for any organization indispensable source of development. They create a strong foundation for the competitive struggle, being the initiators of innovative and creative solutions. The objective of a coherent program of talent management is to use the potential of the most talented employees. Well prepared and implemented program can ensure the success of the organization and human resources built on the talent will secure the future of the organization. Hence, the struggle for talent becomes a strategic dimension, being not only an additional, but also a necessary part of organizational behavior. This trend is also visible in Poland. The result of these changes is the consciousness of managers about the need to implement the process of talent management in their organizations and emphasizing the need for special development programs for employees with the greatest potential.

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Labour market analysis in Hunedoara county in terms of employment

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Abstract

In terms of labor resources, Hunedoara County is among the counties showing attractive to investors both in terms of its density and in terms of training. Creating opportunities for investors (road infrastructure, tax breaks, etc.) is likely to harnesses in a higher degree of human potential available, reducing its migration to more prosperous areas (whether they are within or outside the country her).

Keywords: labor market, labor demand, unemployment, investments

1. Introduction

Mankind is not only the main production factor, but also an active factor of development, the one who at the highest level causes a high valorization of the other factors. Under the circumstances, reviving employment must be a requirement and a priority. In the present context, most of the opportunities for creating new jobs and increasing employment are dependent on: the level of productivity and its enhancement possibilities; the characteristics of each job, company, sector, of the economy as a whole; on individual income and the size of the community transformed into a demand to stimulate the economy and to support employment.

Due to the various implications in the economic, social, educational-cultural and political environment generated by changes related to labour components, establishing and maintaining a high degree of employment represents an important condition for ensuring sustainable economic development, social and political stability and a target pursued by administrations whether central or local.

2. Characterization of Hunedoara County through relevant indices of labour power supply

Hunedoara County is located in the Central-Western part of Romania. It borders Alba County to the North-East and East, Vâlcea County to the East and South-East, Gorj County to the South, the counties of Timiș and Caraș-Severin to the West and Arad County to the West and the North-West. Hunedoara County covers an area of 7.063 km² (2.9% of the territory of Romania) and in 2015, according to data provided by INSSE, had a population of 403.554 (2.03% of the country's population), 206.033 of which women (51.05%). Referring to the situation registered in previous years (2012, 2013 and 2014), one can find that the stable population continues to decline from year to year. The population density is 57.13 inhabitants/km², which is below the net national average of 83.35 inhabitants/ km².

Fig.1. Nationally location of Hunedoara County

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From administrative point of view, the county consists of 7 municipalities, 7 towns and 55 communes, registering a great difference between the urban population of 74.61% and the rural population, which represents 25.39%. These values are clearly differentiated in relation to the national values, which are more equally distributed (53.84% for urban areas and 46.16% for rural areas). In comparison with the past three years (2012, 2013 and 2014), in 2015, there are 301.092 people living in the municipalities and cities of Hunedoara County, an ever-decreasing value, the decrease of the population in urban areas being superior to a reduction in the whole stable population of the county, so that one can find a reduction in the share of the urban population to the detriment of the rural environment (74.61% in 2015 as compared to 74.74% in 2014 or 74.89% in 2012).

An analysis of internal migration balance (calculated as the difference between the number of persons arriving and departing) in Hunedoara County highlights the fact that it is permanently recording negative values through the entire period between 2006 and 2015. If this analysis is done by area of residence, one can find that in urban areas, the domestic migration balance is negative, while in rural areas, this balance is positive, the last recorded values (in 2015) being 1,842 in cities and 351 in the countryside.

Table 1. Migration flows registered in Hunedoara County between 2006 and 2015

Indices	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Internal migration (balance), by location										
Total	-1929	-1748	-1628	-1203	-1891	-1475	-1556	-1588	-1534	-1491
Urban	-2382	-2611	-2435	-1590	-2202	-1923	-2088	-1758	-1866	-1842
Rural	453	863	807	387	311	448	532	170	332	351

Source: INSSE, Tempo-Online, http://statistici.insse.ro/

The dependency rate, which represents the number of young people (0-14 years old) and the elderly (over 65 years of age), related to 100 working-age people (aged between 15 and 64), is lower at county level in 2015 (47.2%) in comparison with the national level (48.13%). This coincides with a high percentage of labour resources out of the total of stable population within the county which can be considered a good point worth to be taken into account when trying to attract investors in the territory.

Table 2. Evolution of labour resources in Hunedoara County between 2006 and 2014

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Labour power (thousands of people)	310,1	307,7	305,8	307,1	309,4	307,4	304,7	301,2	256,4
Active population (thousands of people)	205,7	209,6	206,6	204,2	194,8	187,3	193,8	194	189,4
Employed (thousands of people)	192	199,5	192,8	182,4*	178,3*	176,1*	180,9*	179,5*	-
Rate of employment (%)	61,9	64,8	63,0	59,4	57,6	57,3	59,4	59,6	69

Source : INSSE, Tempo-Online, http://statistici.insse.ro/

**Hunedoara County Statistics Directorate, http://www.hunedoara.insse.ro*

3. Characterization of Hunedoara County through relevant indices of demand for labour power

On December 31st, 2013 in Hunedoara County (according to data provided by Hunedoara County Statistics Directorate) there were 8813 local active units registered with up to 9 employees, representing the majority of 85.80% of the total. At the level traders within the county there are 179.5 thousand people employed in the following fields of activity:

Table 3. Structure of employees per scope of activity within Hunedoara County in 2013

Field of activity	2008	2009	2010	2011	2012	2013
Total	192,8	182,4	178,3	176,1	180,9	179,5
Agriculture, forestry and fishing	41,5	41,4	41,5	42,1	43,5	41,1
Industry:	59,6	53,6	52,6	51,9	53,8	52,9
- Extractive industry	11,9	11	9,1	8,2	8,1	7,3
- Processing industry	40,6	35,7	36	36,5	38,2	38,5
- Electricity, heating, gas and hot water production	3,3	3	3,5	3,2	3,2	2,9
- Water distribution, sanitation, waste management, decontamination activities	3,8	3,9	4	4	4,3	4,2
Construction	14,4	12	11,2	11,1	11,9	12,2
Wholesale and retail trade, repair of motor vehicles, motorcycles and	30	28,8	29	28,8	29,1	30,7

of personal and household items						
Hospitality	8,7	8,5	8,8	8,8	8,3	7,7
Transportation and warehousing	3,3	2,9	3	3,1	3	3,9
Information and communication	1	1,1	1,5	1,3	1,8	1,5
Financial transactions and insurance	1,7	1,7	1,5	1,4	1,3	1,2
Real estate	0,8	0,8	0,4	0,4	0,5	0,7
Professional, scientific and technical activities	2,4	2,2	2,1	2,1	2,1	1,8
Administrative and adjoining services activities	3,6	3,7	3	2,9	3,2	3,5
Public administration and protection; public social insurance	5,3	5,1	4,3	3,9	3,8	3,8
Education	8,4	8,1	7,6	7,5	7,5	7,4
Health and social work	9,3	9,7	9,1	8,1	8	7,8
Entertainment, culture and recreational activities	0,5	0,7	0,7	0,8	0,8	1
Other national economic activities	2,3	2,1	2	1,9	2,3	2,3

Source: Hunedoara County Statistics Directorate, http://www.hunedoara.insse.ro

From the analysis of the distribution of employees per scope of activity, it appears that most of them are employed mainly in industry and agriculture; the highest share is held by industry representing 29.47%, followed by agriculture, forestry and fishing with 22.9%, trade with 17.1%, constructions with 6.8%, health and social work with 7.8%, hospitality with 7.7%.

Analyzing the period between 2008 and 2013 in terms of the evolution of the average number of employees, one can find a steady decrease of this number (in 2012 the total number of employees registered an increase as opposed to the previous year, but it was insufficient to reach at least the level of the year 2008). By reporting the average number of employees in 2008 to the year 2013, one can find that only five sectors of the national economy registered an increase of personnel, namely: distribution of water, sanitation, waste management, decontamination activities; wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household items; transportation and warehousing; information and communication and entertainment, culture and recreational activities. On the other hand, in other important economic areas, such as extractive and processing industry, constructions, hospitality, health and social work, and many more, the number of employees decreased significantly.

A representation of the distribution of the number of employees in the main municipalities of the County shows various developments, justified by the emergence of new economic activities in certain municipalities (e.g. Orăștie), in parallel with the closing down of existing businesses in other municipalities (e.g. Petroșani).

Table 4. The average number of employees in municipalities within Hunedoara County

- *people* –

	2008	2009	2010	2011	2012	2013	2014
County TOTAL	128.927	118.140	108.851	106.870	108.047	106.384	106.877
Deva	33.994	31.506	29.869	30.518	32.556	31.926	31.786
Hunedoara	20.795	19.092	16.185	15.990	14.935	13.725	14.530
Petroșani	17.837	15.502	14.231	13.290	12.991	12.170	10.549
Orăștie	6.402	5.685	5.636	7.153	7.960	9.432	10.247
Brad	6.032	5.539	5.202	5.322	4.990	4.580	4.350
Vulcan	5.780	5.925	5.164	5.322	4.990	4.580	4.356
Lupeni	5.728	5.136	4.752	4.350	4.244	4.790	5.843

Source: INSSE Tempo-Online, http://statistici.insse.ro/shop/

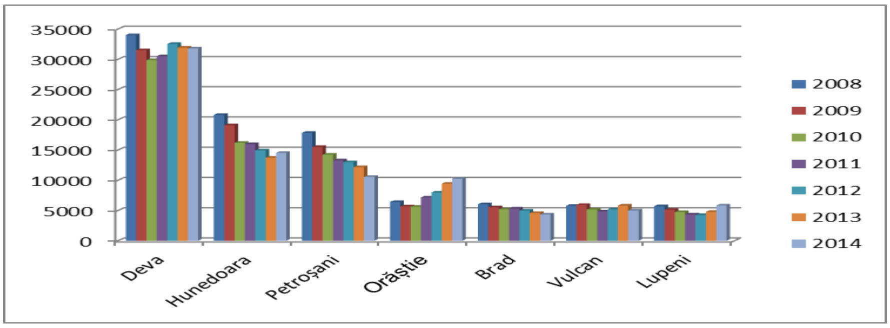

Fig.2. Evolution of the average number of employees in municipalities within Hunedoara County between 2008 and 2014

The largest employers with foreign capital in Hunedoara County are Sews Romania (with subsidiaries in Deva and

Orastie) specialized in manufacturing wires, chains and springs, Dar Draxlmaier Automotive specialized in manufacturing electrical and electronic equipment for motor vehicles and motor vehicle engines, and also Autocom Amicii Lupeni specialized in the manufacture of textile goods. With regard to domestic capital companies, employers can be found in the sector of coal mining and electricity (Hunedoara Energetic Complex) or in the field of water collection, treatment and distribution (Apa Prod Deva).

4. Conclusion

In most cases, the supply of labor available to be used for productive purposes is unbalanced in relation to the demand. In the case of Hunedoara County the discrepancy between the high level of supply and the low level of demand is not due, unfortunately, to certain demographic factor scores (higher rates of births in relation to those of mortality) or to some large positive balances of internal and/or foreign migration; quite the contrary, it is because of the restrictions of economic activity in certain fields (such is the case of Jiu Valley where, starting with 1997 we have been witnessing a continuous restructuring in the mining sector at higher or smaller degrees). An analysis of the level and evolution of job offer reveals that, at the level of county labour resources hold an important place within the total population, concentrated mainly in urban areas, whilst at the same time one can assists at a slight but permanent regression of the total population especially of the urban one (due to the migration phenomenon, both internal and external).

The demand for employment, whether it is regarded locally or regionally or nationally, is influenced by various economic, social or political factors. In general, the demand for labor does not change much over time, only in special cases, such as the restructuring of the mining industry -influencing negatively its level, or, conversely, that of establishing a major multinational company within the area, which results in a sudden increase in the level of activity generating a significant increase in the demand for labor. Currently, the most important employers in the county can be found in the manufacturing industry (SEWS Romania and Dar Draxlmayer), Hunedoara Energetic Complex being ranked 3rd in terms of number of employees.

It is obvious that an increase in the demand for employment does not represent too much of a concern but if it exceeds the availability of work in the region, the new jobs do not find their counterpart in the structure of labour power available in the region in terms of qualifications required or whether the new economic coordinates of the region are becoming more attractive to the labor force abroad so immigration absorbs a significant proportion of the regional labour demand.

Instead, the decline in employment demand generates multiple problems, primarily for those who live in that area and whose living standard is affected because a low rate of employment and high unemployment generates poverty, social conflict, delinquency, depopulation, etc. by putting authorities either local or central in a position to seek ways and means to compensate for this process.

When the demand for jobs is smaller than the offer in Hunedoara County, we are faced with the phenomenon of migration, both internal to more prosperous regions of the country, and external – leaving the country. The actual extent of external migration flows is difficult to estimate since statistical records provide data only for internal and permanent migration.

Creating opportunities for investors (road infrastructure, tax benefits etc.) is likely to contribute to the capitalization, at a higher degree, of the human potential available, reducing its migration towards more prosperous areas (whether they are in the country or abroad).

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Theoretical delimitations regarding the management of start – up business

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Abstract

This paper aims to approach a few issues relevant to all those who want to manage a start- up business. Thus, besides the conceptual aspects are given benefits and risks of such a business, potential funding sources and a range of features of start-up entrepreneurs in Romania. It also aims to highlight the importance of entrepreneurship development in the current period.

Keywords: entrepreneur, entrepreneurship, start-up

1. Introduction

Entrepreneurship is the process of creating a new business that will provide value to clients and will bring income.

An entrepreneur is the person willing to take risks (hazards) and to devote time and effort to start his own business.

Any entrepreneur who sets up a business begins by seeking an economic or business opportunity, i.e. an attractive possibility to provide a certain product, service, or transaction that can generate profit in time.

As regards the reason underlying the decision, it may be based on the following assumptions (Cordoș et al., 2008):

- Developing is the most precious resource of a contractor;
- The added value brought to the business, to the social environment and to family;
- The desire to be independent and not dependent on others;
- Be the master of his own destiny and of the fate of the employees (in terms of assuming risks);
- Social recognition (as a factor of social involvement and responsibility);
- Following dreams and the pleasure of doing what you love.

Economic practice showed that there are certain categories of business opportunities which are very frequent. They can provide different types of businesses such as: franchise business, outsourcing business, licensed production, start-ups, etc.)

2. Defining elements of a start-up

A **start-up** is a company, a partnership or a temporary organization designed to look for repeatable and scalable business patterns. Generally, these newly created companies are in a phase of development and research for markets.

Among **the advantages of a start-up**, it is worth mentioning the following:

- flexibility in relations with trading partners;
- quick managerial decisions;
- reduced number of employees;
- efficient management of interpersonal relations.

However, in order to maximize the success of the business one must identify and promote the feature which is unique to the business. It confers competitive advantages and maintains relationships with trading partners by:

- adapting products and services to customer requirements;

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- decreasing the time of delivery;
- -optimizing the price and quality ratio;
- providing after-sale services;
- permanent on-line assistance.

However, various **risks** that may equally affect start-ups and "mature" companies should not be neglected. These risks may be:

- the dynamics of the business environment and increasing competition;
- limited access to financing sources;
- the lack of information with regard to the European regulations for various fields of activity.

In respect of **business strategies**, in the case of start-ups, they are the result of the entrepreneur's *personal experience and managerial skills*.

In the case of start-ups we can talk about building strategies "with zero base", meaning that the company does not have a track record as guidance based on an analysis of targets and results, effects and efforts.

In order to elaborate strategies in the start-up phase, entrepreneurs may focus on the model of other companies on the market, but they have to bring a touch of originality so as to be distinguished from the competition.

Any start-up business is based on the following pillars that support entrepreneurship:

- Taxation and regulation;
- Access to financing;
- Coordinated aid;
- Entrepreneurial culture and education

The characteristics of a successful entrepreneur can be summarized as follows:

✓ *to cope with difficulties and uncertainty*. It is probably the most important element of an entrepreneur's personality because entrepreneurship means daily difficulties and frequent disappointments;

✓ *vision-objective*: a successful entrepreneur has vision and can establish specific objectives to be carried out. Through this process, in addition to success he may obtain personal satisfaction;

✓ *risk taking*: a good entrepreneur can take risks when necessary, but first he will assess existing opportunities and threats in case of a difficult situation;

✓ *Creativity*: a good entrepreneur is wise enough to act on specialized market segments or to satisfy consumer needs that have not been covered by the competition by providing new products/services;

✓ *full commitment*: hard work, energy and focus on objectives are the main characteristics of a good entrepreneur.

3. Sources of financing of start-ups

Achieving economic potential and the implementation of business ideas largely depend on financial possibilities; whether the business is in the early stages, or it is in the development phase, there is a need for financing.

In the case of a start-up business, financing sources may classify as follows:

✓ **Structural funds**, such as: Regional Operational Programme "Axa Prioritara 4": "*Strengthening regional and local business environment*", DMI 4.3 "*Supporting the development of microenterprises"*; Roman-Swiss Programme for SMEs; JEREMIE - *Joint European resources for microenterprises and SMEs;* COSME - *Programme for the competitiveness of enterprises and SMEs*; *Progress - the European instrument of micro-financing*, etc.

✓ **National Funds**, such as: *The program for the development of entrepreneurial skills among young people and easy access to START funds*; *Programme to stimulate the establishment and development of micro-enterprises by business debutants - LLC-D*; *National multiannual programme on the establishment and development of technological and business INCUBATORS; Entrepreneurial development programme UNCTAD/EMPRETEC Romania for supporting the development of small and medium-sized enterprises*; *Programme for stimulating the establishment and development of micro-enterprises in the field of social economy.*

✓ **Other sources of financing,** are:

- *Bootstrapping.* Bootstrapping is a process of self-support which does not require help from outside, meaning that the business can be supported by own funds;
- *Crowdfunding*. Crowdfunding means that people can donate or buy products in advance using the online platform to support projects they believe in;
- *Non-equity Grants*! Can be found mainly at competitions regarding start-ups but also in some acceleration programs (such as Startup Challenge Lisbon or Eleven Bulgaria);
- *Angel investors*. Angel investors are people who invest in start-ups in exchange of a part of business. Generally, such financing forms represent a seed (small investments up to 100,000 euros, intended to support financially the business until they start to generate their own income). Angel investors are usually found at relevant events in the field of interest or through networks of private investors;

- *Venture capital*. It represents the financial capital offered to scalable start-ups with great development potential which have registered spectacular increases by the time of investment. This type of funding follows the seed investment and aims at the rapid development of the company in order to generate profit in the future by selling or listing them on the stock exchange.

4. Characteristics and perceptions of Romanian start-up entrepreneurs

An x-ray of start-up businesses in Romania reveals certain ***characteristics of entrepreneurs***:

➢ Most **start-up entrepreneurs are young**, open to new initiatives and quite willing to take risks;

➢ **Romanian start-up entrepreneurs work, on average, 10 hours per day at their own business**

Most entrepreneurs, in the early stages of business, spend ten hours each day working on it, which indicates that they work by 21% more than other full-time employees from Romania. According to a Eurofound survey, in 2014, Romanian employees worked more than other European Union employees, the number of hours worked per week coming to 41. Although most of them spend 10 hours on their business, many entrepreneurs go beyond the limit of ten hours, some of them working even 18 hours a day.

✓ **the vast majority of start-up entrepreneurs go to at least one networking event a week**

Most entrepreneurs understand the significance of building relationships for the success of the entrepreneurial initiative. On average, they participate in at least one networking event per week. Whether we are talking about building business partnerships, sales and marketing relations or about identifying service providers for startups or mentors, developing business relationships is vital to the growth of the business.

✓ **Bureaucracy - the most relevant impediment to entrepreneurial initiative**

Bureaucracy was identified by start-up entrepreneurs as the most relevant obstacle in developing a business in Romania. Vagueness of regulations, lack of information, bushy legislation - are just some of the issues raised by start-up entrepreneurs and they can be correlated with bureaucracy. The main obstacles identified by entrepreneurs, both mature and beginners, are fiscal issues, difficult access to financing and the lack of entrepreneurial education.

✓ **Entrepreneurs wish for a fiscal relaxation process**

Romanian entrepreneurs want fiscal relaxation aimed specifically at startups, but also a general fiscal relaxation at company level. The top measures to be followed by authorities in order to support entrepreneurial initiative are: relieving bureaucracy, creating multiple financing programs for startup from European funds or non-refundable grants from the State, as well as establishing institutions to actually support startups by providing consultancy, workspaces, business incubators administered and funded by the State; a functional e-counter and digitizing institutions.

✓ **Reducing labor taxation would have a great impact on start-ups**

As regards taxation, reducing taxes for both employees and employers, simplifying regulations and startup taxation and minimizing income tax of startups are the most important measures from the perspective of the entrepreneurs in order to improve the regulatory and fiscal environment for startups.

✓ **Own funds - the most important source of financing when starting a business**

According to the *Global Entrepreneurship Monitor 2012 U.S. Report*, 73% of entrepreneurs who have set up companies in the United States used their personal savings. In Romania this percentage has almost the same value, 69% of respondents indicating their own funds, including personal loans and salaries from jobs other than the startup business, as the most important source of funding. The following two places are taken by the European funds and non-refundable grants offered by the Romanian State; family and friends represent only the fourth most important source for local startups.

✓ **Marketing and promotion is an important investment area for startups**

Many start-up entrepreneurs will allocate the largest resources for promotion, sales and distribution. Defining the product or service is the third area of investment, most likely due to the fact that half of the responding companies are less than one year old. Operations and HR are the last areas on the investment list, just like defining and optimizing the business model.

The international market of successful start-up may include: CORTILIA (online sale of Bio products), SELFIENATOR (extensible stick which allows selfie photographs), LE CICOGNE (child care services, guidance and transportation), ENNOVA (remote assistance for mobile devices, tablets or PC) etc.

Of the Romanian start-up businesses which obtained important financing, participated in European business accelerators, were awarded, turned out new products and want to expand on foreign markets, it is worth mentioning the following: VECTOR (Vector Smart Watch), SKINVISION (application that detects signs of skin cancer), MIRA REHAB (a software platform which makes physical recovery more funny and comfortable for patients transforming exercise into video games using an external sensor to track and evaluate progress of patients), DEVICEHUB.NET (an electronic platform), etc.

In perspective, in order to develop the start-up business sector in Romania, one should focus on:

✓ developing entrepreneurship among youngsters;

✓ implementing public policies designed to support the development of the business environment;

- ✓ promoting this type of business;
- ✓ breaking bureaucracy in order to facilitate access to financing;
- ✓ encouraging research and development activities and innovation;
- ✓ supporting infrastructure development for start-ups (business incubators).

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Corporate social responsibility within the romanian beer industry

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Abstract

In Romania, the beer industry is known to be a key economic sector with an important contribution to the economic development. This is due to the ability of this sector of self-regulation, to some common objectives of the brewing companies translated into a common mission within the Brewers of Romania Association that represents their interests, but also to the long-term strategies implemented by these companies. In addition to economic aspects, these strategies aim at drawing a strong CSR policy. The social programs and projects of the companies in the beer industry fall into various categories and reach the following main areas: responsible commercial communication for beer, funding for projects within the communities where they operate, social programs for different categories of people, volunteering etc.

Keywords: corporate social responsibility, the beer industry in Romania, brewing companies, social projects and programs, responsible commercial communication, sustainable development.

1. Corporate Social Responsibility – Conceptual Approaches

Corporate Social Responsibility (CSR) is a concept becoming more present in the Romanian business environment. The main factors in this process are the multinational companies who have transferred their organizational culture at a local level.

The concept is originally from the United States and began to be promoted at European level in the mid 80s. The definitions of this concept are numerous in the literature. The latest and most commonly used can be found on the web platforms www.responsabilitate-sociala.org and www.actionamresponsabil.ro.

The World Business Council for Sustainable Development defines CSR as "*ongoing commitment of the companies to behave ethically and contribute to economic development by improving, in the same time, both the quality of life of employees and their families and also of local communities and society as a whole*".

The European Commission proposed the following definition: „*CSR is a concept whereby companies integrate social and environmental concerns in their operational activities and their interaction with stakeholders on a voluntary basis*".

Also, into a material entitled „*Involvement of SMEs in social responsibility projects (CSR)*" Corporate Social Responsibility is defined as: *The organization's commitment to contribute to community economic development through active involvement of employees, their families, of the local community and society widely; Realization of community activities with a high impact on society; A concept through which the organization decide to contribute voluntarily to the improvement of the community in which it operates; A transparent and responsible business practice towards society; The relationship that a company develops with its wide range of stakeholders. This category includes customers, employees, community members, investors etc.; An investment made by companies for the good of the community / society; A contract between society and the business sector*.

In the same material is stated that CSR is, in every sense of the word, a business culture that includes: Economic equity; Social equity; Correct behavior; Transparent relationships; Integrity; Moral principles; Investments in the community.

All this simply means that CSR ensures the strong connection between the private business and community while ensuring the sustainable development of the company.

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2. The beer industry in Romania

Currently the brewing industry is an important economic sector in Romania. This importance is given by a few key elements: the use in the manufacturing process of raw materials from Romanian agriculture, the generation of a significant number of jobs, the high value of contributions to the public budget, the considerable contribution brought to economic growth etc. Below we present and analyze these factors in order to obtain an overall picture of the size of the beer industry in our country.

Thus, unlike other economic sectors, the production of beer in our country provides 97% of domestic consumption, only 3% representing imports from countries intra or extra EU. The informations made public through the study carried out by Europe Economics „*The Contribution Made by Beer to the European Economy – Romania, January 2016*" show that at the level of 2014, although decreasing as against the previous year, domestic production of beer was situated at 14.75 million hectoliters.

Beer production was provided by a number of 16 companies producing beer through a total of 22 breweries of which 7 are microfactories.

In 2004, some of the largest brewing companies from Romania have set up the Brewers of Romania Association (BRA). The mission of the association, presented on its website (www.berariiromaniei.ro), is to promote and develop a responsible and sustainable beer industry in Romania to ensure a healthy business environment in this industry sector.

Currently, members of the Brewers of Romania Association, as they are presented on its website, are five of the largest brewing companies in our country: BERGENBIER SA, HEINEKEN Romania, UNITED ROMANIAN BREWERIES BEREPROD, URSUS BREWERIES and MARTENS, alongside the micobrewery CLINICA DE BERE. Together, the five producers account for over 80% of the beer consumed in Romania. At the same time, representatives of raw material producers are part of the Association: SOUFFLET MALT ROMANIA and ASSOCIATION OF HOPS PRODUCERS.

Another important attribute of the brewing industry is that domestic production is sustained in proportion of 70% of raw materials from the Romanian agriculture. In this regard, former Ministry of Agriculture, Daniel Constantin said that „*… by integrating cereals cultivated in Romania in the beer production, the beer industry acts as an incentive in building the Romanian agriculture*". (http://www.berariiromaniei.ro/mesajul-autoritatilor)

The data provided by the same study mentioned above shows that the value added generated by the beer industry amounted to 862 million euro in 2014. This value integrates as shown in Table 1, the added values obtained from the retail sector, the hospitality sector, the supply sector and of course from the brewing companies activity.

Table 1. Value added generated by the beer industry in 2014 (million Euro)

Value added obtained from:	**2014**
Retail secor	354
Hospitality sector	60
Supply sector	231
Brewing companies	217
Total	**862**

Source: Europe Economics, *The Contribution Made by Beer to the European Economy – Romania, January 2016*, Available online at: http://www.brewersofeurope.org, accessed on 24th of August 2016

Thus, the direct contribution of brewing companies to the national economy through the added value created represents 25.17% of the total value that this sector generates.

Regarding the number of jobs created directly and indirectly by the beer industry in Romania, the informations presented in the study carried out by Europe Economics and taken over by the Brewers of Romania Association in its *Annual Report 2016* show that this amounts to 84 988, as it can be seen in Table 2. Out of these jobs, only 5,400 are jobs in brewing companies, and of these 4,000 belong to the BRA's members. (http://www.berariiromaniei.ro)

It is important to note that out of 24 543 jobs from the supply sector for the brewing industry, 10 189 represents jobs in agriculture.

A special chapter of the *Annual Report 2016* of BRA is dedicated to the authorities' messages regarding the beer industry in our country. Thus, Viorel Stefan, President of the Budget, Finance and Banking Committee of the Chamber of deputies states that: „*The beer industry is clearly a success story in terms of honest fiscal behavior. The beer industry has zero tax evasion in production, which translates into higher revenues for the state and local budgets*."

Table 2. Total employment generated by the beer industry in 2014

Jobs generated from:	**2014**
Retail secor	27,965
Hospitality sector	27,081
Supply sector	24,543
Brewing companies	5,400
Total	**84,988**

Source: Europe Economics, *The Contribution Made by Beer to the European Economy – Romania, January 2016*, Available online at: http://www.brewersofeurope.org, accessed on 24th of August 2016

Total revenues collected to the state budget and generated by the beer industry amounted to 533 million Euro in 2014. Structurally, they are presented in Table 3 where it is noted that the contributions paid by brewing companies amounts to only 3.75% of the total value of revenues that are generated by this industry.

Table 2. Government revenues generated by beer industry in 2014 (million Euro)

Government revenues:	**2014**
Excise duties	150
VAT (on-trade)	77
VAT (off-trade)	208
Income tax, payroll tax and social security revenues (brewing companies)	20
Income tax, payroll tax and social security revenues (other sectors)	79
Total	**533**

Source: Europe Economics, *The Contribution Made by Beer to the European Economy – Romania, January 2016*, Available online at: http://www.brewersofeurope.org, accessed on 24th of August 2016

Everything we presented above, as well as authorities' messages voiced by some ministers, committee chairmen or members of the European Parliament make us conclude that the beer industry in Romania is characterized by dynamics and performance, is an outstanding exponent of the Romanian business environment, an example of good practice, is the principal economic sector that contribute to GDP growth and last but not least is a key factor for Romanian economic development.

3. Policies and programs of social responsibility of the Brewers of Romania Association and its members

In recent years, companies from the Romanian business environment have embraced the practice of the companies from other countries of the world to conceive and implement corporate social responsibility programs. The beer industry as a key sector of the food industry from Romania it makes no exception. We intend to further analyze the CSR policy developed by the BRA, as representative of the largest part of the companies operating in the beer industry in Romania, and the CSR policy and programs implemented by some of the brewing companies, members of this association.

3.1. Brewers of Romania Association

Since its foundation, the BRA has established seven priority targets which together lead to the fulfillment of its mission that is to promote and develop a strong and responsible beer industry in Romania. Among these objectives is found „*implementation, in partnership with various state institutions, different social projects by having impact on certain communities*” (http://www.berariiromaniei.ro).

Under the aegis of social responsibility, the Association presents in its *Annual report 2016* two main directions: setting out standards for commercial communication and education and information campaigns targeting varoius public categories. These directions were implemented through:

- **Code of responsible commercial communication for beer** – by issuing this Code *„the beer industry thus became the first industry in our country to self-regulate. The Code, adopted in 2005, sets out a series of rules regarding the commercial communication of all members of the Association, focusing particularly on encouraging responsible beer consumption and targeting the advertising messages exclusively to persons over 18 years old. As a member of the Managing Board of RAC (Romanian Advertising Council), the Brewers of Romanian Association sets a best practice example within the entire Romanian business environment. For this purpose, the Code of Commercial Communication is enclosed as an Annex to RAC's Code of Advertising Practice."* (BRA, *Annual report 2016*);

- **”Alcohol Doesn’t Make You Big” Campaign** – this campaign was launched as a pilot program in Bucharest in 2006 and conducted in nine other cities until 2010. Elaborated and implemented by ABR, Campaign had as partners General Inspectorate of Romanian Police and Ministry of Education, Research, Youth and Sports and had as objective: *”promoting an effective behavioral change in terms of alcohol consumption among Romanian teenagers”* (ASB, *Raport anual 2016*);
- **”Pass the Steering Will When You Drink” Campaign** – This campaign, conducted in partnership with the Ministry of Internal Affairs and the National Council of Audiovisual was launched in 2008 and it is on-going. The campaign objective is to *„inform the romanian drivers about the danger of drunk driving”* (ASB, *Raport anual 2016*). This broad campaign shows that the Brewers of Romania Association aimed at acting responsibly towards the beer consumers from Romania, promoting moderate and responsible consumption and demonstrates the social commitment of Association. (http://www.berariiromaniei.ro)

3.2. HEINEKEN Romania

Through the *Sustainability Report* released in 2015, Heineken Romania, part of HEINEKEN Group and member of BRA, shows that the company has continued to improve its performance and to achieve its objectives set at local level within the Sustainability Agenda ”Brewing a Better World”. This represents the integrated strategy in the long term of the company, meant to generate sustainable value. Key milestones of this strategy refers to: protection of water resources, reduction of CO_2 emissions, sustainable supply, promoting responsible alcohol consumption, promoting health and safety and not least the development of communities. This last element translates, according to data presented in the Report, through investments of over 175,000 euros annually for social responsibility programs. (HEINEHEN Romania, *Sustainability Report 2015*)

The same report states that in 2015, for the fifth consecutive year, was conducted ”Heineken for Communities” program, in partnership with CSR Nest. Identifying the needs of the communities where the company operates, this invited the organizations that applied for funding to carry out projects in areas such as: culture, education, environment, social problems, promoting volunteerism, etc. Thus, the communities in Constanta, Craiova, Miercurea Ciuc and Targu Mures have received funding for 33 projects, totaling over 1.6 million lei, from which benefited directly and indirectly 440,000 persons. (http://www.slideshare.net/TheCSRReport/raport-sustenabilitate-heineken-romania-2015)

However, the company management considers that *„the greatest contribution we bring to the communities where we are developing our business activity consists in the effects of this activity, such as job creation, generation of business for our suppliers and payment of taxes.”* (HEINEHEN Romania, *Sustainability Report 2015*)

3.3. UNITED ROMANIAN BREWERIES BEREPROD

On the online platform Responsabilitate socială.ro is presented the CSR profile of the company UNITED ROMANIAN BREWERIES Bereprod (URBB), also known as Tuborg Romania. This profile begins with a presentation made by the Company Chairman Hezy Ovadia of the CSR philosophy: „*We wish that through the social responsibility projects sustained by the company to bring our contribution to long-term development of the communities in which we operate, we want us to represent a model and an example for other companies. We are an important player and we want to demonstrate that we bring value to the community through our business activities. We encourage our employees, but also citizens to engage and contribute along with us to a cleaner environment.”* (http://www.responsabilitatesociala.ro)

The CSR policy of Tuborg Romania has as important objective to return to the community at least a part of the support and respect that the consumers manifest for its brands. Tuborg's CSR programs have two main directions: contribution to a cleaner environment and how developing a better life for the community members affected by the vicissitudes. These programs are presented chronologically on the platform Responsabilitate socială.ro and refers to (http://www.responsabilitatesociala.ro/companii/tuborg-romania-urbb.html):

- *Since 2001, URBB funds an annual program of research fellowships and environmental projects of Balkan Environmental Association.*
- *Since 2003 on Easter and Christmas holidays, the company unfolds the Social Program* ***„Together closer to the people”*** *addressed to persons in material difficulties. The program brought together leading companies in the food industry. The URBB employees were volunteers in the program and have offered packages with products for more than 35,000 people with social problems, in Bucharest and other cities.*
- In 2007, URBB launched the program of environmental responsibility **„Green Umbrella”**. It aims to change the wrong perception of some Romanian that „my gesture does not matter” and convince them that we have „to keep Romania clean”, all this through actions aimed at responsibilization through power of personal example. After 3 years, the program enjoys the support of over 1,200 volunteers from 32 counties and more than 1,000 bloggers who are partners. In addition, more than 150,000 car stickers with the message „I do not throw garbage on the street”

were distributed both through punctual actions, undertaken in traffic, as well as direct to beneficiaries, following the requests received on the campaign website - *www.umbrelaverde.ro*.

- In 2010 URBB launched the competition **„Green Capital of Romania"**, a project that is part of the Green Umbrella campaign and is supported by the Ministry of Environment and Forests. The project goal is to aware the Romanian population to assume responsibility concerning the environmental compliance, also causing both the local authorities, as well as the citizens to develop ecological projects in order to improve the urban lifestyle.

3.4. URSUS BREWERIES

Ursus Breweries is part of SABMiller, one of the largest brewers in the world. CSR policy developed by Romanian company is presented in the *Sustainability Report 2014/2015*, as well as on its website (http://ursus-breweries.ro) in the chapter Sustainable Development. It comprises three main action directions: social responsibility, responsible consumption of alcohol and policy on commercial communication.

The company management believes that *„Social responsibility initiatives must be seen less for the glory and more as a natural conduct of ethical, responsible, consistent and relevant community involvement. The presence in the community life in a way that is beneficial and based on a type of sustainable development is not only a necessity but is a sine qua non condition for a successful company."* (http://ursus-breweries.ro/responsabilitate/responsabilitate-sociala/)

Therefore it is not surprising that the CSR programs developed and implemented by Ursus Breweries, or those at which it took part as an active partner, are not few in number, being presented in detail on the company's website (http://ursus-breweries.ro), some of them we will present briefly below:

- **"Students for Community" scholarships** – *Starting with 2011, Ursus Breweries has been financing this scholarship, which addressed to Babes-Boylai University students, who prove a remarkable involvement in volunteering activities, complementary to their high academic results. 10 students are awarded annually, but in 2014, the company increased their number to 12*.
- **Let's do it, Romania!** - *Ursus Breweries has been a Let's Do it, Romania! partner ever since the first edition of the project, which took place in 2010. Approximately 1000 Ursus Breweries employees have volunteered in the project up to the time being, in Bucharest, Timisoara, Cluj-Napoca, Buzau and Brasov, proudly contributing to the wellbeing of the communities in which the company activates.*
- **LEADERS School Program** – *this is the only leadership school in Romania exclusively addressed to young people, aged between 18 and 25 years old and is supported by Ursus Breweris. The program is developed around 3 key concepts –* ***personal leadership, team leadership and communication leadership****, aptitudes that differentiate successful young people, both as entrepreneurs, as well as managers.*
- **Ursus Scholarships of Excellence** - *Through these scholarships, 10 annual scholarships of 1000 lei each are offered in Cluj-Napoca for great academic results. The scholarships are offered to Babes-Bolyai University students, Medicine and Pharmacy University, the Technical University and the University of Agricultural Sciences and veterinary Medicine. Starting with 1999, 150 students benefited of these awards, which have become a tradition in the university environment from Cluj-Napoca*.
- **Recycling Movement** - *is the first national public education project with regards to recycling (packaging, WEEE and other waste types), developed under the patronage of the Ministry of Environment and Sustainable Development, and is meant to inform the public, make them aware and get the public informed with regards to recycling. Ursus Breweries joined the* ***Recycling Movement*** *in 2009*.
- **D'ale Gurii Dunarii** – *is a project launched by „Save the Danube River and Delta" Association and supported by Ursus Breweries. Within the project, the Association organized on October 10, 2009 the first edition of the* ***„D'ale Gurii Dunării"*** *gastronomy and cultural heritage festival in Uzlina. This festival accommodated a competition between six communities living in the Danube Delta for the three prizes at stake: The Great* **Ursus Breweries** *Prize (EUR 3,000), the Special eJOBS Prize (EUR 2,000) and the „Radu Anton Roman" Prize (EUR 1,000)*.
- **The national program „Measure Your Lifestyle!"** - *was launched by Ursus Breweries in 2006, aiming to promote, among young people, a balanced lifestyle, with no excesses, and encourage dialogue about addictions in general with important social life personalities. The program was meant for all students in Romanian university centres and was organized as a road show of debates with young people on addictions. 22 debates were organized in 8 important Romanian university centres, which were attended by over 1.000 students. Through this social responsibility program, Ursus Breweries „aimed to bring attention to responsible consumption of alcohol as part of a healthy lifestyle"*.
- **The social responsibility program „Millions of People, Millions of Trees"** - *is a national volunteering movement with a strong national communication platform, the main objectives of which is to inform the population with regards to the importance of environment protection and attract volunteers for planting activities that are meant to recreate the green areas in the cities or in the regions affected by massive deforestation. Ursus Breweries has been the founding member of this program, which was initiated in the autumn of 2006 by PRAIS Foundation, in partnership with the Ministry of the Environment and Sustainable Development. As part of the environmental*

program, for 3 consecutive years, Ursus Breweries employees took part in plating activities, each spring and autumn, in Timisoara, Cluj, Buzau, Brasov and Bucharest.

4. Conclusions

The beer industry in Romania is proving to be a sector with a strong contribution to the economic development of our country. The brewing companies that exist currently on the Romanian market represent, in the vision of the authorities and their business partners, examples of good practice in Romanian bussines.

The brief analysis carried out in the paper regarding the beer industry in Romania revealed that this product, unlike many others, is consumed overwhelmingly from domestic production, only 3% of the amount consumed by Romanians beeing imported. Also, the entire beer industry uses raw material from Romanian agriculture in proportion of 70%. This industry generates directly and indirectly a considerable number of jobs and also generates significant revenues to the state budget and the local ones. Authorities believe that at the level of this industry is zero tax evasion.

The positive economic impact of this industry in Romania is well established. Therefore we have proposed in this paper to carry out a study which highlighted the social contribution that the companies in this industry have at the locallevel. The study was focused on the Brewers of Romania Association, which brings together a significant part of the brewing companies from Romania, and on three largest companies, members of the Association: HEINEKEN Romania, UNITED ROMANIAN BREWERIES Bereprod (URBB) and Ursus Breweries. Their common mission and objectives, but especially the individual ones are translated in terms of CSR by elaborating and implementing, alone or in partnerships with various authorities and NGOs, of strategies, policies, programs and projects of social responsibility that will lead to the long-term development of the communities in which they operate.

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The analysis of strategic alternatives using BCG matrix in a company

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Abstract:

This paper presents the importance of developing and analyzing strategic alternatives in a company in the allocation of resources among different strategic areas of activity. Our strategy must be realistic and mobilizes the necessary resources for its development, conditions which ultimately ensures a high level of success and profitability of the company. The analysis of strategic alternatives can be based on several managerial models and in this paper we used as model the Boston matrix analysis Consulting Group (BCG). The objective of this analysis is the company's focus in the allocation of resources among different strategic areas of activity.

Keywords: strategy, strategic alternatives, competitive position, market

1. Introduction

The strategic information system comprises a set of data of known global company, both currently and in the future. It must be sensitive enough to perceive and that very weak signals in the system, but in the future could affect a whole. The main role of strategic information system is to provide information needed for the strategic decision of the company. The information that make up this system must meet certain conditions:

1. It must be synthetic and with a high degree of aggregation;
2. The information must be primarily qualitative rather than quantitative;
3. Are future-oriented outlook of the company, wishing it to be a relevant starting base for safe enough anticipations of events;
4. The information must be both extroverted, describing the current environment of the company and its development and analysis skills allowing introverted firm and weaknesses / his country.

The objective of this analysis is the company's focus in the allocation of resources among different strategic areas of activity. Following the strategic analysis can determine appropriate strategies both in the assembly of a large company and group level in the company.

The general principles of analysis models portfolio of strategic alternatives is to set the strategic position of each area based on two criteria: attractiveness of markets (with indicators such as: accessibility market growth rate, market size, stage in the life cycle, the price level the level of margins, competitive intensity, possibilities for product differentiation, etc.) and competitive position of the company (with indicators: relative market share, low cost, novelty product, technical and technological level control of intermediaries, brand awareness, brand image , etc.).

The strategy is chosen course of action to achieve the mission, goals and objectives of the organization. It covers technological capabilities, financial and human resources, and organizational and managerial skills of the organization. The strategy envisages the firm's long-term prosperity by remaining in that business in the next 10-20 years. The long-term growth strategy of the company assets and not short-term portfolio.

The strategy formulation considers the following issues:

- The market opportunities, competitive forces and branch activity;
- The skills, capabilities and internal resources of the company;
- Unexpected hazards that could affect the welfare and performance of the company;
- The personal values, aspirations and visions managers;

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- The social, political, legal, ethical and economic aspects of the external environment in which the company operates;
- The organizational culture and business philosophy of the company.

Whatever the activity, the strategy should include the following:

- the portfolio of the company;
- the performances or desired goals;
- the resource requirements;
- the running programs.

2. The presentation of the company which is the subject of the study

The services offered by the group of companies covering all subsystems COMANDOR an Integrated Security: Perimeter protection systems; detection and burglar alarm systems; detection and warning fire; access control and time attendance systems; video surveillance systems; monitoring systems; intercom and video intercom systems; automation systems and access restrictions; Voice solutions - data.

One of the priority directions of activity of companies COMANDOR was to promote security market in Romania a competitive environment based on professionalism and loyalty among the players in this market: companies which offer security solutions, beneficiaries security, state authorities and insurance companies. In this firm order is one of the initiators and founders of the Romanian Association for Security Technique - ARTS, association representing the interests of companies operating in the security market. The products offered by the company are: automation and drive gates; Burglar security systems; fire detection and signaling; access control systems; rond control systems; monitoring equipment; intercom systems; CCTV; accessory; electronic control systems for the commodity.

3. The analysis of strategic alternatives using BCG matrix

A model for analyzing strategic alternatives at Boston matrix business is Consultig Group (BCG). The objective of this analysis is the company's focus in the allocation of resources among different strategic areas of activity. Having analyzed the situation can be established portfolio strategies suited to each strategic business unit and for the portfolio as a whole.

The general principle of methods of analysis of the business portfolio is to set the strategic position of each area based on two criteria: market attractiveness and competitive position of the company in each case.

BCG matrix uses one indicator for each of the two criteria for classification core areas of activity.The market attractiveness is valued based on the rate of its growth and business competitiveness based on market share relative to the strongest competitor.

Notations:
1- automation and drive gates;
2- burglary and CCTV security systems;
3- fire detection systems;
4- access control systems;
5- rond control systems;
6- monitoring equipment;
7- intercom systems.

Interpretation:

- If the Commander society services "STARS" are the burglary security systems, as these systems hold a leading position in a fast growing market. In order to support growth and strengthen our foothold position, significant financial resources are needed. Generating profits, these products have the ability to finance itself.
- "Dilemmas', specifically fire detection systems have a relatively small share in a market in rapid expansion, requiring a large amount of cash in order to finance growth. If the product is successful, it is recommended to support the financially for increasing market share, otherwise the waiver.
- Services "milking cows", where Commodore International, access control systems, along with automation and drive systems gates, have a relatively high share, but on a slow growth market. They generate significant cash, arguing in terms of financial services "dilemma".
- Services "millstones" if studied, rond control systems and intercom systems have a relatively low share in a declining market. Intercom systems, Commander International recorded sales in decline compared to the same period last year, due to special restriction.

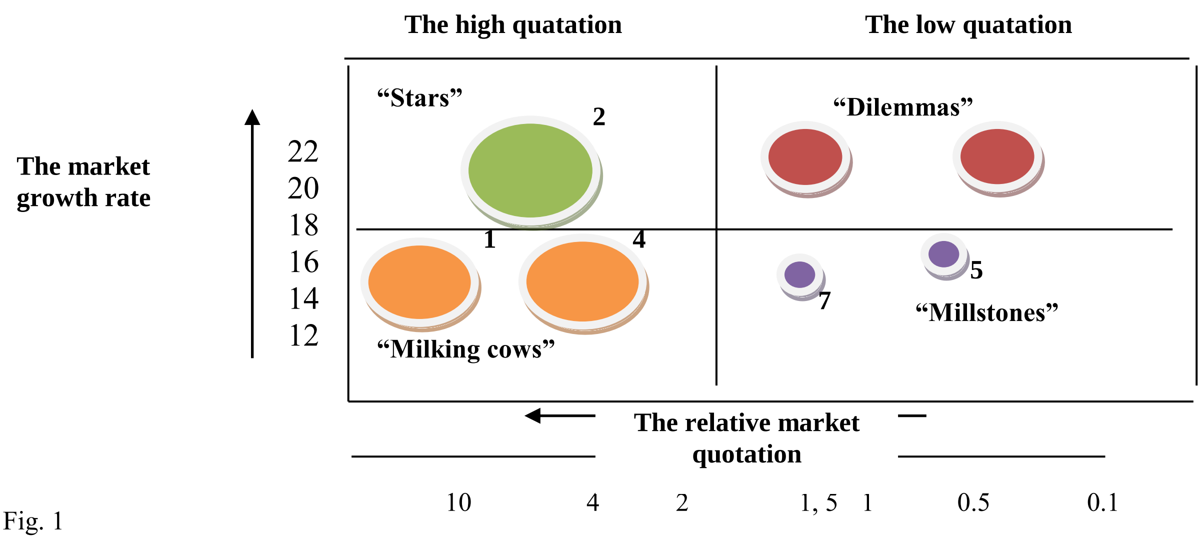

Fig. 1

Following developments in the market, we can predict how it will look this matrix after five years.
Notations:
1- automation and drive gates;
2- burglary and CCTV security systems;
3- fire detection systems;
4- access control systems;
5- rond control systems;
6- monitoring equipment;
7- intercom systems

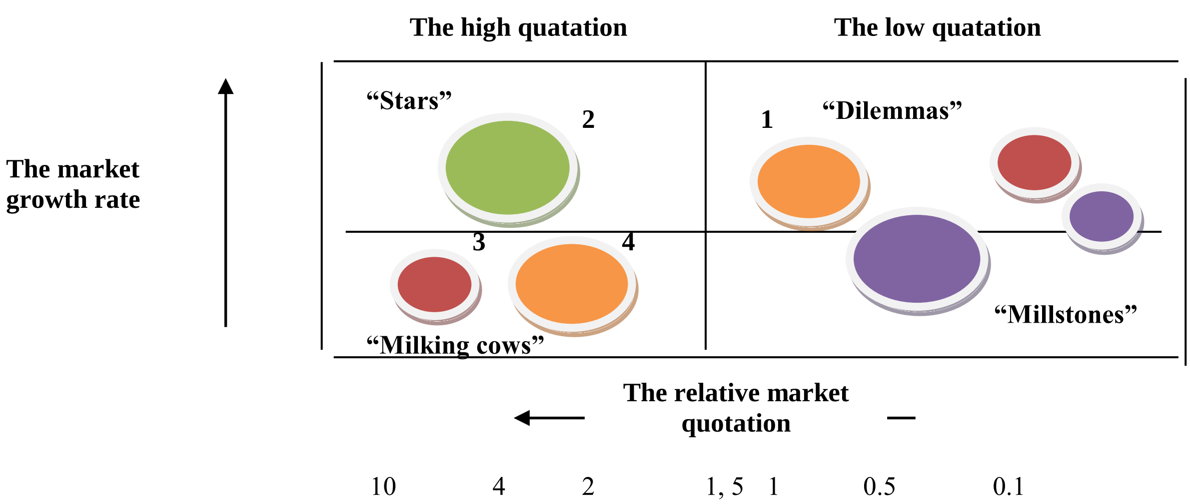

Fig. 2

Interpretation:

- It was intended strategy of disinvestment in systems intercom but ultimately opted for keeping them in the portfolio, due to strategic reasons: serve supplementing the range of products and maintain customer behaving conservatively until time of importation new systems. With the revival of the construction sector, intercom systems begin to have greater search. They convert the "millstone" in "dilemma".
- In group "dilemma" find automation systems and drive gates, equipment for monitoring and control systems round. There has been considerable investment to increase market share because the retail market in Romania is expanding and has great potential.
- "Milking cows" are made up of signaling and fire detection systems, access control systems respectively.

- These products are very profitable for the company. Their marketing is encouraged by the legal framework (legal) which requires institutions, whether public or private, providing spaces with fire alarm systems.
- Access control systems are liked by most large companies, especially foreign, but not only.
- Using an access control system with PIN (code under which shared), proximity (SIM) or biometric (fingerprint, palm), companies can more easily generate time data. In monetary terms, this means a saving of time and money, a not insignificant detail in a recession.
- It notes further stability services "STARS", namely, security systems burglary. Were maintained in the same category as Commodore International has managed to capture the customers of competitors, especially those of the firm Secpral renegotiated on favorable terms for both parties product prices, how settlement transport (for larger orders) payment terms and method of payment (promissory note payment order).
- Burglar security systems are constantly perfected, incorporating technological progress and are up-and-thread data according to customer needs. Commodore International was able to maintain its leading position in terms of security systems, flexible solutions because they provide customers.

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An introduction into the preventive financial control exercised in a public entity

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Abstract

Preventive financial control should not be viewed separately but integrated into the business management. Financial control acts to the proper functioning of economic activity, acting systematically to prevent irregularities and deficiencies, increasing efficiency, protection of heritage and knowledge of the observance of economic and financial legality. Preventive financial control is proposed in a European manner, meaning that the law only provides general and specific duties of its organization but the exercise possibility remains available to the public entity's manager.

Keywords: control, prevention, management, entity

1. Introduction

Preventive financial control should not be viewed separately but integrated into business management. Control is the act establishing the material accuracy of the operations that are carried out in advance of their execution, simultaneously or soon lapse of the conduct of operations.

Preventive financial control is a component of internal control that represents all policies and procedures designed and implemented by management and company personnel to provide reasonable assurance to achieve company objectives in an economic, efficient and effective manner; foreign policy compliance and management; protection of assets and information; prevention and detection of fraud and errors; quality accounting documents and timely production of reliable information on financial management segment.

Financial control includes within its scope: relationships, financial phenomena and processes; the administration and management of heritage; results of economic and social activity at all times, units and locations of household material, money and expenditures.

Financial control ensures the proper functioning of economic activity, acting systematically to prevent irregularities and deficiencies, increasing efficiency, protection of heritage and knowledge of the observance of economic and financial legality.

The period 1990-1999 was characterized by profound reorganization, resulting in a gradual reduction of compulsory controls and a system of internal control organized and kept according to the risks facing the organization. Since 1999, the Romanian control system introduced by law "internal control and internal audit" for public entities, which required clarification of concepts and practices in the field.

Internal control is proposed in a European manner, meaning that the law only provides general and specific duties of its organization and the exercise is available to the public entity's manager.

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2. Organization of preventive financial control (PFC)

Preventive financial control is the work of verifying the legality and regularity of transactions on public funds or public property, prior to their approval, and is a component of the internal control system. "Internal control means all forms of control exercised at the level of the public entity, including internal audit, established by management in accordance with its objectives and legal regulations in order to provide fund administration economically, efficiently and effectively".

Ministry of Finance is coordinating authority and regulation of the PFC to all public bodies. PFC is organized and exercised in the following forms:

a) own PFC at all public entities on all operations with financial impact on public funds and public property;

b) PFC delegated to the principal loan of the state budget, social security state, and the budget of any special fund, the National Fund and the implementing agencies of the Community funds and other public entities for high risk by delegated controllers of the Ministry of Finance.

The authorizing officer is not free to use budget but is constrained by the legal provisions which are mandatory. This stems from the fact that "public heritage officer and managing public funds work on a warrant. Compliance with relevant legal provisions mandate and management of documents is to be checked.".

PFC will integrate gradually into the sphere of managerial responsibility as management control will eliminate risks in managing public funds. Reaching this level will be assessed by the audit ordered by the Minister of Finance, under the law.

PFC aims to identify projects of operations not meeting the requirements of legality, regularity and / or, where appropriate, employment and destination within budget appropriations and the commitment and performance of which would harm public property or public funds.

Legality is "characteristic of an operation to comply with all legal provisions that are applicable in force on the payment date".

Regularity is "the characteristic of an operation to comply in all respects set of principles and rules applicable procedural and methodological category of operations which is part of".

PFC is held, usually in the specialized compartments financial - accounting. In the nature of operations, the head of the public entity can decide its spread in other specialized departments is initiated by legal acts, or state liabilities or other obligations of patrimonial nature.

3. The conditions needed to be met by persons appointed to exercise the preventive financial control visa

PFC is exercised by the specialized compartments, so designated by the head of the public entity. The appointment act will include competence limits in exercising PFC. The persons appointed to carry out this work are other than those initiating the transaction subject to visa.

The appointment, suspension, dismissal or change of personnel performing PFC is made by the head of the public entity, with the consent of superior public, and if public entities that perform the duties of chief credit of the state budget, insurance budget State social budget or any special fund, with the approval of Ministry of Finance. Persons designated to exercise PFC must have the professional skills required for this activity. They shall respect a specific code of professional standards developed by the Ministry of Finance.

They may be called to exercise PFC own people who are employed by the public entity or, where appropriate, have the legal capacity to enter into a contract to perform this task and meet the following conditions:

a) Romanian citizenship and residence in Romania;

b) knowledge of Romanian language, written and spoken;

c) have full legal capacity;

d) have a health condition, evidenced-based medical examination;

e) have higher education in economics or law;

f) have an actual length in public finance at least 3 years in the case of public institutions, and at least 3 years in the financial field - accounting for other public entities;

g) have not been convicted of a crime that would make them incompatible with the conduct of business;

h) have at least two letters of recommendation.

Exercise of the PFC is based on the following principles:

- Professional competence. The designated person must know and apply the law consistently and firmly in the field, is expected to know the legal regulations specific to their duties.
- Independence decisions in terms of separation of powers. The person designated to exercise the visa PFC is independent and its decisions can not be imposed in any way to grant or refuse visa PFC.
- Objectivity. In pursuit of control, especially in the decision to grant or reject visa, the person appointed must not give in to prejudices, pressures or influences that might affect the correct assessment.
- Moral conduct. The person designated to exercise the visa PFC must be recognized probity to conduct themselves properly, to demonstrate professional conduct irreproachable, at the highest standards.

- Confidentiality. The appointee is bound by secrecy on the content of projects subject to visa operations, not to disclose any information to third parties.
- Incompatibility. There may be designated to exercise the activity of PFC persons under prosecution, trial or have been convicted for crimes related to abuse of office, forgery, use of forgery, fraud, giving or taking bribes and other crimes which have caused damage to natural or legal heritage.

There should not be designated for the exercise PFC individuals who are spouses or relatives with the leader of the public entity and those persons who may be in a conflict of interests in relation to operations which are subject to endorsement.

Dismissal of the persons exercising the activity of the PFC is for causes that lead to termination of employment.

Evaluating the activity of the person performing PFC is made by the head of the public entity with the consent of that endorsed the appointment annually through scores based on information contained in internal audit reports and reports of the Court of Auditors, where appropriate.

4. Exercising of the preventive financial control

PFC's operations are carried out based on documents and / or certified documentary evidence of the reality, regularity and legality by leaders of specialty departments.

Transactions on legislation which commits patrimonial public entity are PFC subject after their endorsement by specialized legal and financial departments . Public entities where there are organized specialized compartments legal and / or financial, PFC is exercised solely by the person designated by the manager of the public entity.

Leaders of specialty departments are responsible for the accuracy, regularity and legality of transactions of the paths acts and / or documents they have certified or approved. PFC visa for operations which are based on acts and / or certified or approved documents which are subsequently proven false, inaccurate or unlawful, not exonerates the chiefs of specialty or other competent persons within them.

PFC is exercised by visa by people within specialized compartments designated for that purpose by the head of the public entity. The instrument appointing the limits of competence includes the exercise PFC and are people who exercise other than those subject to visa approval and performing the operation.

Target of PFC include the following information: name of the public entity; mention "targeted for preventive financial control"; ID visa holder; signature of the person appointed to exercise the visa and the visa grant date. PFC target is exercised by hand or electronically.

If the visa holder is exercising handwritten seal number identifier held by the designated person.

In the event of documents in electronic form, PFC visa is extended to electronic signature and is exercised by the person appointed for this purpose, using a secure electronic signature creation, certification, issued under the law by an authorized service provider certification.

Data from documents submitted to the visa PFC recorded in the register on transactions submitted to visa PFC. Register should provide: numbering in chronological order, from number 1 in each year; ban inserts, Interstitial, and any subsequent deletions or additions; registration data according to their competencies (columns 0-8 and Column 8, by the person exercising PFC, and in column 7 the person showing the operations for visa PFC. Registry can complete the form fully handwritten full electronic or combined.

Documents relating to operations over which is compulsory to exercise PFC designees are transmitted with its exercise by the specialized departments initiating the operation. Documents relating to operations which affect public funds and / or public patrimony are accompanied by the opinions of the specialized compartments, the substantiation notes, acts and / or documents.

The person designated to exercise PFC receives the documents, records them in the register, then proceed to formal verification by completing the checklist specific to the operation received the visa, regarding: completion of the documents according to their content, the existence of signatures of authorized persons from the departments of specialty and the existence of supporting documents specific operation. The inspection of the designated person is going through the checklist specific to the operation received the visa is mandatory, but not exhaustive. This may extend the checks whenever necessary.

If by completing the checklist at least one of the formal verification is not met, the documents are returned to the specialized compartment issuer, indicating in writing the reasons stated in restitution and register column 8 of "transaction value returned ...".

After the formal verification has been completed, the person designated to exercise continuous scrolling PFC verification and inspection operation in terms of legality, regularity and, where appropriate, the classification and destination within budget appropriations and / or commitment.

If after checking the background operation meets the conditions of legality, regularity and, where appropriate, employment within the destination budget appropriations and / or commitment shall be granted visa by applying a seal and signature on the copy of the document being archived at the public entity. By default the visa certifying the conditions mentioned in the checklist.

Targeted and supporting documents that accompanied them returned, signed, issuing specialized compartment in order to continue their circuit, this fact shall be recorded in the register.

The designated person to exercise PFC has the right and obligation to refuse visa PFC in all cases in which, when tested, considers that the proposed transaction does not meet the conditions of legality, regularity and employment within budget appropriations or commitment, if applicable.

A refusal must in all cases be given in writing by the person responsible PFC visa by having the obligation to keep track of projects refused by PFC visa.

An operation which was denied visa PFC can be made by the authorizing officer on oath, only if this does not exceed the approved budget appropriation. The authorizing officer may decide to carry out the operation only on the basis of acts of internal decision issued in written form, which has, under its responsibility, the operation.

After receipt of the document internal decision issued by the head of the public entity, the person designated to exercise PFC inform in writing the inspection bodies and economic - financial in the Ministry of Finance and, where appropriate, the superior body of public entities on the operations of rejected visa and made on oath, by sending a copy of the internal decision and the refusal of visa.

5. Conclusions

As shown in the paper, financial control is a specialized control, which involves checking and analyzing economic and financial activity in terms of legality, opportunity, necessity of acts and operations, the cost-efficient use of assets and money and ensuring therefore the public entity patrimonial integrity.

PFC is conducted in compliance with the Ordinance no. 119/1999 on internal control and preventive financial control - republished Law no. 301/2002 for approving the Ordinance no. 119/1999 on internal control and preventive financial control and the Order no. 923/2014 approving the Methodological Norms on general preventive financial control and a specific code of professional ethics for people performing the preventive financial control.

Surely, as the activity of the PFC is limited by a specific regulatory framework and in order to reduce the risk to a tolerable level for the society it was made operational the procedure for the organization and exercise PFC and also I consider appropriate to remove the exercise of PFC from the list of sensitive positions.

By control, information management provides dynamic, real preventive conclusions that raise the value and quality of decisions. Control reaches the essence of phenomena and contributes effectively to the effective notifies of negative effects when they occur and intervenes as a trend for prevention and liquidation of their causes.

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Labour law in the European space for Romanian citizens, limitations and inequalities

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Abstract

Working in the European area represents a fundamental right under EU law. Currently, around 56 million Europeans live and work in a country other than their own. Romania has not remained unaffected by this phenomenon. The statistics allow awareness the influence that had a liberalization of European labor market for Romanian citizens, namely that the number of Romanian citizens working in the European Union has increased considerably. Working in the European area is one of the most obvious advantages of the European Union and Romania's accession to the European Union is the most important event in employment law, an event which allowed Romanian citizens to work under equal conditions and legal within the European Union.

Keywords: labor market, free movement of workers, labor law, migration, social policy, rights, obligations, inneequalities

Working in the European area is one of the fundamental rights that the european citizens have. Free movement of workers, which we will focus our analysis is presented in the institutive treaties starting with the European Economic Community (Treaty of Rome) and finishing with the new regulations and directives that are embedded in existing legislation.

Role of labor law in the European Union social policy was outlined and structured over time, especially after the 70s of last century, with the acceleration of incorporation in the Community policies of social policy. National labor law was no longer able to answer community requirements. Thus was born gradually by the adoption of Community instruments (mainly directives, but also some regulations), Community employment law.

Working in the European area is defined by the right to respond to offers on jobs, to move this purpose in the Member States to carry out an activity and to remain in one of these, after someone exercised an activity (article 48 par.3, Article 39 in the consolidated version).

Free movement of labor implies from the beginning that a worker who moves effectively respond to an offer made on the job. It is not about therefore the right to freely leave the territory of member countries to search for a job. In principle, only workers of Member States are free to circulate in the community, but each State shall determine under its own law who are its citizens, as well as the modalities of loss and acquisition of nationality.

European labor market uses the term worker. For the purposes of Community law,, term worker "includes persons employed in the host country, those who are looking for a job, unemployed people of working age who were previously employed, people unable to work due to illness or injury incurred during employment in the host country [Art. 7 (1) of Directive No. 68/360], people who have reached normal retirement age of the work of the host country. Worker within the meaning of Community law is one that provides only an occasional activity or part time. It's enough that the activity should be effective, might not be literally one voluntary.

It is also use the term labor migration,, ". Labour migration represents: the movement to change the place of living and working, determined by social factors, political, economic or natural, so migration represents a departure of a territory basic another suitable economic activities, which also involves changing normal residence. In this context it is necessary to distinguish between the concepts of immigrant and emigrant. According to the Explanatory Dictionary of the Romanian Language, we speak of immigration when we leave home and settle down, either permanently or temporarily in another country. In this case the verb is synonymous with the verb to emigrate to expatriates.

Regarding the term "immigration", it can be used when changing the perspective and look from the land of "adoption" of a migrant. I mean, once you arrive in the foreign country where we arrived we become immigrants.

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Similarly, those who come from other states and settling in Romania immigrating when they get here, but emigrated when they leave their country of origin. Simply to remember: a migrant is an emigrant at his departure and a immigrant to his destination.

In Community law, the directive is a enforceable legislative instrument for Member States which it is addressed regarding the result to be achieved, but leave to their choice the form and methods for obtaining the same. Directives may be adopted in accordance with the EC Treaty either by the European Parliament and the Council, either by the Council or the Commission. Community institutions use Regulations more often than Directives in judicial cooperation in civil matters. Once adopted, the Community directives must be transposed by each Member State, ie they must be implemented through national laws.

The first and main directives and regulations on the right to work in the European area are:

a) Directive No. 68/360 / EEC concerning the rights of entry and residence;

b) Regulation nr.1612 / 68 / EEC on access to employment conditions;

c) Regulation no.1251 / 70 / EEC on the right to remain in the territory of a Member State by engaging in that State;

d) Directive No. 64/221 / EEC on the right of Member States to derogate from free movement on grounds of public policy, public security or public health;

e) Directive nr.2004 / 38 / EC on the right of free movement and reside freely within the Member States for Union citizens and their family members.

Directive No. 68/360 / EEC was the first Community document through which were suppressed the restrictions on movement and residence within the European Union and members of their families (article 1).

Thus, has established the migrant worker rights:

a) leave the state of residence to carry out an activity as a person employed in another Member State (Article 2);

b) to enter the territory of another Member State only on the basis of an identity card or passport [Article 3 (1)].

Entry visas (or their equivalent) were no longer required, except for family members who are not nationals of a Member State. These states were asked for them to grant the necessary facilities for obtaining visas [Article 3 para. (2)].

c) to obtain a residence permit based on:

-documents which entered into territory;

- Confirmation of employment from the employer or a certificate of employment [3 paragraph. (3) a) and b)].

Directive nr.2004 / 38 / EC codified and reviewed the existing Community instruments dealing separately with workers, self-employed persons as well as students and other inactive. Unlike the Community act, Directive 2004/38 / EEC entry retains not only the right to enter but also the right to exit that all Union citizens have.

EU citizens have the right of residence in the host Member State for a period not exceeding three months without being subject to any conditions or formalities other than the requirement to hold a valid identity card or passport, without giving more favorable treatment applicable to persons seeking work, according to the Court of Justice (Article 6).

Instead, the right of residence for more than three months is granted, according to art. 7 paragraph. (1) of Directive nr.2004 / 38 / EC if it capitalizes Union citizens:

a) are employed or self-employed in the host Member State;

b) have sufficient resources for themselves and their family members, so as not to become a burden on the social assistance system of the host Member State during their stay and have a proper medical insurance valid in the host Member State;

c) are enrolled in a private or public establishment, accredited or financed by the host Member State legislation or practices on the basis of its administrative duties, the main purpose of studying, including training;

d) have adequate insurance in the host Member State and assure the relevant national authority, by declaration or by such equivalent choice that they have sufficient resources for themselves and for family members, so as not to become a burden on the social services of the host Member State during their stay;

e) are family members accompanying or joining a Union citizen who meets the requirements under a), b) or c).

Freedom of movement and residence of persons in the European Union is the cornerstone of Union citizenship and was established by the Maastricht Treaty in 1992. In addition to three other fundamental freedoms: free movement of goods, services and capital. They were first gradually eliminated internal borders according to Schengen Agreement, initially in only some Member States. Currently, free movement of persons is governed by Directive 2004/38 / EC on free movement and residence within the Member States for Union citizens and their family members. The legal basis of this freedom is Article 3 (2) of the Treaty on European Union (TEU); Article 21 of the Treaty on the Functioning of the European Union (TFEU); Titles IV and V of the TFEU.

The original meaning of the concept of free movement of people has changed over time, with the expansion of the right to free movement. First rules date back to 1957, included in the Treaty establishing the European Economic Community. The Maastricht Treaty introduced the concept of EU citizenship, which automatically benefit every citizen of a Member State. This EU citizenship is the basis of individuals' right to move and reside freely within the territory of the Member States. The Lisbon Treaty confirmed this right is also included in the general provisions relating to the area of freedom, security and justice.

An internal market without obstacles to the free movement of persons has been the objective of concluding the two Schengen agreements, namely the Schengen Agreement itself of 14 June 1985 and the Convention implementing the Agreement, signed on 19 June 1990 and which entered into force on 26 March 1995. the Convention implementing the Schengen Agreement (signed only Belgium, France, Germany, Luxembourg and the Netherlands) was based on intergovernmental cooperation on justice and home affairs. Since the majority of the provisions of the Schengen agreements are now part of the EU acquis, starting with the EU enlargement in May 1, 2004 adhering countries no longer have the option of non-participation (Article 8 of the Schengen Protocol).

Currently, there are 26 full members of the Schengen area: 22 EU Member States plus Norway, Iceland, Switzerland and Liechtenstein (which have associated status). Ireland and the United Kingdom are not parties to the Convention but have the opportunity to join the application of certain provisions of the Schengen acquis; Denmark, although it is part of the Schengen Agreement, benefit from the option to not participate in any new measures, including the Schengen, yet bound to certain provisions of the common visa policy. Bulgaria, Romania and Cyprus are expected to join, even if there are delays for various reasons. 1 July 2015, Croatia began the process of applying for Schengen accession.

Due to the common Schengen area it is now possible for Member States: a) elimination of internal border controls for all people;

b) measures to strengthen and harmonize external border controls: to enter the Schengen area all EU citizens must present an ID card or passport only;

c) a common policy on visas for short stays: nationals of third countries on the common list of non-member countries whose nationals need an entry visa (see Annex II of Regulation 539/2001) can get a single visa valid for the entire Schengen area;

d) police and judicial cooperation: police forces assist each other in detecting and preventing crime and have the right to pursue fugitive criminals into the territory of a neighboring Schengen; There is also a faster mechanism for extradition and mutual recognition of criminal judgments;

e) establishment and development of the Schengen Information System (SIS).

Although the Schengen area is generally regarded as one of the main achievements of the European Union, he is currently subject to considerable pressure as a result of unprecedented flow of refugees and migrants in the EU. Extremely high number of new arrivals has led a number Member States to reintroduce temporary checks at the internal borders of the Schengen area in recent months, in accordance with the Schengen Borders Code. An additional challenge to the movement of passport-free Schengen area appears as a terrorist threat increased attacks in November 2015 in Paris and March 2016 in Brussels demonstrating the ease with which persons suspected or accused of terrorism could not enter and to travel in the Schengen area.

Free movement of citizens within the European area offers both rights and obligations:

• For stays less than three months: the only requirement is that Union citizens have an ID or passport. The host Member State may require the persons concerned registering their presence in the country, in a reasonable time and non-discriminatory;

• for stays exceeding three months: the right of residence is subject to certain conditions: if not working, EU citizens and their family members must have sufficient resources and a health insurance to ensure that they do not become a burden on social services the host Member State during their stay. EU citizens do not need residence permits, but Member States may require to follow a procedure of registration with the competent authorities. Those family members of EU citizens who are not nationals of a Member State must apply for a residence permit for the duration of their stay or over a period of 5 years;

• permanent residence: Directive gives EU citizens the right to permanent residence in the host Member State after five years of continuous legal residence, in case have not seek any expulsion decision against them. The right of permanent residence is no longer subject to any conditions. The same rule applies to family members who are not nationals of a Member State who cohabited with a Union citizen for five years. Right of permanent residence can be lost only through absence of more than two consecutive years in the host Member State

• restricting the right of entry and right of residence for reasons of public policy, public security or public health: Union citizens or their family members may be expelled from the host Member State on grounds of public policy, public security or public health. Expulsion decision may be taken in any event for economic reasons. Measures affecting freedom of movement and residence must comply with the principle of proportionality and be based exclusively on the personal conduct of the individual concerned. Such conduct must represent a genuine and sufficiently serious threat affecting one of the fundamental interests of the state. Previous criminal convictions do not automatically justify expulsion. The mere fact that the entry documents used by the individual concerned have expired does not constitute grounds for deportation. Only in exceptional circumstances, where there are overriding reasons of public security, can take decisions of expulsion against a Union citizen who has lived in the country for ten years or who is a minor.

There not may be issued under any circumstances acts of expulsion valid for the duration of life of the person in question and persons subject to a decision of expulsion may request a review after three years. Moreover, the persons concerned have access to a way of judicial review and, where appropriate, a way of review of decisions in the host

Member State.

Even if freedom of movement is a fundamental right laid down in EU legislation, there were various difficulties and controversies, there is evidence of serious shortcomings in the implementation and persistence of obstacles to free movement. Directive 2004/38 / EC must be transposed into national law and implemented by all Member States.

For new countries acceding there is a so called transition period. Accession Treaty signed on 16 April 2003 allows the 15 member states "old" EU to apply the "transitional arrangements" to nationals of the Member States that joined the EU in 2004. This meant that citizens from 'new' Member States could be maintained some restrictions on freedom of movement on a transitional period of up to seven years from the date of their accession. For Bulgaria and Romania, the period lasted from 1 January 2007 to 1 January 2014 and for Croatia it shall apply from 1 July 2013.

An important part is played by European Parliament. Parliament submitted long efforts to support freedom of movement, which we consider as a basic principle of the European Union. Parliament calls on Member States to comply with the provisions of the Treaty on EU rules governing freedom of movement and ensure that the principle of equality and the fundamental right to freedom of movement are respected in all Member States. In the debate taking place at present on social tourism, Parliament strongly opposes calls from some European leaders modifying and restricting the free movement of citizens after the termination on 1 January 2014 transitional arrangements on the free movement of workers from Bulgaria and Romania.

Parliament also rejects any proposal to cap the number of migrants in the EU, which constitutes a violation of the principle of free movement of persons enshrined in the EU Treaty. Parliament calls on the Commission and Member States to ensure strict implementation of EU legislation so that all EU workers should be treated equally and not be discriminated against in terms of access to employment and labor, working conditions, remuneration dismissal and social and tax advantages. Finally, it reminds Member States that combating the misuse of social security funds take their responsibility, whether it is guilty nationals or other EU citizens.

As regards the pressure put on Schengen flow of refugees and migrants in 2015, Parliament, in its resolution of 17 September 2015 on migration and refugees, and reiterated its "commitment to open borders within the Schengen area, ensuring while the effective management of external borders "and stressed that" free movement of persons within the Schengen area is one of the greatest achievements of European integration. "

Access to labor market

Right to answer the job offers actually made is consecrated by Regulation No. 1612-1668. By adopting this law in all European Community countries employment regime has two characteristics:

- Firstly, through the care of the public service recruitment is now optional. Every a citizen of a Member State and any employer exercising any activity in the territory of a Member State may change requests and their offers of employment to contract work and to put them into execution under applicable law and without discrimination ;
- Secondly, to obtain the release of a residence permit, the employee shall furnish proof that he is the beneficiary of an employment contract by a declaration of employment or a certificate of employment provided by the employer.

Romanian citizens being nationals of a Member State, namely Romania, have the right to seek a job in another Member State. Receive the same assistance from the national employment offices work as nationals of that country.

In case is looking for a job, according to the European Court of Justice, can reside in a host Member State for a reasonable period of time sufficient to allow information about available jobs and performing steps needed for employment. After expiry of such period, Romanian citizen may be expelled if it turns out that he is seeking employment and employability are (for example, when job interviews scheduled).

After Romania joined the European Union, we have recorded a large number of citizens who have chosen to leave the country to work abroad. As from January 1, 2007 Romanian citizens can make this easier, entitled in that it provides citizenship: the right to work in Europe. However, for new states are introducing restrictions, restrictions on the labor market access to workers from the new Member States, is the way in which the old member states tried to protect their domestic labor by a possible wave of immigrants coming from these countries .

Labor market inequalities between Romanian citizens and citizens of the host country

Although equal treatment is a fundamental right in the European Union, is unlawful discrimination against gender, age, racial or ethnic origin, religion, there are times when there are inequalities, especially in the labor market. There are limitations on official access to the labor market, which are not considered inequalities, such as reasons of public order, health, security and public employment also some inequalities unofficial, that should not exist : reasons on the worker's age, language knowledge at an advanced level on home grounds.

An EU national working in another Member State must be treated exactly the same way as his colleagues who are nationals of that State regarding working conditions, covering for example pay, training, dismissal and professional reintegration. The disadvantage of migrant workers is seen as indirect discrimination.

The first inequality in comparison with citizens of the host country, that Romanian citizens meet when working abroad is the ability to communicate at a certain level of language that will not reach the level of others employer or colleagues. According to the European Court any linguistic requirement must be reasonable and necessary for the job in question, and should not be used as an excuse to exclude workers from other Member States.

Another inequality represents recognition of qualifications, automatic recognition of diplomas is provided only for a few professions, especially in the medical professions. A national of a Member State who is fully qualified to exercise a regulated profession (ie one that can not be practiced without certain specific professional qualifications) in one Member State may have the qualifications recognized in another Member State. However, if the training or field of activity of the profession in question is substantially different in the host Member State may require it to comply a period of adaptation or an aptitude test.

Migrant workers are entitled to the same tax and social advantages as nationals of the host Member State. The Court held that this means all the advantages which, whether or not related to a contract, are generally first granted to national workers due to their status as workers or by virtue of the mere fact of their residence on the territory national. Also, when there is a job open for competition, have priority citizens of the host country, as nationals of other European countries and third-country nationals are the last.

Inequalities can have a positive side, each state tried to protect its citizens, and to this end, all the measures taken are first to benefit citizens, even if these measures contradict the norms of equality promoted by European legislation area.

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From 1 January 2014, seven years after accession, were lifted labor market restrictions by some member states of the union European, Romanian citizens thus received the full right to work on the European territory of the union.

Among the countries that have removed restrictions for Romanian citizens before the deadline of seven are Italy, who shared the peninsula from 1 January 2012, Romanian citizens who had certain professional categories could work without requiring a work permit, Germany opted for gradual opening of the labor market for certain categories of work (construction industry, including related branches, activities cleaning of buildings, university graduates and their family members, workers accepted into the training system).

The existence of restrictions at the time did not mean that the Romanians could not commit, but that employment could be based on a work permit obtained by the employer from the local authorities.

Romanian citizens currently enjoy the right to work in all European countries without any restrictions. But Britain is one of the countries which imposed conditions to work in the country, not only for Romanian citizens and for citizens of member states. These conditions were imposed after he had a storm of workers from Eastern Europe from the Member States of the European Union which joined in 2004, when Britain, Ireland and Sweden were the only one who did not impose any transitional period.

Another country in which Romanian citizens have special regulations is Switzerland. Most Europeans do not need a work permit to work in Switzerland, although not a member of the union is the European country, Switzerland and the European Union were signed over 120 bilateral agreements. After the accession of Romania and Bulgaria to the European Union, Switzerland and the EU have negotiated a protocol extending the EU Agreement - Switzerland on the free movement of people from the new Member States.

According to the National Agency for Employment, the agreement on free movement has been extended to these two new states on 01.06.2009. Initially, seven years after the entry into force of the Agreement, ending on 01.06.2016, there was a control of the labor market or limitations on the right of employment in Switzerland.

Although the free movement is unrestricted, will overlap the first three years, until 2019, the period of special protection clause that permit reducing the number of residence permits, in terms of immigration too strong. These transitional provisions are designed to ensure a gradual and controlled opening of the labor market.

Priority in employment have Swiss citizens and the EU Member States that joined the EU earlier, a Swiss employer can hire a Romanian worker, only if he proves that for the work in question has not found a Swiss citizen or in other Member States that joined prior to EU . The employer must justify why that job can not be filled by a Swiss worker or the other Member States. Justification is the proof job advertising, organizing interviews or contest for the position. From 06/01/2016 Romanian citizens have the right to work in Switzerland, Romanian citizens access to the Swiss labor market is no longer within quotas

Romania is a country of emigration, every year it increases the number of Romanian citizens leaving the country. According to statistics, the number of Romanian citizens abroad for at least 12 months residing in Romania on 1 January 2013 was approximately 2.3 million people.

Labor migration within the European area must not be approached as a negative phenomenon, influencing Romania decreasing demographics. Labor migration for the country of the origin decreases the rate of unemployment which leads to higher wages, recorded revenue growth by transferring migrants, many citizens migrants tend to return to the country invest monies and implement improved qualifications. Destination country for migration also has a positive effect by increasing human resources, a developed country will always need foreign labor force. Therefore, in addition to negative, labor migration is a positive for both parties.

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Incompatibilities: significance, normative support, critical views

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Abstract

In recent years, the Romanian society, especially in the political or administrative area encountered different incompatibilities, which have become a common concern for both directly involved and for the public. Legislative bans deployment for simultaneous activities in a particular period of an activity or the notion of incompatibility of offices have produced various legal effect. Sometimes it has been claimed that some issues aimed limits or unclear legislative support or different interpretations, but factually it was confirmed that their field is one of imperious matter. For its management solutions have been created in a large national way by creating an autonomous central administrative structure whose main activity aimed largely the problem of incompatibilities. If such a concern is natural, or at least useful, perhaps a greater focus on aspects of prevention and guidance would be more effective, in a public system already affected by internal and external problems.

Keywords: incompatibility, public servants, legislation, public administration

The topic of incompatibilities is not of absolute novelty in the Romanian legislation, since it has had legal foundations starting some years ago. However, primarily in the last decade, as never before, the phenomenon has either reached immense amplitude or, similarly unprecedented, the focus has been placed of this issue. Either way it may be, we Romanians have been prepared. Hence the old saying, from popular wisdom, "priest and thief, one cannot be both", destined seemingly to underline or foretell in an entirely popular language the accumulation of functions, attributions and activities, in certain situations and by certain determined persons. The issue of incompatibilities, regulated in certain situations even through fundamental norms, opposable to those that make-up high level Romanian authorities or institutions, becomes with each day a more consuming preoccupation for the legislative body but also for the entire administration and, without doubt, for each and every person since, one way or the other, every citizen is to some degree tangent to the local, or hierarchically superior, administrative act. Law has been created to protect individuals and these, by means of legal provisions, have been recognized freedoms. At the same time, in order to promote and protect the interest of society, through law, therefore through the very quintessence of social order, behavior constraints have been put in place for all members of society (Kelsen, 2000; Dănişor, 2011). The idea behind this mechanism is that of protecting social life in general and by way of consequence, to allow the individual to coexist with its peers, sharing the same values, enjoying the same freedoms and having similar categories of restrictions or responsibilities of social nature.

In the year 2003, after more series of discussions after opinions, some of these inspired from the mass-media or arising from the civil society, the legislative body of the country, the Parliament, adopts Law no. 161/2003 on certain measures to ensure transparency in performing high official positions, public and business positions, for prevention and sanctioning the corruption. As expected, the legislative act began to be implemented more and more energetically, generating in the same time criticisms, some of which were considered fair, others less so. It is important to underline the fact that the legislative act, although altered more than one time, continues to still be in force and produce effects even today, being therefore opposable to meaningful and numerous categories of high officials and other state public servants. It has somewhat represented the beginning in this field. In order to ensure the efficiency of the measures set to prevent and sanction the regime of incompatibilities and not only, an institution was created, with the following object of activity: identify fortunes that cannot be justified and situations of incompatibility but also other irregularities pertaining to official public attributions or the area of criminal legal provisions. The institution in question is the National Integrity Agency (N.I.A.), central autonomous administrative institution that for years has enjoyed positive reviews both internally and externally. However, there have been criticisms brought against N.I.A, not further in the

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past than 2014 when a candidate for the office of European parliamentary, while being in an open conflict with the agency, obtained a very good result, even for more than one political formation. The situation of the person in question was perceived by a large part of the electoral body as not normal and unfair and the rebuttal of the electorate was to measure. The creation of this agency was possible after the revision of the fundamental law and its activity has been possible also due to the fact that “decision-making liberty implies for the bodies in question an increased capability in taking the measure that they consider to be opportune in their own activity, without any containments towards the position the hierarchically superior bodies might express” (Manta, 2014). Nonetheless, the present paper does not focus upon this aspect and not even upon the organization or functional issues of the Agency. The text concentrates in broad lines upon the legislation in the field of incompatibilities, the effects and the impact of these legal provisions, of an administrative and sometimes even criminal nature, in certain situations.

Previous to Law no. 161/2003, Law no. 78/200 was adopted, for the prevention, discovering and sanctioning of corruption acts. According to the provisions of this legislative act, actions carried out for the purpose of obtaining gains under different forms, under the form of acts of commerce that are incompatible with the function, with the attributions or the assignments that a person has, are incriminated, if the actions are done by using any pieces of information obtained through the office detained (Law no. 78/2000 for the prevention, discovering and sanctioning of corruption acts, art. 12, letter a). In other words, incompatibilities can generate even legal liability issues of a criminal nature, by reference to the provisions of the law adopted in 2000. However, the general legal regime of incompatibilities will find extensive provisions in the law adopted three years later and in the succession of legislative acts that would follow either to alter it or to consolidate the legal frame-work in the field.

Incompatibilities refer to those situations when a person detains a certain positions or carries out, itself or through a relative or kindred, an activity in the same time or during a period when the same person holds a public office or is a high rank official or other assimilated positions. In the light of the aspects previously presented but also taking into account the general context and the climate created in the last decades in our country, the Romanian legislator has decided that those that hold a public office, high rank offices or offices assimilated to these, after certain criteria, both at their investment and at the end of any sort of mandate of office, must fill-out and make available two types of declarations that, although have a personal character represent public documents. These two are the declaration of fortune and the declaration of interests. More than once a year, these two must be renewed or updated whenever the case after certain procedures and in certain dead-lines that are expressly provided for by the law. In the field of incompatibilities, to remain within the chosen topic, a direct interest presents the document entitled declaration of interests, drawn up and deposited in accordance with those indicated.

The obligation to draw up this document is opposable to approximately 40 categories of public servants, high officials, magistrates, persons that are nominated into certain offices or candidates or functions that are assimilated to these ones (Law no. 176/ 2010, republished, regarding the integrity in exercising the public officials and dignities, in order to modify and complete law no 144/2007 regarding the establishment, organization and operation of the national integrity agency as well as for the modification and completion of other normative acts, art. 1). Among these the following are expressly nominated: the president of the country, members of the governments, members of the parliament, magistrates, local elected and candidates to the eligible nominated offices. Thus, the enumeration reunites a large and varied scale of persons that detain decision-making powers in those activities that have a public nature, on the territory of the Romanian state. If this document is not deposited within the indicated time-frame or is not deposited at all, the person in question can be subject to pecuniary forms of sanctions and, in the same time, other control procedures that can be undertaken. More so, the public nature of this document implies yet other obligations, such as to bring to the knowledge of the citizens, with all the consequences that derive from such an act, having this trait.

However, the declaration of interests represents merely a presentation of the situation the person that draws it up is found in, a presentation of the activities carried out. The foundations of the regulations in the field of holding more than one public office or high public office or exercising certain activities while holding a public office are expressly provided for and have many times been subject to debates within the parliament and also in the mass-media. Many cases have been brought before the constitutional contentious court and the sole political-jurisdictional institutions of the country has each time given a decision by referring to the limitations set through the provisions of the fundamental law. Incompatibilities are applicable to more categories of persons, among which are numbered also the magistrates, members of the parliament, members of the government but also of central or local subordinated authorities, local officials, public servants and other persons from central autonomous administrative authorities, such as the Romanian Court of Accounts, the Romanian Intelligence Service, the National Audiovisual Council of Romania, The Ombudsman and other legal entities.

Perhaps the most spectacular incompatibilities brought into the light by the Romanian mass-media, following their identification by the institution especially established to this purpose or perhaps even confirmed through decisions of the courts of justice themselves, have been those concerning members of the government, members of the parliament or local elected, with priority those that ensure the executive leadership at county level or the level of big urban towns.

The first office in the Romanian state, besides the fact that confers immunity to its holder, according to the fundamental law, it is in the same time impossible to cumulate with any other offices or positions, be they public or private (Romanian Constitution, art. 84.). Therefore, the office of head of state is incompatible with any other office and this means that the head of state is forbidden from any accumulation of offices, for those regulations that allow certain other activities for those that hold public office are not opposable to the person holding the office of head of state. If we add to this the fact that the president holding office is forbidden to be a member of a political formation, including the one that offered support in the electoral competition to win the office, the interdiction to hold cumulatively one other office besides the one of head of state represents a legal provisions founded upon an adequate legal reasoning.

The President of Romania, during the years of mandate, cannot cumulate the supreme office in the state with any other office or position and this interdiction refers to both public and private offices and positions (Popescu E, Manta C, Răcean M, Şuţă V, 2010).

Certainly, we cannot talk about perfect legislation and the counter-arguments can be multiple, including the fact that the involvement from this position of the head of the state in a certain field of activity, from a possible executive stance, can lead to positive results. However, from the position of president, the holder of this office can participate and lead certain activities, some having a special character and others carrying throughout the entire period of the presidential mandate. For example, the fact that the president is the commander of the Romanian armed forces has not been considered as an incompatibility but, on the contrary, as a strategic position, expressly provided in a fundamental provision. The same is true for the position of president of the Supreme Defense Council of the country, position that the president holds throughout the terms of the mandate. Therewith, the president presides the sessions of the Government or of the Superior Council of Magistracy, whenever present at their sessions. However, these situations are quite rare in practice. The incompatibility of the supreme office in the state refers to other offices, remunerated or not, with the exception of those qualities that derive from the constitutional attributions of the presidential institution, including the types presented in the previous paragraphs. On the issue of immunity, this aspect does not belong to the topic approached in this paper. However, it is necessary to make a determination, that the president of the country, as concluded from the interpretation of the criminal legal provision in force today, at least during terms of office or offices, becomes almost infallible, since, in theory, the president can be found guilty solely for the crime of high treason, although there has been a period during which this deed was not even incriminated expressly through criminal legal provisions. At the level of the legislative power there have also been legislative acts that established a few interdictions, regarding the accumulation of the office of member of the parliament with other offices or high public offices or the carrying out of certain activities. First, it must be mentioned that a person cannot hold simultaneously the office of senator and deputy. Even if following the revision of the fundamental law, the parliamentary chambers do no longer hold the same attributions and each of them has the final decision in the adoption process of legislative act on certain fields of activities.

The constitutional text expressly forbids any member of the parliament to hold any other office of authority, the sole exception (Romanian Constitution, art. 71) provided by the law referring to the permission for a Romanian parliamentary to be in the same time, a member of the Government therefore a ministry. This exception has been the cause of numerous criticisms, especially from the public servants or different associations of public servants, who complained that although at the level of the public office incompatibilities are almost inflexible, without hardly any exceptions, at central level, however, one and the same person is permitted, by the fundamental law itself, to hold simultaneously, both the office of minister and the office of member of the parliament. In this context, it is our belief that another aspect, in connection with the issue of incompatibilities in the public field must be taken into consideration. To prove my contention, I would like to start with the first article of the revised Constitution, where the principle of the separation of powers under state organizational aspects is expressly provided for. Two of the three powers, in the order of the enumeration, are the legislative and executive ones. Or, when a member of the unique legislative authority is, within the same chronological time-frame, also a member of the main executive body of the country, we naturally ask ourselves whether the principle found in the beginning of the constitutional text is not in discord, to some degree, with the provisions from the same fundamental law that allows the accumulation of these offices. Naturally, there are opinions in the scholarly doctrine that confirm the fact that such an accumulation, although permitted by the fundamental law, is in contradiction with the fundamental principle earlier invoked. This is the opinion that we also sustain, not out of a critical spirit aimed at the accumulation in parallel of the two offices, but merely out of the interpretation of the fundamental legal provisions invoked.

There are states, in the world, that allow the accumulation of these types of offices and states that forbid it. This does not imply, however, that any of these models is superior over the other. They represent simply means of organization and are aspects pertaining to national law. There are yet other incompatibilities provided by the law concerning members of the parliament. Actually, reported to the legal provisions in the filed, these are only allowed to cumulate certain types of activities, such as the ones in the teaching, artistic creation and scientific research fields. We can find some interesting provisions concerning the possibility of a member of the parliament to exercise the profession of lawyer. The normative regulations do not forbid members of any parliamentary chamber to exercise the liberal profession of lawyer. However, for reasons pertaining to the need of keeping a balance in front of justice and for the purpose of avoiding certain interferences, those lawyers that are members of the parliament are forbidden, among others, to plead in front of courts of reduced territorial and material competence, such as local courts of justice and tribunals. Similarly, they cannot represent or assist or even offer legal assistance to persons that are suspected or under investigation for corruption crimes or actions assimilated to corruption or other crimes such as person trafficking, drug use, money laundering, crimes that threaten national security, crimes against humanity or that concern the carrying-out of justice (Law no. 161/2003, republished, art. 82). The reason behind establishing such interdiction for lawyers that are in the same time members of the parliament might have consisted, we think, in the desire to avoid the influence that these, due to the high public office they hold, might exercise or even create the impression that they might exercise, taking into consideration the social impact and the gravity of the crimes previously mentioned. The same considerations can be maintained for the interdiction of pleading at the level of local and county courts.

As far as the members of the government are concerned, there exist a series of incompatibilities in the form of the interdiction to cumulate this office with others and exercise certain activities. Still, it is necessary to point out, once again, that the position of minister or prim-minister, in the condition already presented previously, set by the Romanian legislation, is compatible with that of member of the parliament. On the interdiction chapter, we can mention the fact that a member of the government cannot, in the same time, hold positions such as: representation at professional level or on behalf of the state or management position at enterprises or public institutions, as well as be a trader as natural person or be a member in an economic interest group. On the other hand, it is expressly permitted for a member of the government to carry out the same activities permitted for the members of the parliament (teaching, scientific research, artistic creation) and, in exceptional cases, even to represent the state at the level of collective forums in different structures of strategic or economic interest. (Law no. 161/2003, republished, art. 84). Since the government is the state structure that exercises the executive power, it practically coordinates the entire state administration and therefore has, at the level of each county, its own representatives, organized in the Prefects institution. At the level of these institutions, for the office of prefect and vice-prefect, certain interdictions have been expressly provided in the field of office accumulation or of carrying out certain other activities. More so, these officials belong to the category of high public servants and therefore the statutory provision concerning this category of public servants of the Romanian state become incident.

Therefore, the prefect or vice-prefect of a county cannot hold any other elected office within the local administration or at parliamentary level and, in general, the interdictions specific to members of the government exist also for this category of public officials, since their activity is in direct link with that of the executive.

Under a political approach, through the creation of this category of high public servants the final goal pursued was that of de-politicizing the process of occupying the management positions within the County Prefectures so that there wouldn’t be a need any longer, as a consequences of governmental rotations generated by election, resignations or a carry-of-confidence vote, to immediately replace the persons that hold the offices previously indicated. However, although the legislation has been amended to this end and the office from the management of the Prefecture are no longer conditioned by the political criteria, being professionalized, in practice, to great extent, the procedure of replacing the prefects in office by each governmental cabinet has continued and still is undergoing today so the purpose of the legislative act has not been entirely reached.

Analyzing the series of incompatibilities provided in the legal provisions, for high public official and public servants that carry out their work either at central level or lead state institutions at local level, brings out, without any doubt, the fact that these sort of interdictions have also been set for the local elected and the public servants at the level of the local public administration. Through the fundamental text, the local public administration includes county councils, local councils and the mayor (Romanian Constitution, revised, articles 121 and 122) and, naturally, any structures created or subordinated to these are assimilated to local public administration. The county council extends its local administrative competence over each county, with the exception of the capital of the state where a general council functions. The county council is led by a president and two vice-presidents. In approximately a quarter of a century from their set up, after the change of the political regime in 1989, the office of president of the county council has been held following two types of elections procedures: either indirect elections, meaning that the citizens with the right to vote elect the county councilors as their representatives within this institution with deliberative attributions and the county councilors elected their president, or direct elections meaning that the president of the county council is elected by all the citizens of the county through a direct election process, just like in the case of the mayor. In present, the first procedure is functional, according with the legislative amendments from the previous year. Concerning the vice-presidents of the county council, these have always been elected through the votes of the county councilors validated in office. The General Council of the capital as well as the councils of all six sectors of the capital, all these administrative structures are led by a general mayor and general vice-mayors, respectively mayors and vice-mayors for each sector. For all other administrative structures: municipalities that are county residences, municipalities, cities and communes, there exists a mayor in office, elected by the citizens with the right to vote and, as is the case, by one or two vice-mayors for the bigger structures, the latter being elected by the local councilors in office. For all these categories of high public offices with a local character, the law has established more types of incompatibilities, throughout the duration of the mandate so that those persons that get to hold, after an elective process, one the previously showed titles at the level of local administration management, will not be permitted to carry out many other types of activities or to hold other offices or positions. If these persons in question hold a position or are carrying out other types of activities at the moment of their election they must give up the first ones or else can become liable for sanctions of an administrative nature concerning the possibility to hold in the future management positions in the public system.

Pursuing the steps of local public administration, after analyzing the leadership structures and offices within the county councils we need to take into consideration those that effectively ensure local management. On the issue of incompatibilities, there are legal provisions that regulate this topic also for the mayors and the vice-mayors, legal provisions with a prohibitive character, sometimes even interpretable as is also the case for other categories of public servants, if we take into consideration the relatively high number of trial cases brought before the courts and the different solutions generated by the courts. All territorial-administrative units are led by a mayor and a vice-mayor with the exception of those cities that are county residence and the capital of the country where their number is higher.

The interdictions of carrying out other activities or holding other offices or attributions are valid for all mayor and vice-mayors. Therefore, they are forbidden, during the terms of high public office, to be a member of the parliament, a member of the government, a local or county councilor, a prefect or vice-prefect in any county, to have a decision-making position in national companies, public societies or institutions, even from the positions of member of the board, to have a decisions-making position in an enterprise or to be a representative at certain types of societies or to simply hold any other remunerated positions, not within the country nor outside national borders. The one exception permitted is to carry out teaching activities or within non-profit organizations. Under a pure normative aspect, the mayors and their rightful replacers are forbidden, during their mandates, to carry out any commercial activities or to be involved in the structures of groups that promote different economic interests (Law no. 161/2003, republished, art. 87). Legal provisions have been and continue to be a debate subject for the mass-media and the scholarly literature. At times, it has been stated that the restrictions are numerous and diverse to such degree that the mayor, since forbidden to carry out any other types of activities and taking into account that the remuneration in the public system is not high, is tempted to resort to fraudulent actions or even be determined to violate the legal regime of incompatibilities. Other opinions, closer to the reasoning of the legislative at the moment the law was passed, approach a completely different attitude and consider that by setting these kind of restrictions, the local elected will not be able to by-pass the law and obtain other types of benefits during terms of office. Perhaps the second solution would be more logical if the persons in question would have ensured wages and everything adjacent to wages and not fix allowances and if the regime of incompatibilities would generate yet other benefits as is the case of other categories that have set incompatibilities. On the other hand, paying these persons with an allowance although they carry out a primary activity, incompatible with almost anything else, without creating a special status that could compensate the general restrictions generated by incompatibilities represents an arguable legislative approach, to say the least.

Since there are restrictions put in place, under the form of incompatibilities, for high public office holder at central level as well as for the elected leaders, and not only, at the level of counties and of cities, similar legal provisions, though not identical, have been adopted for other categories of local elected. This is the case of county and local councilors. For both categories, there are restrictions put in place, through prohibitive legal provisions, so that during their mandate they are forbidden to: run the city hall or the prefecture since they cannot hold the office of mayor or vice-mayor, of prefect or vice-prefect; they cannot, regardless of their denomination, lead enterprises, public companies or other legal forms of local or national interest that are assimilated whose head-quarters or secondary offices are on the territory of the administrative-territorial unit in which the person in question is a local councilor; in the same time, they are not permitted to be public servants in any public institution or even hired within the institution itself on the basis of an individual work contract; obviously, just like in the case of other categories of local elected, the county and local councilor is not permitted to hold any high public offices at central institutional level, such as member of the parliament, minister or others assimilated. More so, one the same person cannot hold, simultaneously, the position of county councilor and that of local councillor (Law no. 161/2003, republished, art. 88). The legal regime of incompatibilities establishes yet other restrictions, including by reference to the degree of blood relations as well as family relations or by virtue of other activities that can generate, at least under a subjective approach, negative consequences under integrity standpoint.

The apparition of so many regulations in this field and especially the fact that there are institutions specialized on this issue, as well as the creation of a case-law in this area represent aspects specific for the last two decades or even less. Never before in the Romanian administrative life has the focus been so strong on the issues of incompatibility, not under a normative nor an institutional point of view. These sort of legal interdictions have not been put in place solely for the persons elected into high public offices or public offices or for the category of high public servants, as perhaps it may be interpreted out of that previously exposed. There are present incompatibilities set including for the public servants and for the magistrates and for yet other professional categories, some of which are provided for in the general laws that regulate that particular profession or the statutes of those professional categories, such as is the case of lawyers, or militaries etc. Concerning the sanctions instituted through these prohibitive legal provisions belonging to administrative law, many disputes arose after the entry into force of the legislative act and many tendencies to amend the law have emerged. The sanction provided for the person that is found in a situation of incompatibility is of a disciplinary nature and consists of the interdiction to hold a public office for a period of three years, except elective ones. In those cases when the person in question holds such offices the interdictions also applies the interdiction to occupy any other office for the same period, according to the Decision of the Constitutional Court no. 418/2014. Even if the person in question, by the time the state of incompatibility is found, after all the procedures are covered or even after a decision by a court of trials is given that is susceptible to be enforced, no longer holds the public office or high office, the interdiction still is applicable and has the same duration of 36 months (Law no. 176/2010, republished, art. 25). Sanctions of an administrative nature belong either to the disciplinary or contravention sphere and hence are characterized by a lower impact compared to criminal sanctions. However, certain administrative sanctions have accentuated legal effects for the person being applied to by comparison with other types of sanctions such as the termination of the individual work contract on disciplinary grounds, dismissal on disciplinary grounds of a public servant or the payment of a fine in large amount. Even the type of sanction we analyze, the interdiction to occupy a public office or function for three years, represents however a fairly tough sanction. If we take into account and add up the loss of the held position, lack of wage or allowance for the following three years and the impossibility to occupy any other decision-making position, or even the lack of employment possibilities at all, the pecuniary effects of all these measures combined upon a person are hard to be ignored.

In order to ensure the public nature of the status of a person that holds a public office or high public office from those enumerated above and other provided through legal provisions in force, all those that are in this situation must fill out a document called Declaration of interests at the moment they occupy that public office/high office.

This represents a document with a public character that can be consulted by every person interested and can be displayed at the headquarters of that public institution. It is mandatory for all public institutions to upload it on their own web-site. At the beginning of July 2016, on the web-site of the National Integrity Agency, the section dedicated to these declarations contained a number of 6.388.185 declarations of interests and of fortune (https://www.integritate.eu/ situation available at 01.07.2016 (accessed 05.07.2016), put at the disposal of the on-line visitors.

Incompatibilities represent at present regulations that must be taken into account by all those that carry out activities of public nature within a state unit in order to prevent the negative consequences of the indicated sanctions. However, there are many persons, either from the legal literature or the public life that request new legislative amendments, as *lege ferenda*, for the purpose of developing also a prevention activity in the field, prevention that is followed by sanction if the person found in an incompatibility situation would neglect the indications offered by the institution specialized in the handling and identifying process of incompatibilities. Therefore, such references could become in the future applicable legal provisions and the effects could be even better for both the person in question and the institution it works for or the agent that identifies them. Bottom line, a good public servant that due to its competences is requested in more activities is dislocated from the system, although its place and role are in the end benefic for the public unit where that public servants carries out its primary activities.

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Trends values of HDI Index transitional countries of the Western Balkans

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Abstract

The subject of the paper is the analysis of Human Development Index (HDI) trends based on the indicators of the life expectancy at birth, mean years of schooling, expected years of schooling and GNI per capita - PPP US$. Taking into account the accomplished HDI index results, published in the Human Development Report in 2014 by the United Nations Development Programme (UNDP), the paper starts with the hypothesis that there are deviations of HDI index values in dependence on differences in values of particular indicators. The aim of the paper is to show the multiple significance of HDI index application, as well as the position of the national economy of Serbia both in the world and in relation to the countries of the Western Balkans.

Keywords: Human Development Index, education, United Nations Development Programme, national economy, the Western Balkans

1. Introduction

Developmental problems cannot be explained solely by economic indicators and cannot be just simply interpreted through economic disparities. Dynamic processes and intensive changes in the overall societal, political, economic and social background determine and multiply developmental specificities, thus making the process of measurement and interpretation of developmental differences a problem of much greater complexity.

Until the beginning of 1990s, gross domestic product was automatically used as a sole indicator of the accomplished level of development (Hastings, 2009). The development of society in its numerous segments (demographic, economic, social, technological, information etc.) has overgrown the development measuring concept based on only one economic indicator – GDP (Dasic, 2011). Subsequently, a number of new indicators have been formed (including HDI index) – they track changes in growth and development of an economy more comprehensively, multi-dimensionally and from many various aspects.

2. Methodology

In order to estimate progress in realization of numerous aspects of human development it is necessary to analyze a whole spectrum of indicators (Jakopin, 2007). "Human Development Index" was first developed within UNDP, in 1990; it has become the most widely used complex indicator suitable for international comparisons and estimations of the accomplished development level of a particular country and has been published annually ever since, as a Human Development Report. The words "People are the real wealth of a nation" from 1990 Human Development Report marked the new approach to reflections on development (Ferjan, 2014). Increase of the assortment of instruments for measuring a multidimensional, composite HDI index is "the result of application of modern analytical concepts which measure their economic, social and demographic capacities" (Republic Institute for Development, 2013). Klugman, Rodriguez & Choi explain how are calculated indicators measuring HDI index (Klugman, Rodriguez & Choi, 2011; Dašić, 2012).

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The latest Human Development Report 2014 contains the calculated HDI indices for the period 1990-2013 which enable comparison of data among countries, as well as monitoring of trends from the previous period.

HDI value, which ranges from 0 to 1, shows the span that the given country has covered moving towards maximal value, which enables comparison with other countries. The difference between realized and maximum possible value of HDI index aims at showing the shortcomings of that country, whereat it is each country's challenge to find the way to reduce those shortcomings, i.e. to bring them as close to maximum value as possible. Even though HDI index represents the indicator which ranks countries according to the level of human development, it will never be able to encompass human development in its full sense (Kovacevic, 2011).

3. Value and Ranking of HDI Index – Results and Discussion

3.1. HDI index trends on the global level

In recent times, the increasing values of certain human development indicators have been observed in a large number of countries, i.e. the accomplished improvement of HDI index is greater than it was expected. The progress accomplished in all spheres of living (technology, education, increase of income etc.) is constantly providing better chances for longer, healthier and safer life. However, in the world nowadays there is also a widespread feeling of insecurity – regarding survival, personal safety, environment and world politics. Table 1 presents the worldwide HDI values in 2010 and 2013 per groups of countries, with particular countries classified in human development country groups as follows:

- - very high HD countries,
- - high HD countries,
- - medium HD countries and
- - low HD countries.

The values of individual components which constitute HDI index are given as well.

Table 1. Human Development Index and components, 2010 and 2013. (UNDP, 2014)

Human development groups and the world (average)		Very high HD	High HD	Medium HD	Low HD	The world
HDI value	2010	0.885	0.723	0.601	0.479	0.693
	2013	0.890	0.735	0.614	0.493	0.702
Life expectancy (in years)	2010	79.7	73.9	67.1	58.2	70.3
	2013	80.2	74.5	67.9	59.4	70.8
Mean years of education	2010	11.7	8.1	5.5	4.1	7.7
	2013	11.7	8.1	5.5	4.2	7.7
Expected years of education	2010	16.2	13.1	11.3	8.7	11.9
	2013	16.3	13.4	11.7	9.0	12.2
Gross national income per capita (2011 PPP US$)	2010	38,548	11,584	5,368	2,631	12,808
	2013	40,046	13,231	5,960	2,904	13,723

High HD group includes 49 countries. According to HDI value and all indicators, Norway is ranked the first (0.944). It is followed by Australia (0.933), Switzerland (0.917), the Netherlands (0.915), the USA (0.914), Germany (0.911) etc. Out of former Yugoslavia countries, Slovenia (0.874) ranked 25th and Croatia (0.812) ranked 47th belong to very high HD group.

There are 53 countries in high HD group, including all the countries of the Western Balkans that are not EU members. Montenegro is ranked 51st (0.789), Serbia 77th (0.745), FYR Macedonia 84th (0.732), Bosnia and Herzegovina 86th (0.731) and Albania is the worst ranked –95th (0.716).

Medium HD group includes 42 countries, and low HD group includes 43 countries. The following countries are the worst ranked out of all countries: Central African Republic ranked 185th (0.341), Democratic Republic of Congo ranked 186th (0.338) and Nigeria ranked 187th (0.337).

There are a lot of reasons for slowdown of overall social development: financial crisis, wars, natural disasters, climate changes, oscillations in food products prices. Long-term vulnerability is one of the main threats to the social development. There are 1,650 million poor people in the world who live in bad living conditions (short life expectancy), without access to educational and health care system (Alkire & Santos, 2010). Helen Clark, administrator of the UNDP says that "only if we eliminate the causes of vulnerability will everyone have the opportunity to take part in progress, and that will make social development more equitable and sustainable" (UNDP, 2014). Subsequently, reduction of poverty and elimination of vulnerability should be the main topics of discussion about sustainable development goals.

3.2. HDI index trends for Serbia

As previously specified, the value of HDI index for Serbia for 2013 is 0.745 (category of high human development) which ranks us 77th (same rank as Jordan which has the same HDI value) out of total of 187 countries and territories. The HDI of 0.745 that Serbia had in 2013 is above the average for the countries in high HD group which was 0.735. Compared with 2012, when HDI index was 0.743, Serbia achieved a positive trend in 2013, moving one rank ahead.

In the period between 1990 and 2013, the value of HDI index for Serbia increased from 0.726 to 0.745. That is a 2.6 percent increase or the average annual increase of about 0.11 percent. Table 3. give the review of progress made by Serbia per each of the HDI indicators.

Table 3. HDI index trends for Serbia based on consistent data series and new limit values (UNDP Serbia, 2014)

Year / indicator	1990	1995	2000	2005	2010	2011	2012	2013
Life expectancy at birth	71.5	71.8	72.1	72.8	73.7	73.8	73.9	74.1
Mean years of education	8.0	8.7	9.2	9.4	9.5	9.5	9.5	9.5
Expected years of education	13.6	13.6	13.6	13.6	13.6	13.6	13.6	13.6
GDP per capita (2005 PPP US$)	14,264	6,151	7,820	10,122	11,287	11,445	11,030	11,301
Value of HDI index	0.726	0.692	0.713	0.732	0.743	0.744	0.743	0.745

The indicator “life expectancy at birth“ in the period 1990-2013 increased for 2.6 years, the indicator “mean years of education“ increased for 1.5 years and number of “expected years of education“ remained the same. Gross national income per capita for Serbia decreased from 14,264 PPP US$ (1990) to 11,301 PPP US$ (2013), i.e. for about 20.8 percent.

The improvement of HDI index value and overall further human development of Serbia can be accomplished by the reduction of poverty, modernization of health care infrastructure, improvement of education conditions, increase of literacy and improvement of computer literacy.

3.3. Comparative analysis of HDI index for the Western Balkans countries

In this part of the paper, a comparative analysis of HDI index of countries of the Western Balkans has been done (Table 4) which included Croatia, which is a member of the European Union, and Montenegro, Serbia, FYR Macedonia, Bosnia and Herzegovina and Albania which are still not the members of the European Union.

Table 4. Comparative analysis of HDI index of the Western Balkans countries (UNDP, 2014)

	Croatia	Montenegro	Serbia	FYR Macedonia	BIH	Albania
HDI rank	47	51	77	84	86	95
HDI value	0.812	0.789	0.745	0.732	0.731	0.716
Life expectancy at birth	77	74.8	74.1	75.2	76.4	77.4
Mean years of education	11.0	10.5	9.5	8.2	8.3	9.3
Expected years of education	14.5	15.2	13.6	13.3	13.6	10.8
GNI per capita (PPP US$)	19,025	14,710	11,301	11,745	9,431	9,225

As expected, Croatia, which is the member of the European Union, has the highest value of HDI index (0.812) within the observed group of countries, which ranks it 47th out of the total number of 187 countries for which the specified index is measured. In the observed group of countries, Croatia is the best according to the value of almost all indicators used for measuring HDI index. The exception is the indicator “life expectancy at birth“ where Albania has higher value than Croatia (77.1:77) and indicator “Expected years of education“ where Montenegro has higher value than Croatia (15.2:14.5). Croatia is far beyond comparison within the observed group of countries regarding the indicator “Mean years of education“ (11.0) and regarding the value of GNI per capita (PPP US$) which is 19,025. HDI index of Croatia had the same value both in 2012 and in 2013, so its rank remained unchanged. However, even though Croatia is a member of the European Union and regarding the value of GDP per capita (PPP US$) considerably better than the other countries of the Western Balkans which are still not members of the European Union, that does not mean that the other countries of the Western Balkans cannot have higher values and better rank of HDI index. The research of Konya and Guisan confirmed that some undeveloped countries managed to increase the value and rank of HDI index compared with some developed countries (Konya & Guisan, 2008).

Montenegro is ranked 51st according to the HDI index value (0.789). “The expected years of education“ is the indicator according to which Montenegro is far ahead of all the other countries included in this analysis (15.21). It also has the best position according to the value of GNI per capita (PPP US$) within the observed group of countries which are not members of the European Union (14,710). Montenegro improved its position in 2013 by moving one rank up compared with 2012 when its HDI index was 0.787.

The values of HDI index and its indicators for Serbia were explained in the previous part of the paper.

FYR Macedonia, with its HDI index value (0.732), is better positioned (84th) than Bosnia and Herzegovina (86th) and Albania (95th) which were also included in this analysis. According to the value of GNI per capita (PPP US$), FYR Macedonia is ahead of Serbia, Bosnia and Herzegovina and Albania and behind Croatia and Montenegro. Although FYR Macedonia has higher values of GNI per capita (PPP US$) and life expectancy at birth than Serbia, it is still not ranked better. This is due to the fact that Serbia is ahead according to the value of other HDI index indicators. This confirms the hypothesis that there are deviations in HDI index value in dependence on difference in values of particular indicators, and that in actual case it does not always have to be the case that the countries with higher level of GNI per capita (PPP US$) also have the higher value of HDI. FYR Macedonia also improved its position by moving one rank up in 2013 compared with 2012 when its HDI index was 0.730.

Bosnia and Herzegovina is ranked 86th with HDI index value of 0.731. The value of GNI per capita (PPP US$) of Bosnia and Herzegovina (9,431) is higher only that that of Albania (9,225) within the observed group of countries. Although the value of HDI index of Bosnia and Herzegovina in 2013 (0.731) is higher compared with 2012 (0.729), its rank remained the same.

Finally, Albania is the worst positioned country of the Western Balkans (ranked 95th) with HDI index value of 0.716, but it was nevertheless classified in the group of high HD countries. Albania has the highest value of the indicator "life expectancy at birth" (77.4) and the lowest value of GNI per capita (PPP US$) which is 9,225. With HDI index value in 2012 (0.714), Albania improved its rank in 2013 by moving two ranks up.

Based on this comparative analysis of HDI indexes of the Western Balkans countries, we can conclude that the inequality in income is in general more prominent than inequality in education and life expectancy. Similar conclusions were reached by Grimm et al. in research from 2008 (Grimm, Harttgen & Klasen, 2008).

4. Conclusion

All the countries of the Western Balkans that are still not members of the European Union belong to the group of countries with high Human Development Index, while Croatia, as a part of the Western Balkans that is a member of the European Union, belongs to the group of countries with very high Human Development Index. There are some considerable differences among the observed countries regarding the value of achieved GNI per capita (PPP US$). However, it does not always have to be the case that the countries with higher level of GNI per capita (PPP US$) have higher value of HDI.

The positive growth of HDI index has been the result of positive trends of all the elements, both the realized GNI per capita (PPP US$) and the indicators of "life expectancy", "mean years of education" and "expected years of education". All the countries of the Western Balkans need permanent and mild, but constant increase of indicators which comprise HDI, which would result in the advancement in human development. That can be accomplished only by adoption of comprehensive strategies and laws, realistic action plans and implementation route map, with the additional efforts which would insure the overall growth of all HDI components.

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Trend of economic development of Kosovska Mitrovica

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Abstract

Local economic development is not just a concept but a process, and as such it must have its own development path. The elements necessary for successful local economic development can be divided into several stages, of which the most important are: analysis of the state-research potential of human and natural assets of the municipality, the need of the level of development of infrastructure, study the process of passing local regulations, and municipal laws. In this paper is given an overview of current economic development in the municipality of Kosovska Mitrovica as well as future trends.

Keywords: economy; development; Kosovska Mitrovica.

1. Introduction

Kosovska Mitrovica is located in the northern part of Kosovo valley, before the entrance to the Ibar gorge. The area where the city is located is actually a small basin in the north of Kosovo Basin, which is to the south relies on branches Čičavica, it distances itself from the east to the southern branches of Kopaonik, with a northwest Rogozna branches. Otherwise, much of the town, especially the older of the two rivers confluence between rivers, Ibar and Sitnica, while the new part of the city link arm around Ibar. The city has a very favorable geographical position, because it is very well connected, through the Kosovo basin with the rest of the e m part of Kosovo and Vardar valley and the valley of the Ibar with Western Serbia and Montenegro.

After the war in 1999 and the adoption of Security Council resolution 1244 Kosovska Mitrovica municipality, due to ethnic conflict and expulsion of Serbs from the south side of the river Ibar, is practically a divided city. After a complex political process after 14 years of the signing of the Brussels agreement was obtained by chance that the northern part of Mitrovica and functional invocations as a whole, and grows into a modern municipality. Perceiving the boundaries of municipalities and analyzing the condition in which the municipality is a local government has launched a series of initiatives that include the improvement of living conditions of citizens.

2. Economic development of Kosovska Mitrovica

For Kosovska Mitrovica, as well as for the whole of Kosovo in general, is of great importance the communication of the Adriatic Highway Administration, which runs through the city and is the shortest path to the sea, which facilitates the marketing of goods to the world market, which is of great importance with regard to a certain part of the product non-ferrous metallurgy and generally the economy is placing on the world market. In addition Kosovska Mitrovica is located at the contact of different regional segments - Kosovo basin, which is extraordinary and rich in deposits of coal (lignite), an important source of energy and raw materials for the chemical industry, Kopaonik where are largest deposits of lead and zinc ores - Upper Ibar who is also known for its wealth of minerals and very important base of timber. Therefore, the first beginnings of industry in this area and are related to the administration of mining and forest exploitation.

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Origins of industry in Kosovska Mitrovica belong to the period between the two wars, beginning with the development of the timber industry, and later mining. The industry's first enterprise was a sawmill, was transferred from Moistira 1914, which later (1920 year) becomes, after mergers with several finansiera capital Belgrade, a joint stock company. After that (1935 year) was built and other mills in the electrical and drive to years in a day later, the city received a third sawmill. That same year was built the first factory of tiles and bricks. Utmost importance for the overall economic development in the period between the two world wars had on the re-activation e mining in an old mine Trepca, after a break over two centuries.

The deposits of lead and zinc, which have enabled the development of mining activities and other industries that are closely connected with it, which eventually resulted in that Kosovska Mitrovica grow into one of the most important center of industry in Kosovo and particularly industrial basin, an important metallurgical chemical center in the Yugoslavia. As a result of the growing interest of domestic and foreign capital for the exploitation of the mining potential of a more penetrating 1926. foreign capital. That year English geologists association Selection Trust Company starting exploration work in 1927 and more established enterprise Trepcha Mines Limited. Exploratory work has been guided by a very energetic and more on 1928, open the reserves of about 500,000 tons of ore. In August 1930, then began mining, reserves have increased to 1,750,000 tonnes of ore. The mine is up and running on the 14th August 1930, and flotation three days later. Naturally invested capital London Society Selection Trust Company made a huge profit.

To illustrate, here are the fact that the share capital amounts to 1.12 million pounds sterling in 1937, and in 1940 increased to 1,789,028 pounds. That same year, the owners of Trepca has brought half a billion of net income. Economic development continues in the postwar period, but in a different m socio-economic relations. The establishment of a socialist to the relations in our society occur very intense changes in the socio-economic sphere of Kosovska Mitrovica and the whole country in general. Mitrovica has become one of the most important carriers of economic transformation of Kosovo and the remaining countries in the continent. Of course, the further economic development of the industry based on the exploitation of groundwater resources lead zinc ore and associated metals, ie the metallurgy-based lead and zinc with the intention of developing the final industries that provided the raw materials used in this area.

As a result of this orientation, in addition to expanding existing capacity in 1964, started working fertilizer factory, which has in the meantime expanded the range of its products and grew into an important center of the chemical industry in our country with about 900 employees. 1967 started with the manufactory zinc electrolysis (about 800 employees), which also uses the basic raw materials of the area. Plans for development of these organizations are very ambitious, just the access expansion in capacity so that if the volume of production increased from instead of the current 30,000 tonnes to 80,000 tonnes of zinc. Within its works plant produced sulfuric acid, whose production volume moved at about 126,500 tons per year (1977 year). That same year plant began to produce car batteries (about 1,000 employees) which annually produces over 15,000 tonnes of batteries with a tendency to increase production to 20,000 tonnes (1980 year).

It should be noted that all these facilities were built on a complex south of the town, at the exit to the Kosovo valley. The rapid development of Kosovska Mitrovica has caused a strong migratory movement of the rural population and the surrounding population from poor areas to the city, which was reflected in the rapid growth of the urban and suburban population and the development of the city as an urban center and the satellite settlements. The strong development of industrial structures was not an appropriate extent associated also need to respect environmental laws environment. The main mistake was made in the deployment of the industrial plants, which are located in the city. In fact, the city itself is pinched between the two industrial complexes. In the north of the city in the Ibar gorge was built in the industrial complex in Zvečan (Smelter, Refinery lead, sulfuric acid plant, flotation and thermal power plants), while the southern part, the output of the Kosovo valley close friend and complex industrial plants (Factory of zinc electrolysis, chemical industry battery factory), which took the most fertile land. In addition, this deployment of the industry indicates that while deciding the location of the industry has not had the insight and the potential impact of meteorological elements.

2.1. Municipal administration

One of the most important institutions operating is the municipality's Office of Economic Development. The office is staffed by trained and proactive employees and provides full support for business and economic development in the municipality. In close cooperation with the municipal business center, the municipal administration provides a wide range of business services, starting from business registration services up to full scale of investor support. Administration places great emphasis on eficiancy. All requests coming from the business community are processed with utmost speed and care, so that all needs are met. Recognizing the need to improve the business environment, the municipality has taken the initiative to provide special attention to attracting investment by offering a variety of options in terms of tax reductions and other incentives benefiije potential investors. In addition, the municipality has taken a more proactive approach to public-private partnerships and the provision of concessionary land towards attracting investment.

2.2. Locations for investment

Municipality of Mitrovica is presently running its business park, which has an area of 3.5 hectares and is fully equipped with all necessary infrastructure. Investment profile of business park is easy manufacturing business. Given the importance of industrial land to attract investors, the Municipal Assembly has approved the allocation of 60 hectares for development of Mitrovica's industrial zone. This large space will be a hub for business and economic development activities of the municipality. The municipal administration has developed a stimulus package for all potential investors who are willing to invest in Mitrovica.

Fig 1. Designated locations for investments in development (marked in red colour)

2.3. Quality of life

Kosovska Mitrovica is economic, educational, cultural and sports center. The municipality is largely invested in improving the quality of life of citizens. As such, there are many opportunities for rest and recreation in the city and surrounding areas. Pleasant Boulevard is located adjacent to and near the river Ibar, or walk to the largest city park in Kosovo will be refreshing after a long day. Visits the new lake or botanic garden will allow you to admire the beauty of nature. Walk to the largest multifunctional center in the country or the sports hall will give you excellent recreational opportunities. Municipal investments of over $ 50 million assures all investors an excellent quality of life in Mitrovica.

2.4. Natural resources, tourism and competitive advantages

Mitrovica is one of the richest opštinasa natural resources in Kosovo and the region. Trepca, one of the largest industrial mineral mines and processing plants in the Balkans. Currently, Tourism - characteristic position of the municipality, mountain range Bajgore, rivers Ibar and Sitnica are valuable resources for tourism development. In addition, the Museum of crystals can become a tourist attraction, as well as educational, research and scientific center. Agriculture Valley Ibar and Sitnica are favorable conditions for the development of agriculture, especially the cultivation and processing of fruits and vegetables. Land market research classify this sector as highly profitable and can create new jobs. Livestock - Soil quality, climate, water resources and population structure represent potential for cattle breeding. Farm cows, sheep and goats - supplemented with meat and milk - are one of the priorities for the economic development of the municipality.

3. Current investment plans and initiatives

Municipality of Kosovska Mitrovica has begun in previous period with the realization of array of planned objects for improving economic situation in the municipality. Below is a list of investment plans and initiatives at the municipal level.

- Business incubator - Mitrovica North.
- Agriculture and Livestock Development Center Suvi Do
- Science and Technology Park
- Three shopping centers in North Mitrovica
- Laka industrial zone Cesmin Lug
- Tourist recreation center Partizansko Brdo
- Construction of three public garages of prefabricated steel structures and zoning parking places in the city-raising capacity of the company parking service
- Capacity building JKP Ibar -water and construction of water treatment plant at Cesmin Lug
- Capacity building JKP standard construction recycling plant for solid waste
- Bus station and capacity service traffic in the city

3.1. Business incubator - Mitrovica North

Incubator objectives include creating ownership of new jobs, reducing the failure of SMEs (small and medium enterprises) and strengthening SMEs in the municipality, keeping young people in the municipality, as well as to support the process of privatization and regional integration. In addition to the stated objectives of business incubator is expected to provide an internal control, providing training and technical consultation in the field of business, reducing fixed costs (reception, photocopying, internet, fax, administration), to provide professional, flexible space, a space suitable for the exchange of ideas and to provide opportunities for networking. The incubation period for new businesses usually lasts from 1 to 3 years. Entrepreneurs would in the first year of their business use the space free of charge, in the second year would pay 40% of the rent, in the third 70% after its expiry full space rent. After the incubation period of one business space would be allotted to new under the same conditions. Business incubator will initially provide about 40 new jobs. Business incubators are organized and registered as a limited liability company. Municipalities and associations of entrepreneurs are mostly registered owners. School and higher education institutions to find their interest may also be owners. Estimated value of construction of business incubators is 250,000 euros.

3.2. Agriculture and Livestock Development Center Suvi Do

Suvi Do as the suburb is of strategic importance for northern Mitrovica, which is seen in the only possibilities for the spread of the municipality of northern Mitrovica to that area. It should take into account that North Mitrovica practically has no free land because the city building land in the town of almost exhausted and the remaining parts of land in peripheral areas of the city because of the configuration is not suitable for any serious apprehension purpose other than to be designed as a buffer zone greenery in the capacity of environmental protection. From the Ibar River to the village of Vidomirić extends about 180 hectares of private land owned by inhabitants of the population of the upper Suhodoll Serbian nationality and about 42 hectares of land that was owned forests „ „ Serbia. If we start from the fact that the entire northern Mitrovica occupies about 1,720 hectares leads to zaljučka that this area represents 15% of the total municipal territory. Taking into account the composition and configuration of this part of the project includes the construction will contain accompanying administrative buildings, mini dairy farm, plants for processing of fruits and vegetables and the like. The value of the project in phases amounts to 500,000 euros in the first, 1,000,000 euros in the second and 500,000 in the third phase.

3.3. Science and Technology Park

"Science and Technology Park" presents a more or less broad term that is used to describe various attempts to encourage development "of entrepreneurship through the establishment of a knowledge-based SMEs" within a state. This name has a lot of synonyms of which are the most common "scientific park", "Technology Park", "scientific and technological park", "research park" and "technopolis". Although there are several definitions of NTP, the fact is that he represents the agglomeration of SMEs, which has the following characteristics:

- is associated with educational or research institutions
- secured infrastructure and services for activities centered SMEs, primarily real estate and commercial property
- facilitates the process of technology transfer
- aimed at encouraging the economic development of the region in which it is located

The road to the Science and Technology Park usually leads through the development of innovative centers. Innovation centers are organizational units, or companies that are formed usually as a supporting unit cluster of SME organization in one region or country. It should be a place where it will be created:

- motivation and climate for enterprise development based on skills within the company
- promotion of self-employment as a modern social trend
- creating a positive image of entrepreneurs

- the provision of detailed information and solutions to business people
- creating new jobs and businesses in the region
- help turn the regional potential in commercial enterprises
- providing high-technology company in the region's profile in the market through foreign partners and international networks of contact

Value of contingent work is approximately EUR 400,000. In Fig. 2 is an image the object that should be reconstructed for premises of the Technological Park.

Fig. 2. Future facility of scientific-technological park

3.4. Light industrial zone Cesmin Lug

Cesmin lug located below the military overhaul the lower corners of the coast of the river Ibar in the direction of Zvecan, across Cesmin lye on the other side of Ibar near Dudin Krs is provided for wholesale markets to the terminal. In line with the strategy of building bypass Cesmin lug - Dudin krs this is the ideal location to build a light industrial zone. In Fig. 3 is given the location of the industrial zone in area of Kosovska Mitrovica.

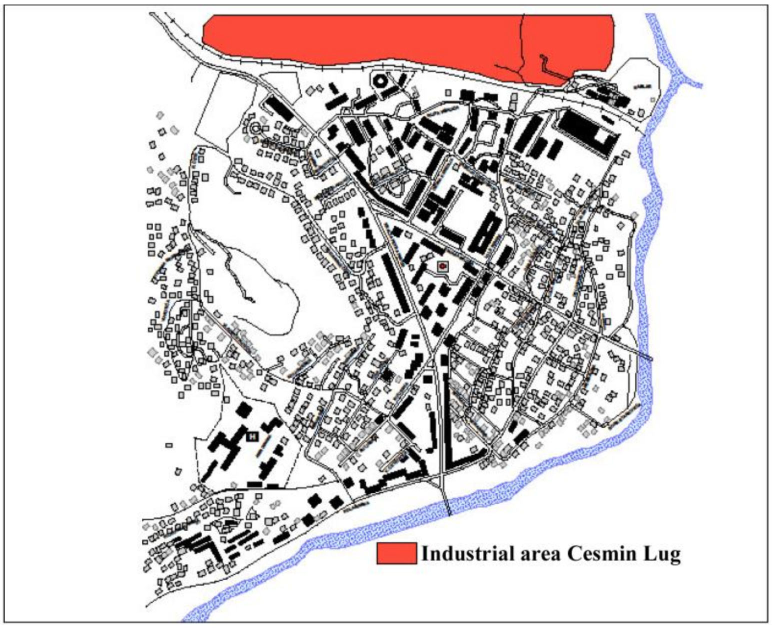

Fig. 3. Location of Cesmin Lug area. Kosovska Mitrovica - North 1:5000

3.5. Tourist recreation center Partizansko Brdo

This project would include the improvement of the entire area of the so-called Partisan Hill and the whole campaign would include three phases. The first phase includes the greening of the auxiliary structures in a wide stretch exterior of the Church of St. Demetrius, where the value of the works amounts to 300,000 euros. The second phase includes the acquisition of private land for the construction of the pool, whose value is estimated at 100,000 euros work. For the final phase is planned] one of constructing a pool of works whose value is estimated at 3,000,000 euros. In Fig. 3 is given a topographic appearance of the center with the legend of the planned facilities.

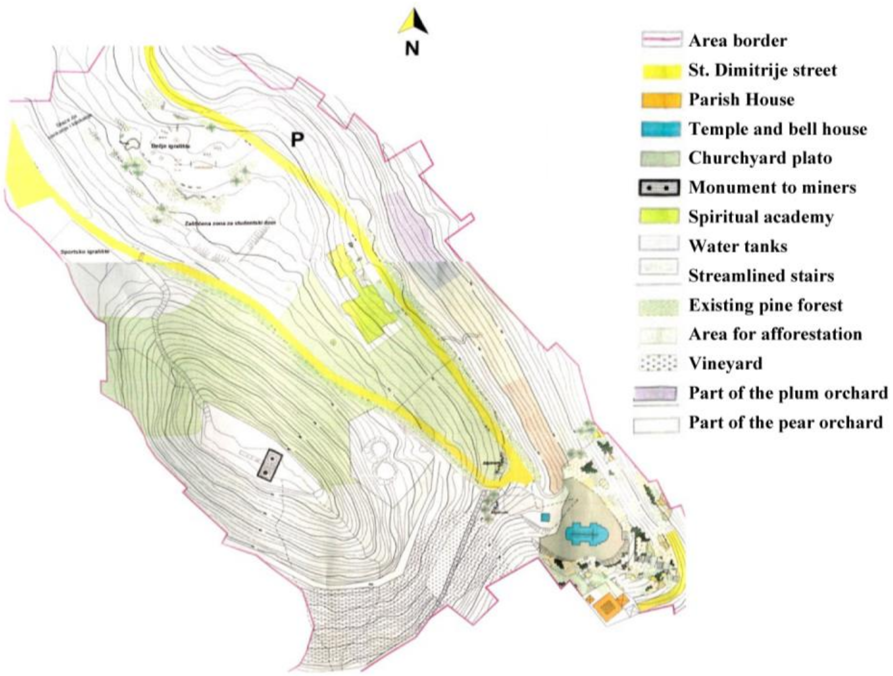

Fig. 3. Topographic appearance of the center with the legend of the planned facilities

4. Conclusion

The main objective of this paper is to present the current stage of development of the Municipality of Kosovska Mitrovica and to present that the diversified economy of the municipality, together with a smaller share of the public sector and larger share of the private sector, to enable faster and more sustained economic growth than currently exists. This is the premise that is widely supported by macroeconomic policy makers in the world, and which convincingly argue that economic diversification reduces the impact of external events and produces robust, resilient growth in the long term. Not only would economic indicators should be balanced between sectors, but to key elements of the economy should be different, be flexible and timely manner applicable in respect of various economic opportunities. If diversification is higher, supported by an environment that is more conducive to business, better access to credit, skilled workforce and reliable sources of energy, then the economic growth faster and more inclusive.

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National legislation on public procurement reform

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Abstract

European new directives on public procurement and concessions represents an obvious opportunity that Romania must use in order to restore the solid basis of a simple, efficient, stable, transparent and consistent national legislation. Development of national strategy in public procurement is a crucial step to reform the Romanian system of public procurement, establishing a common vision, a key moment in which the new directives offer Member States the transition to a new paradigm in the context of the procurement become the main tool for unlocking economic growth in Europe. Public procurement contracts play an important role in the economies of Member States, estimated at over 16% of EU GDP and over 10% of Romania's GDP. Public procurement gives the measure of good governance as it regulates the spending of public money and should ensure unhindered access of the economic operator.

Keywords: strategy, transparency, integrity, efficiency , effectiveness, simplicity, auditing

1. Introduction

Generally speaking, the notion “public procurement” is used in order to describe the process of acquiring works, products and services by the national, regional or local public authorities.

The public procurement market reached 77.4 bn. RON (17.4 bn. EUR) by the year 2014, the highest level since 2010. There acquisitions were made through SEAP (Eletronic Public Procurement System) and represent the equivalent of 11.5% of the GDP. During the year 2015, SEAP recorded procurement procedures of 77.4 bn. RON, 2.8 bn. more than during 2013.

In the EU, the public acquisitions represent about 15% of the GDP of the member states.

2. Implementation of the public procurement system in Romania

In 2004, the European Commission adopted two new directives regarding the public procurement, 2004/17/EC and 2004/18/EC, enforcing regulations that needed to be applied in Romania as well. The basic principles are the removal of the barriers and opening new competitive, non-discriminatory markets. As a result, Romania adopted in June 2006 a new legislation regarding the public procurement, according to the community acquis. This also involved the public procurement by electronic means. The new legislation aimed at realising the public acquisitions based on seven principles: non-discrimination, equal treatment, mutual recognition, transparency, proportionality, effectiveness of using public funds, accountability.

The transparency of the process and of the public procurement procedures were provided by an electronic platform – S.E.A.P – Sistemul Electronic de Achiziții Publice (Eletronic Public Procurement System), available at www.e-licitatie.ro. The public procurement market was supervised by ANRMAP – Autoritatea Națională pentru Reglementarea și Monitorizarea Achizițiilor Publice (National Authority for Regulating and Monitoring Public Procurement). The procurement procedures were supervised by the Ministry of Economy and Finance. The control was carried out also by the Court of Auditors, the supreme institution for audit. Disagreements and disputes arising in procedures for procurement of contracting authorities and tenderers were settled by CNSC – Consiliul Național de Soluționare a

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Contestațiilor (National Council for Solving Complaints).

Since adopting the Government Emergency Ordinance no. 34/2006, for about 10 years, the public procurement system proved itself to be inefficient, largely due to poor implementation of legislation.

Legislative instability, unclear legislation and subject to interpretation, jurisprudence deeply contradictory, deficient institutional system, restricting access to the system of remedies, excessive formalism and bureaucracy had as consequences, in the 10 years of implementation, poor absorption of funds and delays in project implementation.

Romania, like other former communist countries, has not really had a "culture" of fair, transparent, non-discriminatory public procurement prior to GEO no. 34/2006. This inexperience caused serious damage to the public procurement system both macro and micro level.

At the legislative level, Romania has had an absolute rout due to the inability to implement the European directives in compliance with the requirements of European law and with their adaptation to national realities and mentalities. Deficiencies have been repaired during the years through countless orders, but orders without having a vision and a clear strategy on the system.

At the institutional level, became apparent while the power struggle between ANRMAP (National Authority for Regulation and Monitoring the Public Procurement), CNSC (National Council for Solving Complaints) and UCVAP (Unit for Coordination and Verification of Public Procurement) that culminated with the abolition UCVAP. At the micro level, many contracting authorities did not have qualified staff and failed to organize the procedures under the law resulting in countless wrong documents, restrictive requirements, large number of complaints, delay in projects, problematic contract amendments, unlawful contracts concluded, loss of grants.

Based on a comprehensive analysis of the actual situation in the system, through consultations between the actors in the system and with the valuable support of the European Commission, the European Investment Bank, it became imperative to develop a coherent strategy.

Given the new EU directive approved in 2014 by the European Parliament that require transposition into national law by April 18, 2016 and through numerous problems reported with negative effects on the Romanian economy, the authorities have launched a major reform of the public procurement system through developing a national strategy on public procurement for the period 2015-2020. Public procurement strategy seeks to address issues raised during the almost 10 years of enforcement and to allow a stable framework based on the principles established by European directives.

3. The new legislation regarding the public procurement in Romania

The new legislation to regulate public procurement in Romania is part of the national strategy and includes:

- Law no. 98/2016 on sectorial public procurement;
- Law no. 99/2016 on sectorial procurement;
- Law no. 100/2016 on concessions for works and services concessions;
- Law no. 101/2016 regarding remedies and appeals concerning the award of public procurement contracts, sectorial contacts and contracts for concession of works and concession of services, and the organization and functioning of CNSC.

The new package of laws implements the new EU Directive (Directive 2014/23 / EU Directive 2014/24 / EU Directive 2014/25 / EU) and repeals the Emergency Ordinance no. 34/2006. By this, public procurement regime substantially changes, aiming at both small detail aspects and systemic changes, affecting the entire procurement process. Unfortunately, we cannot talk about a simplification of public procurement legislation, when four acts replace a single act, and over 300 pages of primary legislation are designed to replace about 130 pages of legislation (GEO No. 34/2006). The aim of the new directive was, according to the European Commission, to simplify the public procurement legislation, but the result is quite different. The concepts are defined in more detail under the relevant law. The thresholds are now set in RON, the services are no longer divided in Annex 2A and Annex 3A, some being completely excluded from the scope of the law and others covered by a more flexible and higher threshold.

The innovative elements of the new package are:

- award criteria: lowest price; the lowest cost; best quality/price ratio (required for intellectual services and social services); best quality/cost ratio (required for intellectual services and social services);
- detailing how the open procedure and restricted procedure will be conducted entirely by electronic means (online) as of June 2016 for all contracting authorities and from January 2018 by the centralized procurement units;
- market consultation - part of the public procurement process, if desired acquisition of products / services / works with highly complex from technical, financial or contractual point of view, or in areas with rapid technological progress. The consultation process is initiated by the publication in SEAP or any other means of a consultation announcement; at this process can participate any person / organization concerned;

- detailing how the role of ANAP (National Agency for Public Procurement) will increase in the ex-ante documentation award of public contracts;
- contracting strategy: each purchase document, which gives importance to the stages of the procurement process and the preparation for the procedure;
- extending the framework agreement: from 4 years to a maximum of 8 years, except that the contracting authority can justify only by the specific object of subsequent contracts to be awarded;
- estimating the value of the acquisition is achieved by expressing this in RON without VAT, as well as the thresholds are expressed in RON to avoid confusion in the past;
- change of thresholds: the thresholds for the procedures: 1,858,177 RON: sectorial contracts of goods and services as well as for design contests; 23,227,215 RON: sectorial works contracts; 4.4454 million RON: sectorial services contracts which concern the social services and other specific services. Thresholds for direct purchase: 132 519 RON for purchases of products or services; 441 730 RON for procurement of works;
- reducing time-limits in award procedures: Open bidding: minimum term for tendering - 35 days, with the possibility of reducing to 15 days (currently the term of the day is 40). The restricted procedure: minimal term for nominations - 30 days, with the possibility of reducing to 15 days and the minimum time limit for submission of bids - 30 days, with the possibility of reducing to 10 days (currently, the deadline for submitting applications is 30 days and 35 days for submission of tenders);
- European Single Procurement Document (ESPD/DUAE) is a tool that facilitates the participation of economic operators in procedures for the award of public / sectorial procurement and reduce administrative burdens for contracting authorities / entities being established at EU level by Regulation C.E. no. 7/2016;
- relevant activities are considered the following areas: Gas and Heat; Electricity; Water; Transport services; Ports and airports; Postal services (G.E.O. no. 34/2006 excludes electronic mail services, postal financial services, philatelic services and logistics services); Oil and gas extraction and exploration for, and extraction of coal or other solid fuels (compared to G.E.O. no. 34/2006 exploration of oil and natural gas is not included);
- unusually low price: there is no percentage (unusually low price - less than 80% of the estimated price), the market prices are taken as reference;
- direct procurement is done by consulting the electronic catalogue provided by SEAP. If, after consulting the electronic catalogue, SEAP entity does not identify the products / services / works which can meet the need for economic operators or the price is higher than the market price, the contracting entity can make your purchase from any operator;
- simplified procedure: the SEAP initiates the publication of a simplified contract notice, accompanied by the tender documentation relating to: periods and dates for offers

4. The new electronic platform

The Romanian Agency for Digital Agenda develops a new procurement platform, SICAP, which will replace the current SEAP, through the project "Environmental Information System for Performing Collaborative Development of Public Procurement - SICAP". The SICAP platform must contain:

- facilities that will enable the introduction of information in a structured way;
- facilitating how to fill the fields and sections of the forms;
- updated information on contracting authorities / operators redefining their profile (to have a record of the types of contracting authorities / operators);
- the possibility of publishing all changes in public procurement contract / framework agreement (the final contract price);
- introduction of warning messages to assist contracting authorities and economic operators.

The economic logic of the public procurement reform in Romania, promoted by the Strategy and taken from the European directives, revolve around the idea that transparency generates competition, competition generates savings. Econometric analysis and the impact studies carried out in Europe have shown that even a small but stable increase of transparency of the procurement process leads to tangible savings. Specifically, according to *Impact Evaluation Report-Effectiveness of EU Public Procurement and Legislation* (Part 1), published by the European Commission in 2011 following the publication of a notice result savings of 1.2% compared to situations where notices or other information in connection with a contract to be awarded were not published. According to the analysis, a contracting authority publishing an invitation to tender and using an open bid can expect savings of 3.8% of the final value of the contract and whether using the restricted procedure can expect savings of 2.5 %. The savings associated with a higher degree of competition are higher in services and works, resulting in a directly proportional relationship between the economy and competition in these sectors; as the procedures mobilize the competition, the degree of saving increases.

5. Conclusions

In terms of competitive impact on the business environment and reform of public procurement, the reform will allow the implementation of an institutional mechanism for cooperation between authorities for preventing the practices among bidders. In addition, the flexibility of the procedures, reducing administrative burdens for tender preparing, the introduction of consultations with the market will generate greater competition and greater participation of SMEs in award procedures.

In terms of social impact, the reform of public procurement will not be limited only to savings, but will be used as a tool for policy implementation in the environmental, social and energy efficiency policies. According to the impact studies at European level, 70% of notices published in the award criteria include environmental issues, energy efficiency or social issues. According to statistics published in Romania for public procurement, approximately 94% of procedures used as award criteria "the lowest price".

Although there still are a lot of improvements to be done, the use of an electronic platform for public procurement provides more transparency and efficiency to the process and will continue to have a positive effect on the Romanian economy.

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www.e-licitatie.ro

Industrial parks and business incubators as clustering incipient forms

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Abstract

Interest in clusters has exploded in recent years all around the globe; clusters are not extending only in traditional sectors but also in the high-tech ones. Research has provided important developments in the field of industrial localization and spatial economy. Based on spatial agglomeration theories and on the transition from general to particular, we aimed at identifying preliminary forms of business spatial agglomeration, by analyzing concepts of industrial park, business incubator and cluster. The scientific approach involves both fundamental and applied research. We have conducted an investigation into the literature related to these forms of spatial agglomeration and, afterwards, we have evaluated their status inside of the European Union countries.

Keywords: Industrial park, business incubator, cluster

Introduction

Over the time, researchers have begun to argue the importance of entrepreneurship and technological innovation in organizations, which offer advantages in terms of competitiveness (Barbero, Casillas, Ramos, & Guitar, 2012). Innovation in spatial organization of business accounted over the time a highly controversial topic, especially when analyzes were conducted on the level of regional development. Researchers have focused on understanding the phenomenon according to which certain technologies develop with particular rapidity in the towns and determine their growth. Often it is considered that innovation is responsible for this development, and sometimes technology is responsible for changing the spatial organization of the business.

1. A Conceptual Framework for Industrial Parks

Industrial parks were seen as main sources of pollution, which harms both the employees who work in the park, but also the cities in which or near which parks have been developed; in recent years a strong interest emerged in creating ecological industrial parks. According to Cote and Hall, an industrial park eco (park eco-industrial) is "an industrial system that conserves natural resources, but also the economic ones, reduce the cost of production, materials, energy, insurance and treatment, improving operating efficiency, quality, health and public employees, offering opportunities for monetization of recycling or selling the materials wasted. " (Cote & Hall, 1995).

Industrial parks green is the chance given to old parks pollutants to become the protecting the environment through green technologies incorporated and prosecution waste disposal, creating, using their connections between manufacturing enterprises and service providers, so that the environment is protected (Lowe, Moran, & Holms, 1998).

In recent years, the importance of industrial parks increased significantly, technologies used and disseminated knowledge within them giving rise to another type of spatial organization namely science and technology parks.

In Romania, the Law no. 186/2013 regarding the establishment and operation of industrial parks defines this spatial agglomeration of business referring to "green field industrial park, agropark, scientific-technological, technological, business, logistics and innovative, industrial and others, initiated by the founders - the land related and industrial park infrastructure, including those which already exist; by case, owned industrial park residents may include, where appropriate, other buildings owned by third parties, representing the enclosed environment within which economic activities, scientific research, exploitation of scientific research / or technological development, agrobusiness, logistics and innovative industrial etc., in a specific facilities by park residents "(Legex).

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International Association of Science Parks believes science parks, technology and research ones as "an area of innovation, with a significant role in regional development and the dynamism which stimulates the flow of knowledge between universities and companies, facilitating communication and entrepreneurial work in a global network which can often bring together an extraordinary number of innovative companies and institutions that support internationalization." (International Association of Science Parks).

Science and technology parks in Romania, is under Law No.50 / 2003, "a joint venture (...) contract between an accredited institution of higher education and / or research and development unit, on the one hand, and autonomous, national companies, businesses, local government, business or professional associations, individuals, Romanian or foreign investors, on the other hand (..) which have locations and conditions location "(Legex).

The main features of science parks are submitted by Andersson, Deleting, Sørvik and Hansson in "The Whitebook Cluster Policies" (Andersson, Seger, Sørvik, & Hansson, 2004). In their view, these aggregations spaces share the following features:

- Form an operational tie with a major research center;
- They are designed to encourage the formation and development of knowledge-based businesses;
- Have a management function, which is actively involved in technology transfer and competency management organization.

As we can see, there are numerous case studies, empirical research, magazines and web sites that refer to science parks. We must also stress that they are assigned in literature, several names such as: technological parks, scientific and technological parks, research parks, innovation centers, tehnoparks.

2. Business Incubators- A Theoretical Approach

In 1998, in the workshop on "Best Practices in Incubator Infrastructure and Innovation Support" (1998) held in Helsinki, the first definition of the business incubator was issued, a definition which refers to information on the subject existing in 1990 in the manuscripts of European Commission and where "a business incubator is a place where there are concentrated, on a small area, newly created companies. Its objective is to increase the chances of development and survival of these firms by providing a modular building which is equipped with the necessary utilities (phone, fax, computers) and where is provided managerial support and support services. The main aim is to develop and create local jobs. Technological orientation is often side-lined " (Best Practices in Incubator Infrastructure and Innovation Support, 1998).

The article "The History of Business Incubators" (Ryzhonkov, 2013) presents incubators generations since the late 1950s when the first business incubator was established. According to the author, there are three generations of business incubators: first appeared in late 1960 between the mid-1980s, when the emphasis was on business infrastructure; a second generation has grown up since the mid of 1990s helping businesses to speed their passage through the learning curve and the current period, which emphasizes networking incubators in the value chain. Later, within incubators were added services, knowledge-based services such as trainings, coaching and mentoring web sites in order to support entrepreneurs to develop sustainable business (Ryzhonkov, 2013). Currently, due to high performance technology and innovative trends in information technology, business incubators, took the incubators form virtual networks incubators incubators online.

3. Clusters- innovative form of spatial agglomeration

With the emergence of the cluster term in the 90s , numerous studies showed regional industrial parks and business incubators as referring to the same phenomenon (Lazzeretti, 2006).

Cluster term originated as a result of researches conducted in industrialized countries. It was first enunciated by Porter in 1990 as „a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities. The geographic scope of a cluster can be a single city or state or a country or even a network of neighbouring countries" (Porter, 1998).

Following the trajectory given by Porter, Andersson alongside his colleagues defined the cluster as "a critical mass of organizations, resources and skills capable of supporting long-term linkages between actors involved in activities cluster" with an "interaction between member firms showing not only signs cooperation, but also the competition "between them (Andersson, Seger, Sorvik, & Hansson, 2004).

4. A comparison between Industrial Parks and Business Incubators

The relationship between geography and economic growth is a subtle yet complex, involving more than what Marshall called agglomeration model, and this because of the technological changes occurring with great rapidity (Iammarino & Mccann, 2006). The geographic proximity of SMEs causes relationships between them, usually based on mutual trust as a common vision. Successful examples supporting this idea are present in Silicon Valley (Saxenian, 1994) and in Italy (Scott, 1988).

Industrial Parks and Business Incubators have developed around the world, being initially a way of linking industry with universities (Marques, Carac, & Diz, 2006). Silicon Valley California (Castells & Hall, 1994) and Cambridge (Koh, Koh, & Tschang, 2005) in the UK represented a model for Industrial Parks developed in countries such as Russia (Kihlgren, 2003) and China (Watkins-Mathys & Foster, 2006).

There are contradictory viewpoints on the benefits brought within the economy by industrial parks and business incubators: some authors claim their emergence as a success (UKSPA, 2003), while others criticize this idea (Quintas, Wield, & Massey, 1992).

Industrial parks are usually focused on regional development, improvement of existing technology and the initiation of new parks. It also encourages the development of technology-oriented companies and provides location for emerging companies (Felsenstein, 1994).

Business incubators have a deep connection with the term "entrepreneurship". They emerged since 1970 and they are providing cheap alternatives for those who wanted to become entrepreneurs (Barrow, 2001).

Nowadays, business incubators providers have become real collaborative, not just providing aid in the form of financing resources, but allowing access to consultancy and partnership development at the same time (European Commision, 2002).

If we want a comparison between the two, business incubators are focused not necessarily on a definite space, but on the combination of services, not only providing work desk, but coaching and training at the same time (Bergek & Norrman, 2008; Mian, 1997).

Technology Business Incubations (TBI) occurred as a combination of industrial parks and technology incubators. They are tools to support technology and innovation. Organizational form may appear as public-private partnerships between universities, industry and government (Etzkowitz, 2002).

From an epistemologically perspective, Markusen believes that the terms are unclear or „lack nouns clarity" (Markusen, 2003). Martin and Suney have made a special effort to identify concepts appealing to the deconstruction of language. They argued that many authors incorrectly use the terms without making an epistemological analysis (Martin & Sunley, 2003).

Based on the existence of classic industrial parks, there were successful and unsuccessful stories, there were locations offering workspace to various companies, but where the environment's business was not a flourishing one, where resources were exploited in an irrational manner causing pollution. Eco-industrial parks come to support stakeholders in the park enjoying the existent benefits in that area, emphasizing the importance of using resources rationally. In recent years, has placed particular importance greening the industrial parks, and this, in the context of eco-industrial parks with a meaning of those industrial parks where waste materials are renewable and where a firm's output becomes the input for another one, and this attention on waste result in savings in terms of cost (Peck & Ierfino, 2003).

In order to verify the assumption that parks and business incubators are incipient clustering forms, we conducted a descriptive analysis on the common and different aspects that appear in various forms of spatial organization of business. We decided to compare them two by two so as to observe, in a detailed form if they are similar or different preliminary forms of spatial organization of the type of industrial parks and business incubators, compared with the innovative forms as clusters.

Comparing the features of business industrial parks with clusters, we can observe that both are agglomerations of companies, a characteristic of traditional industrial areas.

Moreover, researches made on ways of developing industrial parks and clusters in Europe stood clusters formed in the territory in which it operates industrial parks and industrial parks that were built after the emergence of clusters, in their immediate area. Although the geographic proximity of companies appears to be identical to a certain degree of agglomeration, origins of the two forms are different business space.

Business incubators, as shown in their definition, aim at bringing together human resources skills characterized by distinctive, high-performance technology and know-how, encouraging entrepreneurship and accelerating business development.

The incubators provide office space for innovative companies, scientific and business support. Business incubators facilitate collaboration between companies, universities and other institutions supporting business clusters themselves. They are a powerful tool for initiating new businesses and supporting the existing ones, they represent a key component in regional or local development strategies. Considering all specific business incubators features previously shown, we can say that they represent a spatial organization type for business cluster support.

5. Conclusions

Innovation and entrepreneurship have become intensely debated topics in the context of economic growth. The European Union supports industrial parks and business incubators in order to link different entities, to provide a space in which to work and provide them counseling. Often, an incubator is located in a technology park (Lalkaka, 2002) interconnected with a university or research institute. Based on definitions of industrial parks, business incubators and clusters, we observed that these forms of spatial organization of business shares some common characteristics. However, one can see certain characteristics that differ from the preliminary forms of spatial organization and its innovative shape. Yet, what makes the difference is the intensity of characteristics for each of the forms of spatial organization of business separately.

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Improvements in business towards system of systems engineering approach

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Abstract

The present paper highlights business processes as a living system of systems. The main objective of the research is to obtain the visualization of the business model in order to design the system architecture tower. The virtual picture is represented as a multi-attribute system of systems description available as a model about reused Artefacts of a classification system. There are two specific artefacts used to model the outbound of a specific system: Influence and External Influence. Therefore, the proposed model is a holistic one, as the business is designed as an open system – the model takes into consideration both the internal processes and the macro-environment.

Keywords: model visualisation; system architecture tower; system of systems engineering (SoSE) aproach

1. Introduction

A living system of systems description or, in this case, an enterprise description consists of a number of specific interconnected artefacts from the classification system. The model-driven approach provides the best possible quality and a maintained virtual picture of the reality. More than one source can be discovered and mapped to get a redundancy-free, maintained, interconnected collaboration map available as a multi-attribute holistic model. After discovering and mapping the model, content can be automatically visualized as stakeholder-oriented based on applied rules. Different visualizations depending on the selection and content can be provided as tables, pictures, text, dashboard items or in any required combination. The holistic model has more than one implicit structure, depending on the entry point and applied filters; therefore, many different structures can be shown. Depending on the rules, the essentials of a system of systems can be aggregated and visualized.

Usually, the most important information from an enterprise is the end-to-end view—the value chain of the offered product and services—and the available performance implemented as a horizontal end-to-end view. Process landscapes and individual activities have a vertical view and a control flow orientation. Processes are supported by application, organization, and logistics. In a stack below, there are presented infrastructure and facilities, in order to get the picture. The influence factors document, measure, control, and report the outbound conformance. For inbound conformance, the principles can be reused. The dependencies and interconnectivity are used to measure the systemic relationship. A multi-attribute system of systems description is very complex because it is a digitalized picture of reality. Therefore, some tools (navigators) are required to manage the complexity. Using a navigator, a network of dependencies can be visualized as a structure based on rules and filters. Seeing or understanding all details is not always relevant. Details can be aggregated, clustered, and visualized. A tool is required here because such complexity cannot be managed manually.

There is always something under flux; sometimes a transformation is on. The enterprise tower presents a comprehensive picture of the digitalized reality in a multi-layer diagram, where details can be filtered, aggregated, and visualized for different stakeholders with varying requests.

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2. Methodology

Information needs to be visualized because people have to validate, understand, and work with the discovered information, as well as use it to bring in improvement or change. Given a solid information base, work can be supported, mechanized or atomized. If industrialization is a target without standardization, comparability and reusability are not supported. Without automation, efficiency and effectiveness is limited. Therefore, industrialization requires all these steps.

The SoSE methodology rests with the seven perspectives necessarily attendant to every SoSE effort stated Hall, A.D. (1989). According to Adams, K. MacG. and Keating, C.B (2011), the foundations of the SoSE Methodology are shown in Fig.1.

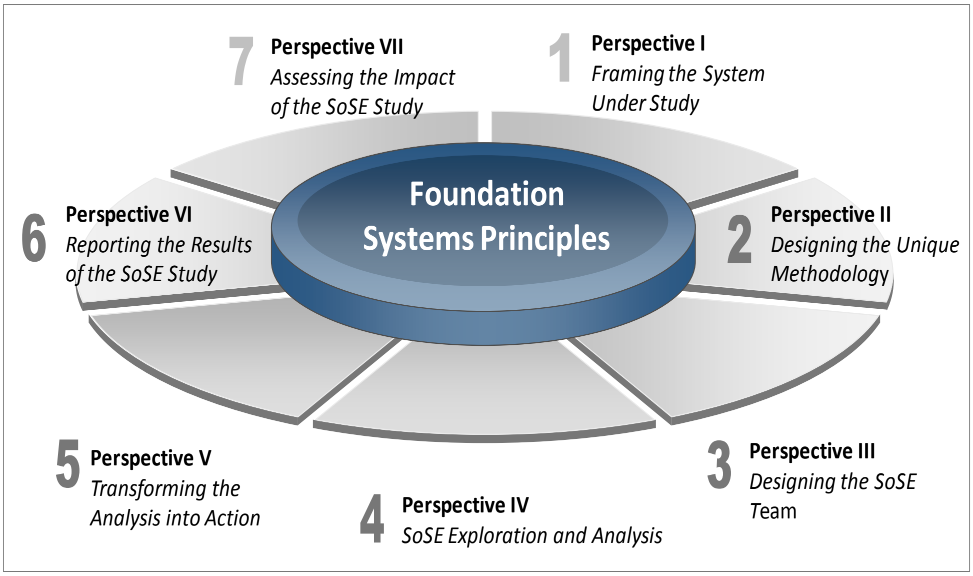


Fig.1. The SoSE Methodology; Source: Adams, K. MacG. and Keating, C.B., Overview of the Systems of Systems Engineering Methodology

Perspective I, Framing the System under Study, is designed to rigorously structure the system problem, the contextual setting and environment within which the problem system exists.

Perspective II, Designing the Unique Methodology, designs a unique methodology based on the problem and the problem context.

Perspective III: Designing the SoSE Team, designs the team to undertake the SoSE study, taking into account the nature of the SoSE problem and the team resources, skills, and knowledge that can be brought to bear for the problem.

Perspective IV: SoSE Exploration and Analysis is designed to explore and conduct the emergent analysis by executing the analytic strategy and SoSE Management Plan (SoSEMP).

Perspective V: Transforming the Analysis into Action is designed to transform the results of the emergent analysis by guiding implementation of derived recommendations.

Perspective VI: Reporting the Results of the SoSE Study, reports the results of the SoSE effort to capture the transformation of the analysis into action.

Perspective VII: Assessing the Impact of the SoSE Study is designed to assess the impact of the report on the real-world SoSE problem under study.

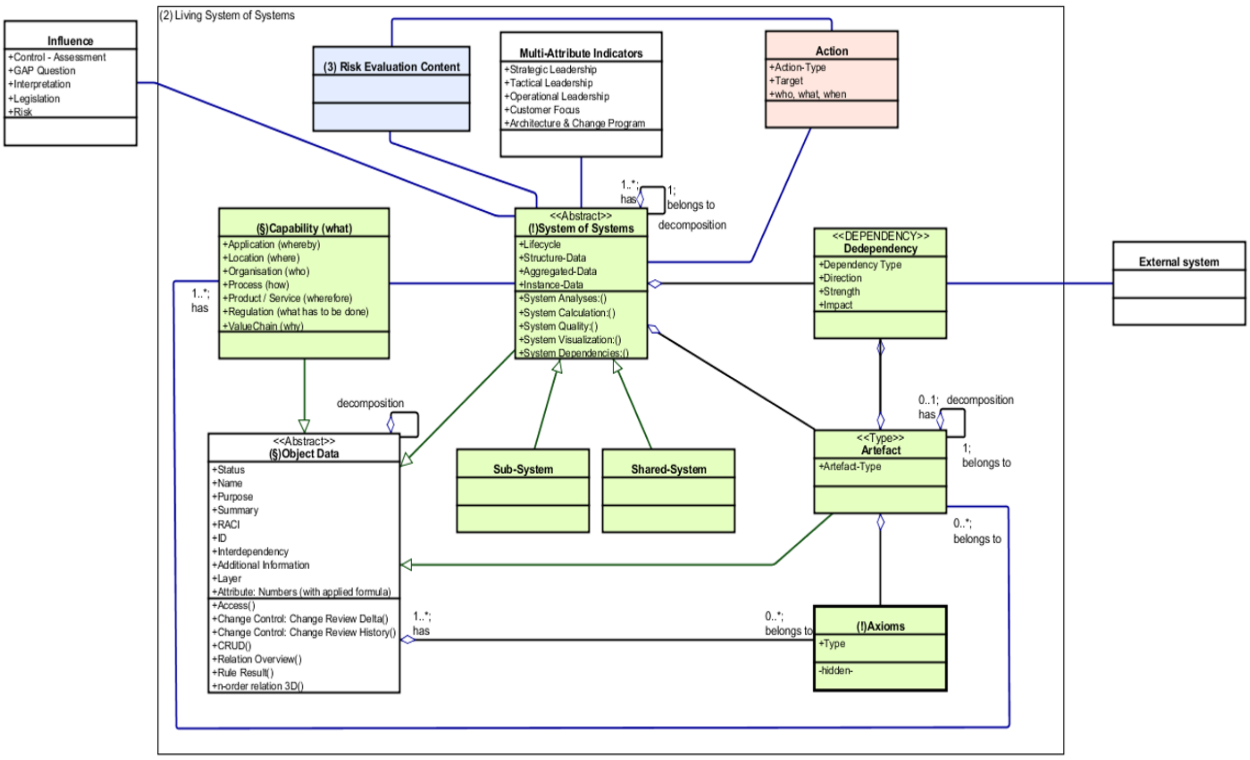
As stated by Adams, K. MacG (2011) and Bucovetchi, O. and Simion, C.P. (2013), each perspective is:

- Essential to a holistic SoSE treatment of a problem area;
- Applied in iterative fashion throughout a SoSE project effort;
- Exists in relationship to all other perspectives, informing and informed by other perspectives;
- Can have a different priority at different times during an effort;
- Flexible in application, requiring tailoring depending on the context and problem domain, and consists of detailed elements (that will vary in application) that serve to structure the application of the perspectives.

In the corresponding model definition, all relevant details are explicitly documented and visualized. The system of systems borderline is essential. This borderline is limitlessly thin and sharp. This is the only guarantee that either a specific Artefact is inside or outside a system and only dependencies (virtual = air, Wi-Fi, real = interfaces) can cross this borderline or scope. It is very important to obtain the precise scope of a virtual picture about a real system landscape. The virtual picture is represented as a multi-attribute system of system description available as a model about reused Artefacts of a classification system. There are two specific Artefacts to model the outbound of a specific system.

With the Artefact influence, any kind of outbound representation of a system of systems can be modeled and documented. The very unique characteristic of an influence is the unidirectional. Therefore, influences are used to document, for example, environment characteristics or legislations because they have to be accepted, because an interaction or modification is impossible. There is a second outbound Artefact called External System (sometimes also External Agent). With an external agent, most of the time, a bidirectional dependency is agreed and often depends on the system context specified by an agreement (e.g. Service Level Agreement). A system of systems is divided into a sub-system and shared systems (see fig. 2) (Osterwalder, Al. and Pigneur, Y, 2010). These two types are important to separate because the characteristics are completely different. To fulfill the target of the system resilience governance architecture to document systemic inbound and outbound dependencies in a systematic way manually, semi- or fully automatic, to obtain a fully digitalized picture about a real system landscape, this separation is essential and helpful. For example, in an organization, several sub-systems are available, some intangible like the access rights systems, the wi-fi system, the documentary chain and other – tangible like the human resources system, the building itself as a system etc. In each office, a specific temperature is expected, in all rooms Wi-Fi is essential, and in some offices, some access password is required. Therefore, engineers will design several shared systems. Design, development, control, maintenance from these two types of systems are different and, so, the split is required. Therefore is essentiality to have a well-defined border line. The interfaces shall be absolutely transparent.

Fig. 2. Model System of systems; adapted after Osterwalder, Al. and Pigneur, Y. (2010)



3. Results

During the development, operation, assessment, and transformation of a living enterprise (system of systems), many stakeholder groups require information. If the common artefacts to document an enterprise are used, numerous common information requests about the enterprise, customer, product, report, transaction, and so on are available in standardized visualizations. The big picture provides different information and dependencies relating to many different things. Assets are of high significance or use for the system. The meaning may be an important protective value for the system itself; it has its uniqueness, was expensive to purchase or is expensive to maintain. Things, for example, can be people, processes, products, locations or infrastructure, among others. In most cases, an asset is a group of artefacts. The value of a system may be what a system passes on to the customer or partner, but there is also internal value. The performance of a system offering is agreed upon with a customer in an SLA (service-level agreement) or, in general, with regard to what a system is able to produce. System risk comprises all risks applied to artefacts and summarized, visualized or aggregated on system level. Conformance is a representation on the system level of a summary of all legal regulations, policies, and guidelines, and the fulfillment of all internal commitments, policies, and agreements. Productivity is often measured in terms of cost, income or number of units produced in a specific period. Quality, maturity, and trust indicators relate to fulfillment, and availability of information or services used inside the system or provided to customers and partners. Changes are a summary of ideas, demands, requirements, and requests validated and mapped to artefacts to show possible gaps as well as how they are identified and planned to be closed or options to improve or optimize business. Generally, across a system of systems landscape, artefacts are redundancy-free in many different pictures. The handling is always the same. An individual, for example exists, only at one time. It can be available and used at different places with different focus and attributes but as it is available only at one time, the engineer has to decide who the real source of an artefact is. There are many technical options for managing redundancy using a computer.

System of systems engineering (development, operation, assessment, transformation) is complex and complicated. In many industries, it is the weakest point. Therefore, it is important to have a consistent and trusted system of systems description available at any time. Here, all the required capabilities must be documented and available to deal with the system of systems dynamic to understand performability, conformability, changeability, and riskability. With this unique, redundancy-free, and model-driven system of systems description, economic and entrepreneurial decisions can be supported, and the consequences visualized.

Moraru et al. (2016) stated that “predicting fault and failure mode occurred during operation of a process allows to control in order to adopt and effectively implement preventive and / or corrective action”.

Performability focuses on product, market, revenue, cost, profit, and solvability. Conformability covers how all legal requirements, commitments, and liabilities can be met, how promises are managed and agreed contracts and SLAs fulfilled. Changeability manages all change requests, and internal and external demands, closes GAPs, applies innovation, and maintains assets. Riskability is the balance or the intersection between the other four topics. This capability is difficult to manage, prevent, forecast, and predict because it is fuzzy, and often depends on people’s behavior and attitudes. With the multi-attribute system resilience governance decision support based on a model-driven multi-attribute system description, the requirements can be met. The holistic view and overlap of performance, conformance, change, and risk can be sustainably managed. A fully digitalized system of systems landscape can be very complex as shown in Figure 3: The Living System of Systems. Documentation of a living system of systems is complex. The quality of documentation is always known but it depends on the discovered digitalized sources. Some systems are documented like a black box, others like a glasshouse, and the rest in perfect detail. This insecurity and uncertainty is normal in a complex situation because there is no time and no alternative to ensure more quality. In a normal situation, the availability and quality is sometimes better. Based on the artefact and the incorporated concept about encapsulation, this can be controlled. In most cases, the artefact type node is better documented; therefore, it is more relevant than the artefact type edge, because there are more relations than elements to manage (n * (n-1)/2).

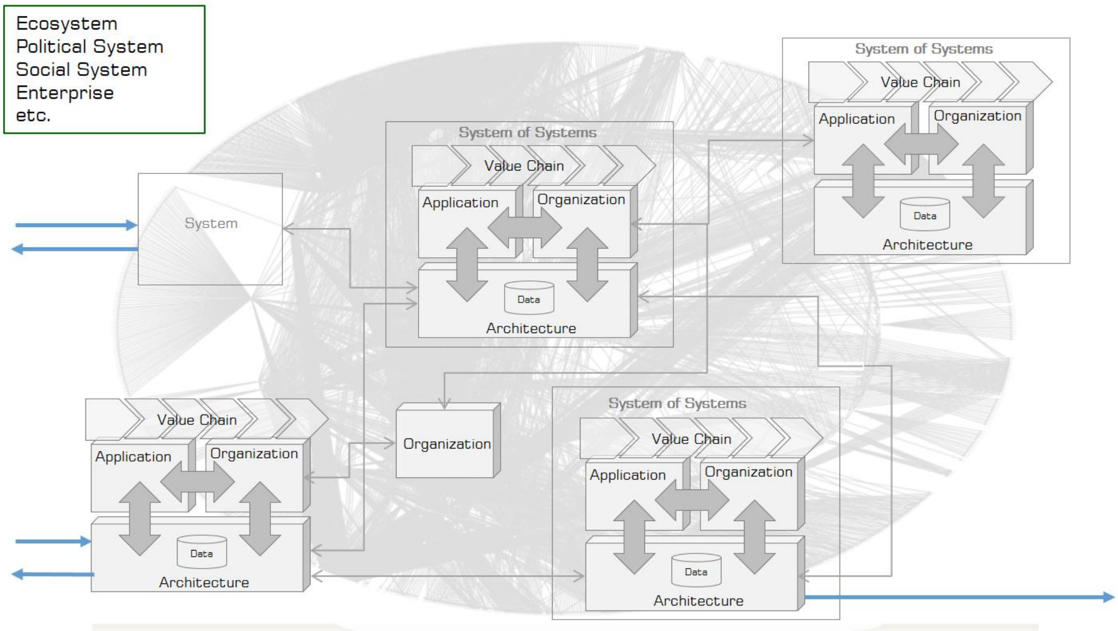


Fig.3. The Living System of Systems; source: Pulfer, R.(2016)

The dynamics and the unmanageability are often driven by unknown or badly documented and managed dependencies. With the comprehensive and highly standardized model-driven multi-attribute system of systems description, all kinds of living system of systems and system contexts can be documented to support engineering and management disciplines like development, assessment, operation, and transformation. To understand a living system, a multi-attribute system description is required. It is important to focus on the importance of a sustainably managed system of systems description. This is the most important part in the system resilience architecture as shown in Fig. 3: Living System of Systems.

The system resilience governance architecture consists of distinct instruments. All these instruments provide the required information about dynamic capabilities to manage complex situations. Dynamic capabilities provide a holistic view of all involved artefacts in a specific situation, with all their details. The system context summarizes all involved artefacts systems and their dependencies. The resilience profile is a comprehensive view on system context assessments. The governance model shows the entire engagement of a living system, system context or all involved artefacts. Risk evaluation shows all risks in different statuses and their dependencies as an asymmetric or symmetric risk matrix. The risk dependency map is a visualization of all risks, risk dependencies, and their origin as a map. The roadmap covers all the activities, along with their dependencies, attributes, status, and rules. All the instruments document the uniqueness of a living system, are available at the best possible quality, and are fully interconnected to provide a homeostatic picture.

Artefacts have a set of standardized dependencies; some of them are not visible in the reality. In a tower advance analyses and simulations are applicable. Any calculations can be applied to each single Artefact, to a relation higher order or to a specified context, component. In this specific case a tower of an enterprise is shown as example in Fig. 4. Artefacts have a set of dependencies and some are visualized in this diagram. Artefacts can be represented in a hierarchy if they are in decomposition or specified in the architecture in a specific layer. If there is a dependency between equal types of Artefacts, all are visualized on the same level. Different types of relations are visible based on different lines. In an enterprise, there are many differs patterns applicable to reduce detail modeling.

In this specific model on top four Business Value Chains (BVC) are visible. Each BVC start with an event and has at the end a product as result. On a Process, layer is visible the handshake to an Artefact called External Agent which is representing a partner, supplier or customer. A value chain is supported or applied by a process landscape. Each process can be expanded and can produce a lot of work product. A work product is something only used inbound and has an intermediate character. A process can be ether supported by Organization or by information technology, logistics, and infrastructure. Between process and artefact witch are supporting a process a multi mapping is possible. Each of the visualized artefacts has his own governance. Visualized with specific artefacts is the information layer where all possible information items can be specified as well as the information RATIO. For validation purposes, is also a BVC visualized on a support layer to clarify the value chain on a technical level can be different from a value chain on a business or Meta level. Additionally, in the tower diagram are also requirements collected in a transformation program visible as well as a SLA represented as a relation higher order to manage and measure the commitment towards customer. All requirements were adapted by taken into consideration several World Economic Forum reports that highlighted the current and future metatrends: World Economic Forum, 2015a-e.

With this tower, the complexity can be visualized in many different diagram filters for stakeholder groups or structured against other rules (relation tree). This is helpful because in a holistic collaboration a top and bottom doesn't exist therefore other visualization technics are required and applied in this diagram.

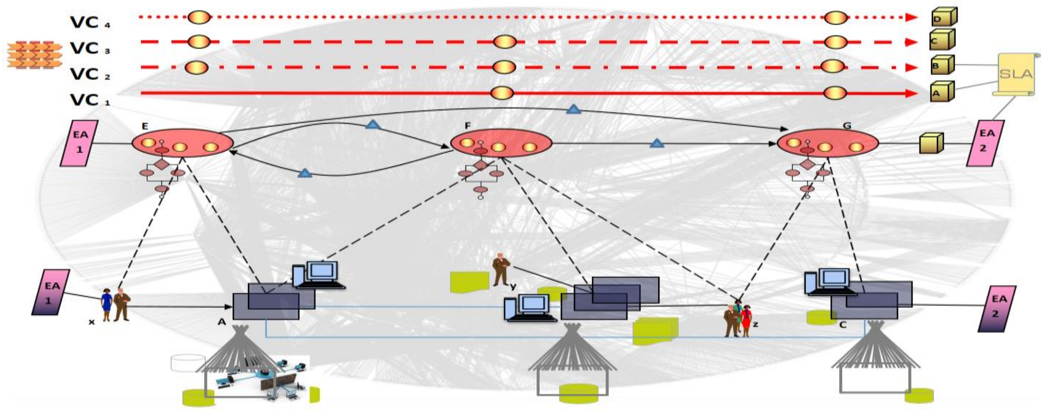


Fig. 4. System Architecture Tower

4. Conclusions

The entire multi-attribute system of system description is made by reusing Artefacts from a classification system. All measurement, indicators and fact and figures are specified, collected and visualized by the class multi-attribute indicator. The risk evaluation content class is the content bridge to the risk evaluation instrument. With the action class, a container for any measure is specified. With the entire model, the capabilities of a specific digitized real system landscape are documented as a multi-attribute system description.

If all the artefacts are also measured and controlled, a sustainable management can be guaranteed. In this manner one can assure:

- standardization: speak the same language, support measurability and control;
- digitalization: reduce maintenance and improve quality, guarantee traceability;
- collaboration: manage the whole and not just the part, improve quality;
- visualization: empower people, get a common understanding;
- automation: enable, optimize, and improve availability;
- industrialization: improve productivity, efficiency, and effectiveness.

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Indicators concerning financial performances

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Abstract

The aim of the paper is to presents the main aspects concerning performances and financial competitiveness of an enterprise, through classical or modern indicators. Enterprise profitability is dimensioned by their results which are obtained by using the production factors, all these results being indicated in the profit and loss account. Performances could be assessing on three aspects: patrimonial, economic and financial.

Keywords: profit, performance, profitability, competitiveness, profit and loss account.

1. Introduction

One of the most important path to measure an enterprise success are their financial performances, because only achieving performances is possible to obtain growth and progress.

Enterprises financial performances are measured usually through profits and profitability ratios. The ultimate goal of an enterprise, to exist and remain on the competitive market is to obtain profit. Enterprise profitability is dimensioned by their results which are obtained by using the production factors, all these results being indicated in the "profit and loss account".

But the word "performance" is more frequently used to express different terms such us: growth, return, profitability, productivity, competitiveness (Colasse, 2009). The author used word "performativity" to express all these different terms.

Usually performances and financial competitiveness expresses a form of success, or a result of an action leading to success.

The indicators used to measure the enterprises performances and financial competitiveness are very diverse, some of them being classified as classical indicators or as modern indicators. Also, performances could be assessing on three aspects: patrimonial, economic and financial.

In financial diagnosis the performance of a company is associated to its capacity of obtaining profit, or generally is mostly associated to its profitability, so that profitability indicators are widely accepted to measure performances (Monea, Guță, 2011).

In order to measure profitability can be used two categories of indicators: the profit and profitability ratios. The profit is an indicator reflecting financial performances as an absolute measure, such us: turnover, operational result, financial result, extraordinary result, gross result or net result. The profitability ratios are used as a relative measure, such us: economic profitability ratio, financial profitability ratio, commercial profitability ratio, or the used resources profitability ratio.

2. The Profit and Loss Account as Main Information Source. The Structure of the Profit and Loss Account

The profit and loss account is a synthesis accounting document, part of the financial statement reporting enterprise financial performances during of a specified accounting period. The profit and loss account summarizes all revenues earned and expenses of an accounting period and reports the results. The profit and loss account is

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useful to determine enterprise's net profit or loss (difference between revenue and expenses).

The profit represents the main component of company's wealth and it reflects both the performance and its capacity to reinvest or allow dividends (Popescu, 2009).

The expenses are decreases of the economic benefits recorded during the accounting period, and the revenues are increases of the economic benefits recorded during the accounting period. In profit and loss account expenses and revenues are structured by the activity in 3 segments: operational, financial and extraordinary.

The form of profit and loss account is different from one country to another according to the informational content and ways of displaying the information (Vâlceanu et.al., 2005).

According to the informational content it can distinguish:

- The profit and loss account with the presentation of the revenues and expenses by their nature;
- The profit and loss account with the presentation by the destination of operating expenses.

According to the ways of displaying the information it can distinguish:

- The profit and loss account in the form of a list (vertically) that presents the results step by step;
- The profit and loss account in the form of account (like a bilateral table) where on the left side are presented expenses and profits and on the right side are presented the revenues and losses.

According to accounting regulations, the content of the Profit and Loss Account is the following:

1. Net turnover
2. Variation in inventory of finite goods and production in progress
3. Production realized by the entity for its own purposes and capitalized
4. Other operating revenue
5. a) Expenses on raw materials and consumable materials

b) Other external expenses

6. Personnel expenses:

a) Salaries

b) Social protection expenses with a separate indication of those covering pensions

7. a) Adjusting value on fixed tangible and intangible assets

b) Adjusting value on current assets, in case of those exceeding adjusting value which are normal in the entity

8. Other operating expenses
9. Revenues from participation interest with distinct indication of those obtained from affiliated entities
10. Revenues from other investments and credentials which are part of fixed assets with distinct indication of those obtained from affiliated entities
11. Other interest receivable and similar revenues with distinct indication of those obtained from affiliated entities
12. Adjusting value on financial assets and investments held as current assets
13. Interests payable and similar expenses with distinct indication of those obtained from affiliated entities
14. Profit or loss from ordinary activity
15. Extraordinary revenues
16. Extraordinary expenses
17. Profit or loss from extraordinary activity
18. Profit tax
19. Other taxes that do not appear above
20. Profit or loss of the financial exercise

In financial analysis it is used the structure of profit and loss account taking into consideration five levels corresponding to the activity types, economical, financial and extraordinary which allows the determination of the results flow as a return margins – (Petrescu, 2010).

3. The Intermediate Management Account Balances

In financial practice these indicators are used to determine the results obtained to different levels of activity (Dobrotă and Chirculescu, 2009).

The specific intermediate management account balances are:

Turnover is an important indicators which shows the economic performances of an enterprise expressing the revenues obtained from current commercial activities of the enterprise. As an indicator of profit and loss account the turnover is formed by production sold and sales of goods and services from the current activity. In turnover analysis are used operational ratios such as net turnover, average turnover, marginal turnover, break-even point. Also important are the analysis of the dynamics of turnover (which gives information about the dynamics of the activity or the importance of the enterprise in its field of activity), the analysis of the turnover structure and the factorial analysis of the turnover (Lala Popa and Miculeac, 2010).

Commercial margin reflects the surplus from the sale of goods and supply cost of goods sold. For commercial companies is useful to made a structural analysis per types of merchandise or distribution areas, and to determine the average rate of the commercial margin.

Production of the exercise is an indicator which measures the global volume of activity, and is used especially in case of the industrial enterprises. It is calculated taking into consideration three elements: value of sold production at selling price, stored production and value of immobilized production.

Added Value is the surplus of value which results from the profit relative to operating activity, resulted after covering the costs of invested capitals (Lala Popa and Miculeac, 2010). It is calculated as a difference between the global volume of the activity and the intermediary consumption, representing the surplus value obtained by the enterprise during the financial exercise, from professional activities and goods and services from third parties through the utilization of its human, technical and financial resources.

Added value analysis is a very complex issue being necessarily to study added value dynamics, the structural changes that appear on its constitutive elements and the analysis of the efficiency indicators computed on the basis of the added value.

It is also an important element on the decision-making process both at the microeconomic level and macroeconomic level.

Gross operating surplus is the first significant intermediate result related to the profitability of the enterprise, reflecting the result of the operational activity which contributes to the formation of the results. It is the indicator which reflects the commercial and industrial performances of the enterprises, being also independent from fiscal policy and financial policy. The indicator can be used in comparative analysis, in time, in space, with results of the similar enterprises activating in the same field of activity.

Operational result is a results computed directly as a difference between revenues and expenses from operating activity, reflecting also the commercial and industrial performances of the enterprises

Financial result reflects the result from financial operations being computed as a difference between financial revenues and financial expenses.

Current result reflects the result obtained by the enterprise from usual activities and it is calculated by summed between the operational result and financial result, it not taking into account the extraordinary elements.

Extraordinary result is computed as a difference between extraordinary revenues and extraordinary expenses and reflects the unusual elements from enterprise activity.

The gross profit (profit or loss before taxation) reflects the profit or loss from activity and it is calculated as a difference between total revenues and total expenses.

The net result of the exercise is the result which takes into consideration both current and extraordinary results being adjusted by profit tax and the employee participation to the result.

Starting from result it is possible to define and determine the capacity of self-financing, self-financing, and cash-flow (Petrescu, 2010).

4. Profitability Ratio Analysis

The profitability ratio is a relative measure that expresses the degree in which the capital generates profit (Popescu, 2009). The profitability ratios are the most synthetically indicators which reflects the efficiency and financial competitiveness of the enterprises.

Depending on the values taking into consideration when computing profitability ratios, these can takes various forms. We can take into consideration gross or net profit expressing effects and capital, consumed resources, cost of production, sold production.

Profitability ratios expressing efficiency and competitiveness have a more informational power than the indicators which are reported by absolute values.

The easiest form of profitability analysis is to relate reported net profit (net income) to the total assets on the balance sheet – return on assets (Helfert, 2006).

$$\text{Re}\,turn\ on\ assets = \frac{Net\ \text{Pr}\,ofit}{Assets} \times 100 \tag{1}$$

Return on equity allows appreciate the return on the owners' investment is the relationship of net profit to equity, or total shareholders' investment, by dividing net profit to equity.

$$\text{Re}\,turn\ on\ equity = \frac{Net\ \text{Pr}\,ofit}{Equity} \times 100 \tag{2}$$

Commercial profitability ratio is calculated depending on result (net profit) and turnover.

$$Comercial\ profitability\ ratio = \frac{Net\ Profit}{Turnover} \times 100 \quad (3)$$

Profitability ratio at costs is a ratio between the results afferent to all activities and the cost of goods sold.

$$Profitability\ ratio\ at\ costs = \frac{Gross\ Profit}{Cost\ of\ goods\ sold} \times 100 \quad (4)$$

The principal financial performance for management is p*rofitability through: r*eturn on assets (after taxes), return before interest and taxes, return on current value basis; economic added value and economic profit, cash flow return on investment, free cash flow. (Helfert, 2006).

5. Conclusions

Analysis of the indicators concerning performances is more complex and is completed by taking in discussion for each result the following aspects: dynamics analysis, the analysis of the result structure and factorial analysis of each result. Results analysis and profitability analysis are essential to measure the performances and financial competitiveness of the enterprises. A strong interest in measuring enterprise performances are mainly the managers, creditors, investors and customers.

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OMFP 1802/2014 - pentru aprobarea Reglementărilor contabile privind situațiile financiare anuale individuale şi situațiile financiare anuale consolidate

Some aspects concerning cost and evaluation of mineral resources

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Abstract

This paper presents some aspects concern evaluation of mineral resources. According International Financial Reporting Standards mineral resources are exploring and evaluating at cost. An entity shall determine an accounting policy specifying which expenditures are recognized as exploration and evaluation assets and apply the policy consistently. In making this determination, an entity considers the degree to which the expenditure can be associated with finding specific mineral resources. At the end of the paper I disseminate some conclusions of the study according the IFRS 6.

Keywords: mineral resources, cost, evaluation, exploration, intangible assets, tangible assets, accounting policy, expenditure, IFRS, IAS, financial statements, tretments, expenses, mineral rights.

1. Cost of mineral resources

Exploration and evaluation assets shall be measured at cost. International Financial Reporting Standards prescribes a treatments for evaluation of mineral resources.

An entity shall classify exploration and evaluation assets as tangible or intangible according to the nature of the assets acquired and apply the classification consistently.

Some exploration and evaluation assets are treated as intangible (e.g. drilling rights), whereas others are tangible (e.g. vehicles and drilling rigs). To the extent that a tangible asset is consumed in developing an intangible asset, the amount reflecting that consumption is part of the cost of the intangible asset. However, using a tangible asset to develop an intangible asset does not change a tangible asset into an intangible asset.

Mineral rights and mineral reserves such as oil, natural gas and similar non-regenerative resources.

Many activities in the oil, gas and mineral extraction industries involve jointly controlled assets. For example, a number of oil production companies may jointly control and operate an oil pipeline. Each venturer uses the pipeline to transport its own product in return for which it bears an agreed proportion of the expenses of operating the pipeline. Another example of a jointly controlled asset is when two entities jointly control a property, each taking a share of the rents received and bearing a share of the expenses.

1.1. Elements of cost of exploration and evaluation assets

An entity shall determine an accounting policy specifying which expenditures are recognised as exploration and evaluation assets and apply the policy consistently. In making this determination, an entity considers the degree to which the expenditure can be associated with finding specific mineral resources.

$$C=E1+E2+E3+E4+E5+E6+E7, \quad (1)$$

where:

E1 - acquisition of rights to explore;

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E2 - topographical, geological, geochemical and geophysical studies;
E3 - exploratory drilling;
E4 - trenching;
E5 - sampling;
E6 - activities in relation to evaluating the technical feasibility and commercial viability of extracting a mineral resource;
E7 – other expenditures.

Expenditures related to the development of mineral resources shall not be recognised as exploration and evaluation assets. The *Framework* and IAS 38 *Intangible assets* provide guidance on the recognition of assets arising from development.

In accordance with IAS 37 *Provisions, contingent liabilities and contingent assets* an entity recognises any obligations for removal and restoration that are incurred during a particular period as a consequence of having undertaken the exploration for and evaluation of mineral resources.

After recognition, an entity shall apply either the cost model or the revaluation model to the exploration and evaluation assets. If the revaluation model is applied (either the model in IAS 16 *Property, plant and equipment* or the model in IAS 38) it shall be consistent with the classification of the assets.

1.2. Changes in accounting policies

An entity may change its accounting policies for exploration and evaluation expenditures if the change makes the financial statements more relevant to the economic decision-making needs of users and no less reliable, or more reliable and no less relevant to those needs. An entity shall judge relevance and reliability using the criteria in IAS 8.

To justify changing its accounting policies for exploration and evaluation expenditures, an entity shall demonstrate that the change brings its financial statements closer to meeting the criteria in IAS 8, but the change need not achieve full compliance with those criteria.

2. Impairement

An exploration and evaluation asset shall no longer be classified as such when the technical feasibility and commercial viability of extracting a mineral resource are demonstrable. Exploration and evaluation assets shall be assessed for impairment, and any impairment loss recognised, before reclassification.

2.1. Recognition and measurement

Exploration and evaluation assets shall be assessed for impairment when facts and circumstances suggest that the carrying amount of an exploration and evaluation asset may exceed its recoverable amount. When facts and circumstances suggest that the carrying amount exceeds the recoverable amount, an entity shall measure, present and disclose any resulting impairment loss in accordance with IAS 36.

One or more of the following facts and circumstances indicate that an entity should test exploration and evaluation assets for impairment (the list is not exhaustive):

- the period for which the entity has the right to explore in the specific area has expired during the period or will expire in the near future, and is not expected to be renewed;
- substantive expenditure on further exploration for and evaluation of mineral resources in the specific area is neither budgeted nor planned;
- exploration for and evaluation of mineral resources in the specific area have not led to the discovery of commercially viable quantities of mineral resources and the entity has decided to discontinue such activities in the specific area;
- sufficient data exist to indicate that, although a development in the specific area is likely to proceed, the carrying amount of the exploration and evaluation asset is unlikely to be recovered in full from successful development or by sale.

In any such case, or similar cases, the entity shall perform an impairment test in accordance with IAS 36. Any impairment loss is recognised as an expense in accordance with IAS 36.

2.2. The level at which exploration and evaluation assets are assessed for impairment

An entity shall determine an accounting policy for allocating exploration and evaluation assets to cash-generating units or groups of cash-generating units for the purpose of assessing such assets for impairment. Each cash generating unit or group of units to which an exploration and evaluation asset is allocated shall not be larger than an operating segment determined in accordance with IFRS 8 O*perating segments*.

The level identified by the entity for the purposes of testing exploration and evaluation assets for impairment may comprise one or more cash-generating units.

3. Conclusions

When preparing financial statements, management shall make an assessment of an entity's ability to continue as a going concern. Financial statements shall be prepared on a going concern basis unless management either intends to liquidate the entity or to cease trading, or has no realistic alternative but to do so. When management is aware, in making its assessment, of material uncertainties related to events or conditions that may cast significant doubt upon the entity's ability to continue as a going concern, those uncertainties shall be disclosed. When financial statements are not prepared on a going concern basis, that fact shall be disclosed, together with the basis on which the financial statements are prepared and the reason why the entity is not regarded as a going concern.

In assessing whether the going concern assumption is appropriate, management takes into account all available information about the future, which is at least, but is not limited to, 12 months from the balance sheet date. The degree of consideration depends on the facts in each case. When an entity has a history of profitable operations and ready access to financial resources, a conclusion that the going concern basis of accounting is appropriate may be reached without detailed analysis. In other cases, management may need to consider a wide range of factors relating to current and expected profitability, debt repayment schedules and potential sources of replacement financing before it can satisfy itself that the going concern basis is appropriate.

Exploration and evaluation expenditures recognised as assets in accordance with the entity's accounting policy.

The objective of IFRS 6 is to specify the financial reporting for the exploration for and evaluation of mineral resources.

In particular, the IFRS requires:

a) limited improvements to existing accounting practices for exploration and evaluation expenditures;

b) entities that recognise exploration and evaluation assets to assess such assets for impairment in accordance with IFRS 6 and measure any impairment in accordance with IAS 36 Impairment of assets;

c) disclosures that identify and explain the amounts in the entity's financial statements arising from the exploration for and evaluation of mineral resources and help users of those financial statements understand the amount, timing and certainty of future cash flows from any exploration and evaluation assets recognised.

An entity shall apply the IFRS to exploration and evaluation expenditures that it incurs.

The IFRS does not address other aspects of accounting by entities engaged in the exploration for and evaluation of mineral resources.

An entity shall not apply the IFRS to expenditures incurred:

a) before the exploration for and evaluation of mineral resources, such as expenditures incurred before the entity has obtained the legal rights to explore a specific area;

b) after the technical feasibility and commercial viability of extracting a mineral resource are demonstrable

An entity shall disclose information that identifies and explains the amounts recognised in its financial statements arising from the exploration for and evaluation of mineral resources.

Also an entity shall disclose:

a) its accounting policies for exploration and evaluation expenditures, including the recognition of exploration and evaluation assets;

b) the amounts of assets, liabilities, income and expense and operating and investing cash flows arising from the exploration for and evaluation of mineral resources.

An entity shall treat exploration and evaluation assets as a separate class of assets and make the disclosures required by either IAS 16 or IAS 38 consistent with how the assets are classified.

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Analysis of entrepreneurs and small and medium enterprises in Serbia

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Abstract

Small and medium-sized enterprises (SME’s) is a significant segment of the Serbian economy which make up 99.8% of the total active businesses, employing nearly 2/3 of employees in the non-financial sector and account for about 30% of GDP in the formation of Serbia. In this paper is given an overview of SME’s state and prospects for 2013 year for which statistical data was available. Increasing the level of development and competitiveness of small and medium enterprises (SME) is the backbone of economic development in Serbia. The transition period is characterized by a number of reform measures and activities of Serbian government, especially in the field of structural changes in the economy, and therefore the continued growth and development of SMEs.

Keywords: SME’s; economy; development; analysis.

1. Introduction

The policy framework for small and medium enterprises since 2008 was the strategy of development of competitive and innovative small and medium enterprises for the period 2008 to 2013, and during the process of making new Strategy for the development of entrepreneurship and competitiveness for the period from 2014. By 2020 the strategy is largely aligned with the Small Business Act, a document that represents the official policy framework, the development of SMEs in the European Union.

The crisis is most evident at the SME. The accelerated pace of increase in the level of development and competitiveness interrupted in 2008. The slow recovery of this segment of the financial sector in the post-crisis years, VAT, employment and productivity in 2013 did not reach the level of 2007, shows that the growth and development at the beginning of the transitional period, is a result of their low starting development base. In the entire transition period, SME’s did not grow to the moving force of development and overall economic progress of the country. Large enterprises (0.2% of the total number of enterprises), with unfinished structural reforms and cumulative unsolved development problems, have a major impact on the functioning of the non-financial sector. There are several studies examining the state of SME’s in Bulgaria (Ahmedova 2015), India (Kumar et al. 2015), Spain (Larrán Jorge 2015; Ruiz Puente et al. 2015), Slovakia (Lesáková 2014; Sedliacikova et al. 2015), Turkey (Şener et al. 2014), Korea (Shin et al. 2015), Romania (Stanciu 2014), Mexico (van Hoof & Thiell 2014; Ríos-Manríquez et al. 2014). General research on efficiency, performance, risk assessment and innovation is discussed in papers by (Cagno & Trianni 2014; Kumlu 2014; Nyirendaavwil et al. 2015; Olevsky & Dunska 2014; Ošenieks & Babauska 2014; Wood et al. 2015; Zulkepli et al. 2015). Some of the macroeconomic indicators of SME are presented in papers (Dašić 2012, 2016).

2. 2. State of SME’s in Serbia

Small and medium enterprises, despite the poor results compared to the previous year, retained in 2013 a relatively high proportion of formation of basic indicators of non-financial corporate sector in Serbia: generates about 2/3 of employment and turnover, 54.1% GDP and a share of 43.2% in exports of non-financial sector. In 2013, the number of

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SME's has been reduced by 0.6% or 1,750. Only the number of micro enterprises increased by 2,586 or 3.3% of SMEs sector employment decreased in 2013 to 13,467 workers or 1.7%, leading to a reduction in the share of SME's sector in employment if non-financial sector by 0.2%. Turnover of SMEs sector in real terms decreased by 6.8% compared to the year 2012, measured in constant prices of 2013 and caused a decrease in participation of SME's non-financial sector in trade of 1.1%, where the total real turnover decline in non-financial sector in 2013 amounted to 5.3%.

In 2013 there was a real GDP decline of 8.5% in the SME sector, measured in constant prices from 2013 (in the whole non-financial sector, the decline was 5.6%), which contributed to the reduction of the share of the SME sector in the formation of non-financial GDP sector by 1.7%. In Table 1 is shown the number of business entities for selected period.

Table 1 - Number of business entities in the period 2004-2013

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Small	7.742	8.030	9.027	9.874	10.415	9.873	9.614	9.656	9.699	9.353	9.198
Micro	64.473	64.254	64.069	71.065	75.540	76.243	77.989	78.890	79.189	81.775	81.327
Entrepreneurs	210.431	201.959	192.919	212.575	214.819	226.241	228.680	228.540	226.132	222.152	231.616
Medium	2.493	2.452	2.500	2.572	2.675	2.470	2.257	2.218	2.142	2.132	2131
Large	769	694	638	598	568	529	504	498	506	494	494
SME	285.139	276.695	268.515	296.086	303.449	314.827	318.540	319.304	317.162	315.412	324.272

Weaker results were recorded also in foreign trade, data is given on Table 2. The real decline in exports of SMEs from 3.5%, measured in constant prices from 2013, in contrast with the trend of export growth around the non-financial sector (an increase of 14.3% in the non-financial sector), and led to a significant decrease in the share of the SME sector in exports of non-financial sector from 51.1% in 2012 to 43.2% in 2013. It should be borne in mind that in such a big difference most significant impact especially high growth of large enterprises, mainly in the automotive industry. SME sector in 2013 also registered a decline in imports, foreign trade deficit and the share of imports in the import of non-financial sector. However, the SME share of the deficit in the non-financial sector deficit was significantly increased from 74% to as much as 91.5% due to a much better foreign trade results of large companies.

Table 2 - Indicators of development of SME's

	SME		**Non-financial sector**		**% of SME's**	
	2012	**2013**	**2012**	**2013**	**2012**	**2013**
No. of enterprises	317.162	315.412	317.668	315.906	99.8	99.8
No. of employed	782.026	768.550	1.202.045	1.184.944	65.1	64.9
Turnover (mil RSD)	6.133.460	5.713.857	9.379.820	8.881.835	65.4	64.3
GDP (mil RSD)	1.053.301	964.007	1.887.944	1.781.655	55.8	54.1
Export (mil RSD)	537.799	519.075	1.052.524	1.202.797	51.1	43.2
Import (mil RSD)	1.049.300	938.186	1.743.790	1.660.812	60.2	56.5
Commodity balance (mil RSD)	-511.501	-419.111	-691.247	-458.015	74.0	91.5
Investments (mil RSD)	298.733	-	677.438	-	44.1	

Reducing the number of SMEs in 2012 and 2013 was the result of difficult business conditions in the country, expressed insolvency accompanied by reduced opportunities for financing and realisation in the domestic and foreign markets. Adverse effects are most evident in companies which have insufficient economic and competitive force on the market - entrepreneurial activities, as well as medium-sized enterprises whose business is burdened with significant development problems.

3. Development of SME's in Serbia

A stable macroeconomic environment is an essential prerequisite for the dynamic development of small and medium enterprises. The beginning of recovery of the Serbian economy in 2013 indicate increased economic activity (real GDP growth of 2.5%), low level of inflation (2.2% versus 12.2% in 2012), the increase in foreign currency reserves (11.2 billion RSD according to 10.9 billion RSD in 2012) and FDI (2.4% of GDP by 0.8% in 2012), reduction of the fiscal (5.0% of GDP by 6.4% in 2012) and the current account deficit (5.0% of GDP vs. 10.5% in 2012).

Crucial development problems of the Serbian economy are unemployment (unemployment rate 23.0%) and the high level of constant growth of external debt (25.8 billion Euros) and public debt (20.1 billion Euros) and a low level of investment, especially FDI (2,4% of GDP). also the dynamics of the recovery of the EU countries, has a direct impact on the international economic position of the country - no progress of the EBRD sectoral transition indicator (2.58), still unfavorable business environment (91st position out of 189 countries) and the least competitive European country (101 position out of 148 countries). The unfavorable international situation of the national economy directly affects the positioning of SMEs in Serbia in relation to the number of SMEs of the EU and neighboring countries. In Table 3 is given the number of small and medium enterprises by category for 2013 year.

Table 3 - Number of SME's by category for 2013

Sectoral schedule of SME's	**No**	**% share**
Wholesale and retail	94.605	30,0
Manufacturing industry	50.043	15,9
Professional, scientific and innovation activities	36.926	11,7
Transportation and storage	32.082	10,2
Construction	23.240	7,4
Accommodation and food services	22.773	7,2
Other service activities	18.565	5,9
Information and communication	8.663	2,7
Administrative and service activities	7.634	2,4
Agriculture, forestry and fishing	5.749	1,8
Health and social care	4.309	1,4
Financial and insurance	2.343	0,7
Arts, entertainment and recreation	2.242	0,7
Education	2.061	0,7
Real estate business	1.773	0,6
Water supply and wastewater management	1.242	0,4
Supply of electricity, gas and steam	698	0,2
Mining	441	0,1
Non-financial sector	315.412	100,0

Serbia in 2013 did not record progress in any sector, so that it maintained its last year's overall average grade (2.56) for the progress of the EBRD sectoral transition indicators (Reports of the EBRD). According to the Report of Operations 2015, Serbia was ranked 91st position, in the middle of total 189 countries (77th position in the previous report). When the order of 189 countries reduces to normalized rank of 0 (worst) to 100 (best), Serbia is at the 48th place. European countries, Serbia has the upper hand only from Bosnia and Herzegovina and Malta, which indicates a still unfavourable business environment, and according to

Competitiveness Report 2014-2015 World Economic Forum, Serbia was in 2013 the least competitive country in the European continent (101 ranking of 148 countries), while in 2014 only more competitive than Albania (94th out of 144 countries). Table 4 shows data on number of SME's by category in Serbia.

Table 4 - Number of SME's by category and region

	Total	Small 10–49 employees	Medium 50–249 employees
REPUBLIC OF SERBIA		**9198**	**2131**
Agriculture, forestry and fishing		360	97
Mining and quarrying		46	10
Manufacturing		2489	825
Electricity, gas and steam supply		43	26
Water supply; sewerage, waste management and remediation activities		138	133
Construction		784	180
Wholesale and retail trade; repair of motor vehicles and motorcycles		2611	359
Transportation and storage		590	118
Accommodation and food service activities		340	68
Information and communication		433	83
Financial and insurance activities		34	11
Real estate activities		52	10
Professional, scientific and technical activities		793	96
Administrative and support service activities		295	62
Public administration and defence; compulsory social security		4	1
Education		34	3
Human health and social work activities		23	18
Art, entertainment and recreation		65	27
Other service activities		64	4
Activities of households as employers		-	-

4. Usage of information technologies by SME's in Serbia

The development of information and communication technologies (ICT), the Internet and other elements of information technology have changed the basic factors of competitiveness of enterprises, so that the knowledge, innovations and information are becoming the most important sources of competitive advantage in the globalized market. Internet and ICT have become the basis for the development of modern economy based on innovation and entrepreneurship, as they allow: to develop products and services that are based on knowledge and application of high technology, the transformation of traditional activities in the direction of their digitization (developing e-commerce, e-banking, e-learning , email marketing, etc.), the development of a completely new activities (Social networks, services for connecting, networking, storage and exchange of data), the development of new forms of organization of companies (virtual enterprises) and others. All these changes require a new way of thinking and operating SMEs and their intense involvement in global value chains and global markets.

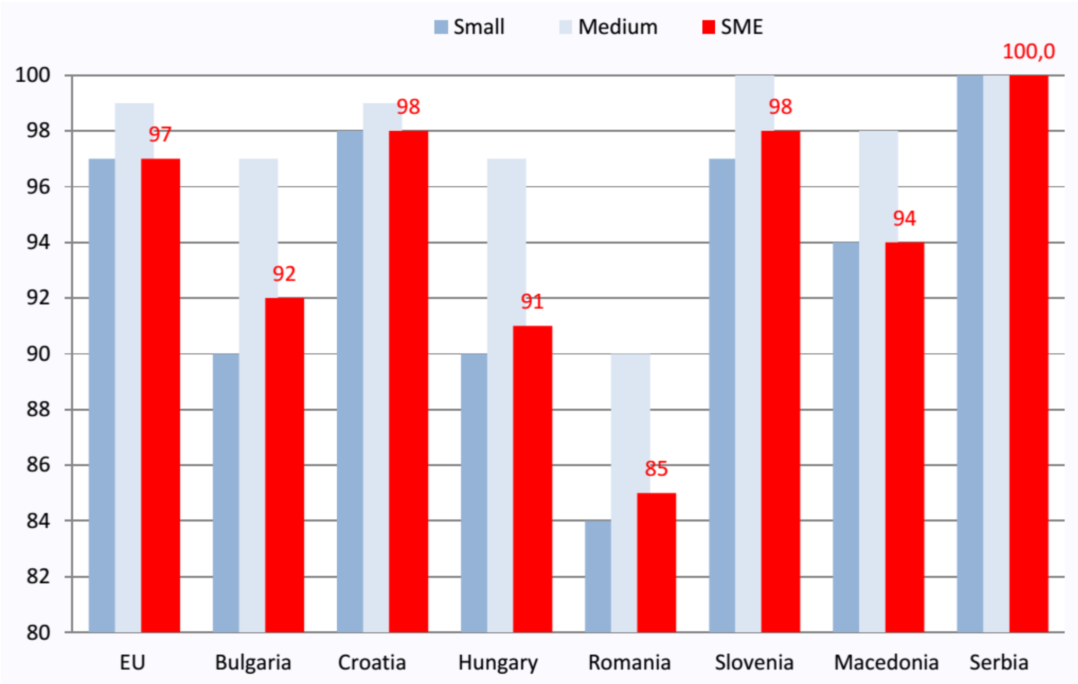

Figure 1. Usage of IT in SME's

SMEs in Serbia use more computers in business compared to the average of the five member countries of the European Union from the environment (Bulgarian, Croatian, Romanian and Slovenian) and Macedonia. Of the countries surveyed, the lowest use of computers was in Romania. Below average EU are also Hungary, Bulgaria and Macedonia, and above average, except Serbia, have only Slovenia and Croatia. Within SMEs, medium-sized companies increasingly using computers in business compared to small businesses, which is most prevalent in Bulgaria, Hungary and Romania as can be seen in Figure 1.

Conclusion

Basic recommendations for increasing the level of development of the entrepreneurial sector in the context of the overall economic activity is the initiation of using the new model of growth based on export demand, increasing employment, investment, reduce public spending, the strengthening of the industrial sector in parallel with the development of the service sector and the like. In the context of improving the existing measures and activities, pay special attention to the development of dynamic entrepreneurship.

Establishing rounded incentive system and solving key problems of enterprise development in the growth and development based on the practice of developed countries of the OECD and the EU to consider specific measures as part of the process of building a system to encourage the development of dynamic companies.

Moving from policy support throughout the SME sector (improving the business environment in order to encourage the opening of more new entrepreneurial firms) the policy to encourage dynamic entrepreneurship, which is dedicated to creating an environment conducive to entrepreneurial growth companies and will encourage talented people with a clear vision of the future work to begin independent work.

Changing the current way of financing (public sources, different forms of grants, subsidies and soft loans), relying on a combination of public and private sources, in the form of loans for research and development and innovation grants, funding from business angels, with the involvement of venture capital and issuing securities.

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Analysis of wholesale and retail trade in Serbia

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Abstract

In this paper is given the analysis of domestic trade statistics which covers wholesale and retail turnover of goods for period of fifteen years. Trade activity data for Serbia originate from Statistical Office of the Republic of Serbia and are based on accounting and other business documentation of organizations. Wholesale and retail trade statistical data cover all business subjects (enterprises and organizations) or their units dealing with all ownership trade activity sectors, and retail trade includes entreprenours' shops. Results show that higher rate of trade had retail market than wholesale which has a consequence that the average annual growth rate (AAGR) for wholesale is 9.99% while for the retail market is 21.29%.

Keywords: wholesale; retail; trade analysis; Serbia.

1. Introduction

Wholesale exchange represents an economic indicator which measures the worth in a given currency of all vendor wholesalers' deals and inventories. Wholesale exchange is one segment of business deals and inventories. Just those organizations which offer to governments, foundations and different organizations are considered some portion of wholesale exchange. Retailers are business firms occupied with offering products and administrations specifically to shoppers. In most-however not all-cases, retail outlets are principally worried with offering stock. Regularly, such organizations offer individual units or little groupings of items to vast quantities of clients. A minority of retailers, in any case, likewise gather wage through rentals instead of by and large offers of merchandise (as on account of ventures that offer furniture or cultivating devices for rent) or through a mix of items and administrations (as on account of an attire store that may offer free adjustments with the buy of a suit).

According to OECD glossary retail trade is defined in the International Standard Industrial Classification (ISIC) as the re-sale (sale without transformation) of new and used goods to the general public, for personal or household consumption or utilization. Retail trade includes the following: non-specialised retail trade in stores; retail sale of food, beverages and tobacco in specialized stores; other Retail trade of new goods in specialized stores; retail sale of second-hand goods in stores and retail trade not in stores.

Various research was conducted on retail trade with most significant being: retail-center viability (Banai & Antipova 2016), Multi-Channel Grocery Sector analysis (Breugelmans et al. 2016), analysis of fulfillment errors (Craig, et al. 2015), big data analysis (Gaku & Takakuwa 2016), product availability in retail stores (Grubor & Milicevic 2015), segmentation of retail customers (Gupta et al. 2016), empirical analysis of the US retail industry (Hançerlioğulları et al. 2016), Chinese total retail sales (Jia & Xu 2016), analysis of Czech customers in retail (Kučera, 2015), Correlation analysis of products prices in the supermarket (Pereira, et al. 2016), retail banking (Leasure 2016), adaptability analysis of system for retail (Li, 2016), dynamic analysis of regulations and productivity (Maican & Orth 2015).

OECD glossary also defines the term of wholesale trade as a form of trade in which goods are purchased and stored in large quantities and sold, in batches of a designated quantity, to resellers, professional users or groups, but not to final consumers. Wholesale includes the following groups: wholesale on a fee or contract basis; wholesale of agricultural raw materials and live animals; wholesale of food, beverages and tobacco; wholesale of household goods; wholesale of non-

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agricultural intermediate products, waste and scrap; wholesale of machinery, equipment and supplies and other wholesale.

Wholesale trade was analyzed in a large number of publications, from different aspects and applications. We can highlight some of the most notable research in this area: wholesale markets analysis in Turkey (Albayrak, 2010), empirical analysis of cheese wholesale in Chicago (Bolotova & Novakovic 2015), analysis of broadband access network wholesale (Francis, 2007), analysis of market power in Colombia (Gallego, et al. 2011), merger analysis in wholesale (Hesamzadeh & Biggar 2013), Osaka wholesale market (Kawamura & Ohsuga 2016), wholesale energy markets (Kiani & Annaswamy 2014), agricultural wholesale market of Korea (Kim & Yoon 2012), transportation costs wholesale (Konur & Toptal 2012), Empirical analysis of physical and electronic wholesale markets (Overby & Mitra 2014) and Italian and Greek electricity market wholesale (Papaioannou et al. 2015).

2. Data and methods

Data used in analysis originate form (Statistical Yearbooks of Serbia 2007,2015). To ensure comparability, the turnover value is shown at 2010 prices and dinars. For analysis and graphical presentation of the results, the standard methods of statistical and regression analysis were used presented in paper by (Dašić, 2001, 2012, 2016; Dašić et al., 2013; Chatterjee Hadi 2012). Analysis is performed using standard economic statistical indicators: Annual Growth (AG), Chain Index (CI), Average Growth Rate (AGR) and Cumulative Growth Index (CGI).

Turnover of goods in wholesale trade shows the value of goods delivered by wholesale trade enterprises/organizations to: domestic trade enterprises, other organizations for further processing, big consumers for their own consumption (health organizations, social insurance and welfare organizations, education, defense and other).

Turnover of goods in retail trade shows the value of goods delivered by retail trade enterprises/organizations to final consumers (primarily to final consumers for personal consumption or use in households, and to legal and physical entities for performing their activities).

3. Results and discussion

Table 1 present the turnover of wholesale for Serbia for the period 2005-2015 (Statistical Yearbooks of Serbia 2007, 2015) in mill. RSD, with calculated values for: annual growth (AG), chain index (CI) in [%], annual growth rate (AGR) in [%] and cumulative growth index (CGI) in [%]. On Fig. 1 is shown the turnover of wholesale for Serbia for the period 2005-2015 in mill. RSD and values of annual growth rate (AGR) in [%].

Table 1. Turnover of wholesale for Serbia for the period 2005-2015 in mill. RSD

Year	Wholesale	AG	CI [%]	AGR [%]	CGI [%]
2005	896990	-	-	-	100.00
2006	1108487	211497	123.58	23.58	123.58
2007	1311976	203489	118.36	18.36	146.26
2008	1544867	232891	117.75	17.75	172.23
2009	1586734	41867	102.71	2.71	176.90
2010	1763037	176303	111.11	11.11	196.55
2011	2022707	259670	114.73	14.73	225.50
2012	2259030	236323	111.68	11.68	251.85
2013	2278300	19270	100.85	0.85	253.99
2014	2209689	-68611	96.99	-3.01	246.34
2015	2255946	46257	102.09	2.09	251.50

Notes: annual growth (AG), chain index (CI) in [%], annual growth rate (AGR) in [%] and cumulative growth index (CGI) in [%].

From Table 1 and Fig. 2 can be noticed that the turnover of wholesale for Serbia for the period 2005-2015 in mill. RSD had a growth trend until 2012, and in 2014 year had a decrease trend (AGR for 2014 was -3.01%). Cumulative growth index (CGI) has increased in 2015 year for 251.50%, compared to 2005. Average annual growth rate (AGR), for turnover of wholesale for Serbia for the period 2005-2015 in mill. RSD, was 9.99%.

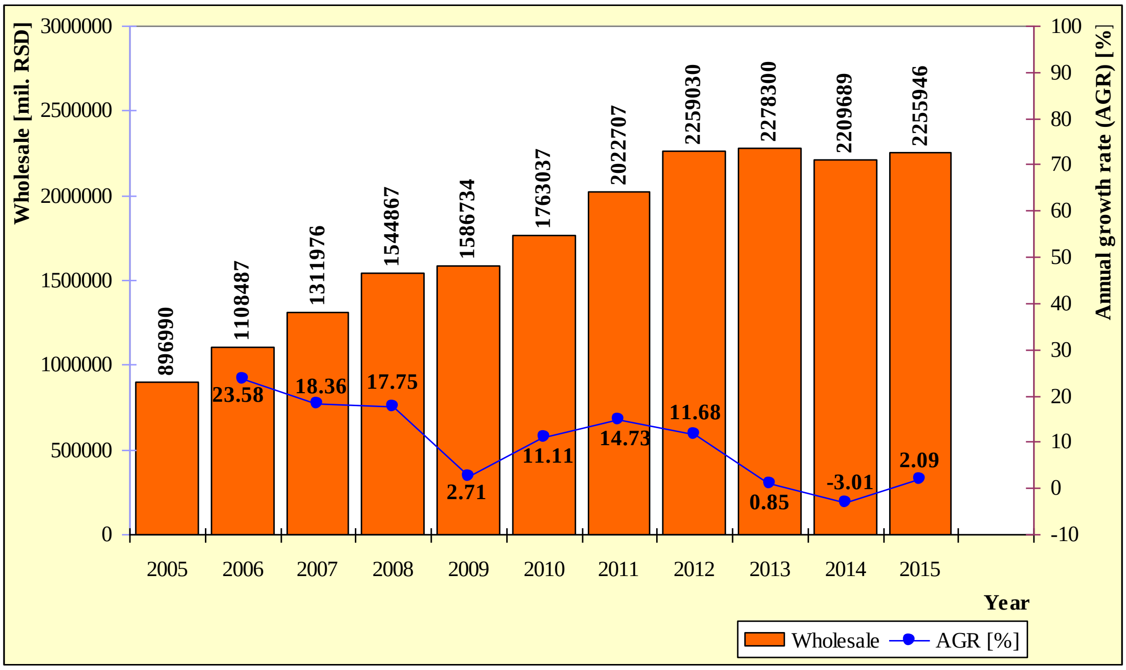

Figure 1. Graphical representation of turnover of wholesale for Serbia for the period 2005-2015 in mill. RSD and values of annual growth rate (AGR) in [%]

Table 2 present of turnover of retail for Serbia for the period 2000-2015 in mill. RSD, with calculated values for: annual growth (AG), chain index (CI) in [%], annual growth rate (AGR) in [%] and cumulative growth index (CGI) in [%]. On Fig. 2 is shown the turnover of retail for Serbia for the period 2000-2015 in mill. RSD and values of annual growth rate (AGR) in [%].

Table 2. Turnover of retail for Serbia for the period 2000-2015 in mill. RSD

Year	Retail	AG	CI [%]	AGR [%]	CGI [%]
2000	101529	-	-	-	100.00
2001	223238	121709	219.88	119.88	219.88
2002	301467	78229	135.04	35.04	296.93
2003	356930	55463	118.40	18.40	351.55
2004	460108	103178	128.91	28.91	453.18
2005	650503	190395	141.38	41.38	640.71
2006	791750	141247	121.71	21.71	779.83
2007	1021342	229592	129.00	29.00	1005.96
2008	1231758	210416	120.60	20.60	1213.21
2009	1130685	-101073	91.79	-8.21	1113.66
2010	1229199	98514	108.71	8.71	1210.69
2011	1118441	-110758	90.99	-9.01	1101.60
2012	1196095	77654	106.94	6.94	1178.08
2013	1203966	7871	100.66	0.66	1185.83
2014	1253924	49958	104.15	4.15	1235.04
2015	1269677	15753	101.26	1.26	1250.56

From Table 1 and Fig. 2 can be noticed that the turnover of retail for Serbia for the period 2000-2015 in mill. RSD had a growth trend until 2008, while in 2009 and 2011 year had a decrease trend (AGR for 2009 was -8.21% and for 2011 was -9.01%). Cumulative growth index (CGI) in 2015 year has increased for 1250.56 %, compared to 2000 year. Average annual growth rate (AGR), for turnover of retail for Serbia for the period 2000-2015 in mill. RSD, was 21.29%.

Table 3 present of total turnover (wholesale and retail) for Serbia for the period 2005-2015 in mill. RSD, with calculated values for annual growth (AG), chain index (CI) in [%], annual growth rate (AGR) in [%] and cumulative growth index (CGI) in [%]. On Fig. 2 is shown the total turnover (wholesale and retail) for Serbia for the period 2000-2015 in mill. RSD and values of annual growth rate (AGR) in [%].

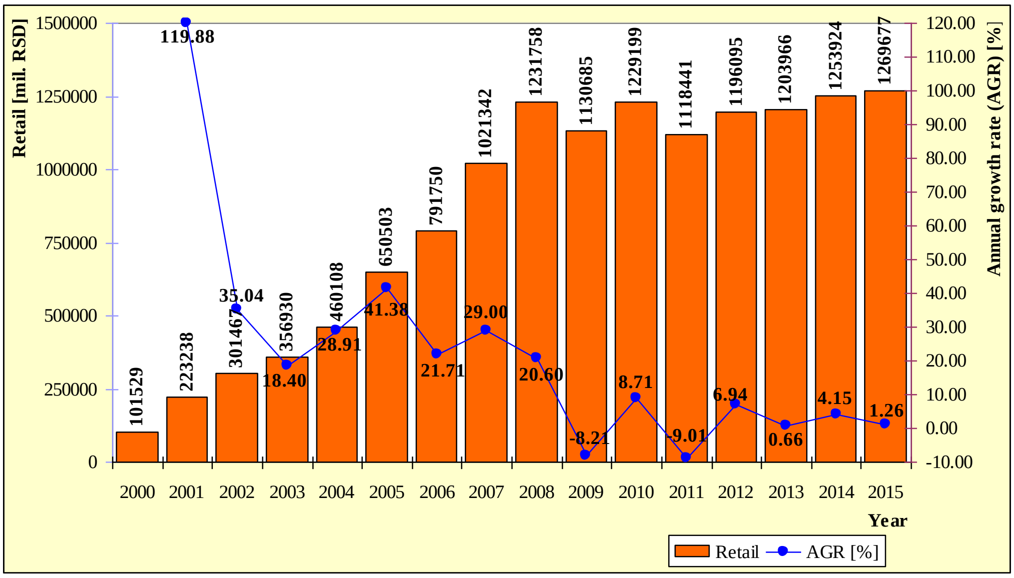

Figure 2. Graphical representation of turnover of retail for Serbia for the period 2000-2015 in mill. RSD and values of annual growth rate (AGR) in [%]

Table 3. Total turnover (wholesale and retail) for Serbia for the period 2005-2015 in mill. RSD

Year	Total	AG	CI [%]	AGR [%]	CGI [%]
2005	1547493	-	-	-	100.00
2006	1900237	352744	122.79	22.79	122.79
2007	2333318	433081	122.79	22.79	150.78
2008	2776625	443307	119.00	19.00	179.43
2009	2717419	-59206	97.87	-2.13	175.60
2010	2992236	274817	110.11	10.11	193.36
2011	3141148	148912	104.98	4.98	202.98
2012	3455125	313977	110.00	10.00	223.27
2013	3482266	27141	100.79	0.79	225.03
2014	3463613	-18653	99.46	-0.54	223.82
2015	3525623	62010	101.79	1.79	227.83

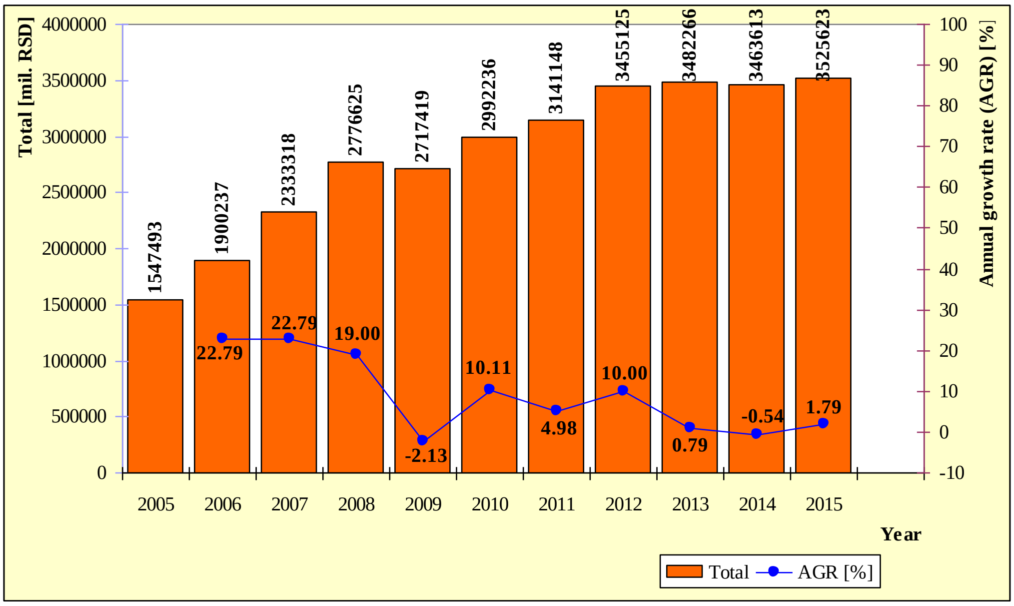

Figure 3. Graphical representation of total turnover (wholesale and retail) for Serbia for the period 2005-2015 in mill. RSD and values of annual growth rate (AGR) in [%]

From Table 3 and Fig. 3 can be noticed that total turnover of wholesale and retail for Serbia for the period 2005-2015 in mill. RSD had a growth trend for period 2005-2008, then for period 2010-2013, while in 2009 and 2014 year had a decrease trend (AGR for 2009 was -2.13 % and for 2014 was -0.54 %). Cumulative growth index (CGI) in 2015 year has increased for povećao za 227.83 %, compared to 2005. Average annual growth rate (AGR), for total turnover (wholesale and retail) for Serbia for the period 2005-2015 in mill. RSD, was 8.96 %.

4. Conclusion

In the paper wholesale and retail turnover of goods for period of fifteen years in Serbia was analyzed. Obtained results indicate a stable growth in total trade until the beginning of 2014 year after which a notable decline is apparent. Results also show significant increase in retail trade by 1250.56 % in a fifteen years period. This is a great indicator of steadily climbing goods consumption and overall domestic spending. Wholesale turnover showed devastating results with only 9,99% of growth in a ten year period indicating that reforms are needed in this area of domestic trade.

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Clustering conception in Poland

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Abstract

Clustering in the economy is not a new process. The clustering has come to Poland after 2000 years and the development of the concept of clustering dates back to these years. This article is about the development of the concept of clustering in Poland. It concerns the problems of clusters in Poland, in the theoretical part this elaboration. It concerns results from primary sources and it indicates perspectives for clustering in practice, in Poland - in practical parts this elaboration

Keywords: clusters, enterprise, network

In Polish cluster policy, identification and enforcement of clustering development processes have been observed. It results from a visible effect comprising an increase in the competitiveness of enterprises and regions in which they operate. The economy becomes a network orientated to a greater extent and interactions among economic and business partners increase. New specialisations have been developed, the R&D sector and internationalisation processes have increased importance. Clusters hitherto existing in Poland stimulated an increase in the effectiveness of entrepreneurs operating therein and even though they are characterised with a diversified economic potential, they became a “locomotive” of many regions. In many clusters a high indicator of partners’ synergy was achieved and thus, led to establishing new values and a faster adaptation of innovative solutions

1. The essence of clustering

Network interactions can occur in an organisation or in relations between organisations. Networks constitute a form of organisational coordination of cooperation. They can refer to enterprises supported by academic – research entities, governmental organisations, nongovernmental organisations and even parties. These are clusters’ network structures (Porter, M., 2001).

As soon as at the end of the last century, C. Jarillo (1995) referred to an organisation as a network, in which one company took a role of a main organisational controller and the material and nonmaterial inflows between companies ensure meeting final clients’ expectations effectively.

A cluster constitutes a specific network form, that is, “a geographical aggregate of companies interrelated and specialised, operating in the same or similar sectors and related with other institutions (university, industrial entities, standardisation entities) in particular industries; competing, but also cooperating among themselves.Clusters reaching critical mass and that are successful commercially constitute a characteristic feature of almost each national, regional an even metropolitan economy, mainly in developed countries”. (Porter, M.,2001). While accepting this definition as a base, one should also consider different forms of interpretation thereof verified in practice. Therefore, in the first years of the 21st century, different approaches to the conception of a cluster were defined and presented by foreign experts, while underlining selected elements of a network. It was reflected in the international literature from this period and, for example:

- Mytelka, L., Karinelli, F., (2000); Enright, F., (2001) underline concentration of enterprises in a given area and cooperation in the same or related industry and services sectors;

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- Best, M.H., (2001) defines a cluster while considering it as a company, in which engaged units transform into a network of entities interrelated with cause and effect relations; the core of such an organisation is made of units specialising in a particular activity;
- Ketels, Ch., (2003) defines a cluster through the prism of consideration entities creating the network;
- Benneworth, P., (2002) perceives a cluster in the light of communication and states that this is “a black box, which academic and political threads come from” (Benneworth P., Henry N. (2002).
- Very popular, apart from the Porter’s one, is the OECD definition of a cluster treating a cluster as “a geographical concentration of similar or complementary enterprises that have active channels to execute transactions and communication, which use specialised infrastructure, markets and services (OECD, 2001).

Thus, while compensating the aforementioned approaches, a cluster can be defined as spatially concentrated aggregates of enterprises interrelated with network relations, using synergy principles in execution of mutual aims, based on the principle of cooperation and preservation of competitive principles, in areas other than mutual, while undertaking cooperation with entities from business and government environment such as, academic entities, research and development entities, administrative entities and others.

2. Assumptions of a cluster policy in Poland

In Poland, the Polish Agency for Enterprise Development established “Standardy zarządzania cluster” (PARP.2016) which should be understood as principles stipulating desired features of management and functioning of clusters, considering, among others, the best practices of the clusters’ activity in Poland and abroad. The standards respond to the problem of unsatisfactory quality of managing clusters and a lack of a system approach to the issue of qualifications of professional coordinators that are of key importance for clusters' success and effectiveness of public intervention.
The aim of the standards is to enforce the quality of managing clusters in Poland, by:

- Providing clusters' coordinators with instruments for effective improvement of cluster management processes;
- Providing clusters coordinators with knowledge, information and support necessary for implementing standards (www.pi.gov.pl).

3. Results of benchmarking for clusters in Poland 2010-2015

While analysing situations of clusters in Poland in the period 2010-2015, one should indicate the following tendencies:

- A majority of bottom-up clusters;
- The most popular form is association, yet a number of companies is gradually increasing;
- The share of enterprises in the general number of members has increased, a number of clusters’ members has increased on average by 42%;
- A number of large enterprises having share in clusters has decreased;
- A number of clusters appurtenant to consecutive stages of a cluster life cycle has increased;
- A number of clusters with development strategies has increased to 91% clusters, main aims of the strategy of clusters have been maintained and they concern the development of innovativeness, the second place is taken by the possibility to obtain funds from the EU;
- The position of clusters in the scope of infrastructural resources has improved and the position in the scope of financial resources has decreased, however, there are very significant disproportions between a leader in a given population and its resources and average values obtained by clusters, whereas, the biggest use of resources has been noted in big clusters; clusters are characterised with a large diversity with regard to the level of financial resources. This range seems to stem from highly diversified abilities of clusters to obtain external funds for their activities, mainly from public resources.
- The use of human resources has improved, whereas, total employment in clusters amounts to 96,540 employees;
- clusters representing particular industries have not yet covered and represented a significant part thereof at a national level and at a level of particular regions.
- Nevertheless, so far it has not been possible to state that there exists a coordinated support system for clusters in Poland, at a regional or central level. Thus, a strong differentiation of principles regarding the access to the public funds should be assessed rather negatively.
- A decrease in the ability of clusters’ members to participate in costs of clusters’ functioning. This phenomenon should be assessed as unfavourable.
- A decrease in the amount of obtained public funds;
- A deterioration in the status of clusters’ budgets seems to stem from reported limitation of available public funds for clusters’ development;
- A tendency of a lack of ability to replace public funds with members’ own resources. It seems that a majority of clusters are not mature enough to finance their activity without external resources, including public, effectively and at a high level of activity.

- The amount of fees in relation to obtained benefits are deemed by a majority of clusters as satisfactory;
- A majority of clusters solved basic infrastructural problems related with the functioning of the cluster itself and, in general, the availability of offices or conference rooms for the cluster's needs no longer constitutes a big problem. Currently, it is challenging to develop more advanced infrastructural resources. It stands for the necessity to work in clusters mainly on modernising internal communication channels.
- A number of clusters using modern technological solutions has dropped;
- An increase in the diversification of clusters in the scope of resources, infrastructure, employment and R&D zone;
- Whereas, negative tendencies are visible in the scope of using ICT technologies in the internal communication in clusters;
- With regard to the majority of clusters one can state maintenance of activities in the scope of a mutual offer drawn up by the cluster, at a permanent and relatively high level.
- Low level has been noted in the scope of establishing mutual distribution channels and mutual supply. A lack of a significant advantage of big clusters in the scope of the market activity with their objectively bigger market power and the ability to use more diversified market instruments means that a barrier limiting the clusters' market activity comprises difficulties in reaching an agreement in the scope of undertaking this type of activities, rather than a low economical or tendering potential of clusters. It appears that the projects hitherto executed by clusters have not been bringing proper results in the scope of market expansion.
- Clusters' promotional activity is conducted at a high level and there are no so significant diversifications in this scope.
- Clusters' coordinator inform about a high and even growing regularity of meetings of clusters' members. It is undoubtedly a positive signal proving willingness of clusters' participants to develop cooperation and build trust and, consequently, to exchange knowledge.
- It appears that in the scope of creating knowledge and innovation big clusters have a significant advantage over medium and small ones.
- Over 7% of the increase in employment in entities belonging to the studied clusters should be considered as one of key results of clusters and a prerequisite for their development and validity of the support.
- Enterprises belonging to clusters show higher innovativeness in comparison with average results in the whole population of enterprises. Natural feature of clusters as pro-innovation environment is confirmed. The influence of clusters on the innovativeness of enterprises has already been noticeable, however, the scale of this influence is not yet satisfactory.
- High activity of a coordinator in stimulating cooperation among cluster members (organising meetings, conferences, the exchange of information and in the scope of obtaining public resources to the benefit of cluster's development.
- Clusters' expectations from coordinators concentrate on improving promotion and facilitating the availability of financial centres along with increasing the access to the R&D zone.
- Clusters have a significant, if not decisive, impact on changing attitudes in local and regional environments. Creation and development as well as successes of cluster initiatives establish trust to economic and social cooperation by giving a good example. Clusters should be perceived as a key and particularly valuable element of establishing social capital in Poland.
- A competitive position of clusters has deteriorated owning to the decrease in the number of participants attracted to a cluster, a number of executed projects and decreasing start-ups and / or spin-offs in a cluster.
- Regional conditions, the policy of public authorities to the benefit of a cluster's development, cluster's institutional environment and management (PARP,2015).

Conclusions

1. In the identified population a majority of clusters are young.
2. As a rule, a geographical distribution of clusters reflects the economic potential of regions.
3. Cluster's development on the grounds of a strategy is still not standard.
4. Clusters execute few projects.
5. Clusters are not at a disposal of data regarding their members, coordinators do not collect data in a regular and systematic manner.
6. Many clusters do not have websites.
7. In the population of potential clusters also structures that have an opportunity (in a medium term perspective) to transform into clusters of full value are identified. In case of others, it would require a significant engagement of coordinators, willingness to cooperate on the part of members, as well as support.

The basic aims for clustering in Poland for 2020 (Dzierżanowski,M., 2012) have been indicated, among others: increasing external networking of clusters, reinforcing integrated planning processes, increasing the number of innovative products and services, reinforcing private investments in clusters and increasing foreign investment inflow, increasing private inputs to the research and innovative activity, development of cluster environment institutions (education, research entities, academic parks and innovation and technology centres), increasing effectiveness of using public inputs.

It has been stated that in the view of stipulated directions of clusters' development, effects concerning various spheres of clusters' functioning are expected. Predominantly, the following will be improved: hitherto methods of economic cooperation, creating innovation, cooperation with the authorities and more beneficial conditions for lobbying to the benefit of clusters will be created. Developing a network of interpersonal communication will have a positive impact on relations with companies and different institutions. The access to specialist trainings will increase and the educational system in the region will begin to adjust to the needs of a cluster, in particular, of the one leading in a given area. Therefore, one can state that the vision for Polish clustering until 2020 is very optimistic.

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Approaches on the relationship between competitive strategies and organizational performance through the Total Quality Management (TQM)

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Abstract

The purpose of this article is to provide a theoretical study in order to highlight the structural relationship between organization strategy (in terms of cost leadership and differentiation strategy), TQM (Total Quality Management) and organizational performance. Many authors have investigated the relationship between generic strategies and organizational performance over time. This is a classic theme in strategic management literature that has been studied from multiple perspectives. Also there are several recent studies that aim to examining the relationship between total quality management practices and organizational performance. Based on a comprehensive analysis of the literature, we want to underline significant or less significant relationship that were highlighted between TQM practices and strategies, as well as the direct and indirect effects of these practices on different levels of performance (in terms of quality and innovation).

Keywords: competitive strategies, Total Quality Management (TQM), organizational performance, quality, innovation

1. Introduction

The issue of establishing relations between competitive strategies may be adopted by firms, their performance and total quality management (TQM) has had much attention from researchers in recent years, as shown by the proliferation of several studies on this theme. Empirical studies argumenta mainly associated benefits of implementing TQM such as improved quality, increased customer satisfaction, and reduced the costs, efficient delivery of products, higher performance (Kiella and Golhar, 1997; Prajogo and Hong, 2008; Kumar et at., 2009).Starting from this aspect, the work is based on a review of literature on issues TQM, especially practices TQM so as to capture the relationship between TQM and organizational performance, because then, having this basis to understand other relationships of the variables mentioned in the title, namely between competitive strategies and TQM, and between organizational strategy and performance. Numerous research articles report how different organizations have agreed to implement the methodology for total quality management (TQM), to achieve improved performance. Empirical studies have shown primarily a direct, strong between the variables described above (Prajogo and Hong, 2008; Taddese and Osada, 2010; Hassan et al, 2012). but must consider the indicators used in assessing the performances that can be as diverse as it is different, such as quality, innovation (product, such as the number of new products developed or process), sales growth, market share, customer complaints, profitability, productivity, etc.).

TQM practices and the implementation of this strategy but may differ from one country to another and from one company to another, where explains the occurrence of certain divergent opinions researchers. If initially the most research considered targeted the United States and other developed countries, emerging economies received considerably less attention lately can be observed targeting of efforts to address this problem in the case of countries developing or transition to a market economy, although the study of quality management practices and organizational performance is quite poor at this level.

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Roughly article is trying to point out and respond to the following questions:

- There is a direct relationship between competitive strategies and performance?
- There is a link between TQM and strategies adopted by organizations?
- There is a clear link between TQM practices and performance recorded by the company?
- TQM has a mediating role between the competitive strategies adopted by companies and improving their performance?

Suggestive, we can build the following scheme that identifies relationships between the three variables (Fig. 1)

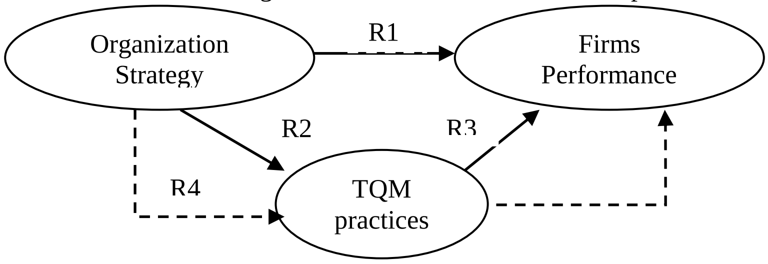

Fig.1 The relationship between organization strategy, TQM and firm's performance

2. Organization's strategy and performance

2.1. Competitive strategies

The last period was marked by a growing intensity of competition in almost all business areas, which has led to a targeting of attention on the behaviour of firms competitive, the competitive strategies most likely to be followed by them. In view of Thompson et at, 2010, competitive strategy comprises all those movements and approaches that a company has to attract buyers to withstand competitive pressure in order to increase and improve their market position. Competitive strategy Michael Porter describes as fundamental arena in which the search for a favorable competitive position in an industry competition, aiming to establish a profitable and sustainable position against the forces that determine industry competition.

Many authors through empirical studies have examined the performance levels associated with these types of strategy in an effort to gain a competitive advantage (Yamin et al., 1999). There were thus identifying a number of typologies or taxonomies of competitive business strategies, some on the basis of a priori conceptual frameworks, and others on the basis of empirical studies.

Competitive strategies most frequently encountered are the ones called ,, generic "proposed by professor M Porte (Porter, ME, 1985), namely: cost leader strategy, differentiation strategy and focus strategy that can be adopted in relation to the strategic advantage pursued: focus based on low costs and focus on differentiation These strategies allow the company to gain a competitive advantage. In Porter's view, companies that try to combine the two strategies (cost leader and differentiation) will give low profitability. Such companies will not attract price sensitive buyers because their costs are too high and differentiation will not be large enough to allow pricing excellence.

The profitability of a company is not influenced only by the industry but also strategic choices adopted by competitors. To be efficient, a company must either have low costs compared to other competitors with a similar offer, either at a given level of cost to offer a higher price than its competitors to offer superior and unique (perceived by the client). But there are some critics of Porter's model, (Datta Y., 2009). Indeed, the 1990s brought examples that show that the discretion that recommends Porter is exceeded. Are quoted companies following a successful differentiation strategy in combination with a strategy of low costs without affecting financial performance (an example often cited is the company's Toyota, known for its relatively low cost of its products According to Armstrong, Toyota topped ratings of product reliability and customer satisfaction while simultaneously producing cars for US $ 1,500 less per unit than US their rivals by using the techniques of managing conflict across functions. (Yamin et al., 1999)

Porter's generic strategies are considered essentially types "ideal" and therefore somewhat difficult operationalized, most studies that have followed the classical structure being applied in organizations in the US and only a limited number of studies being conducted outside the US, predominantly in Canada or European markets.

Lately, because of these problems associated with pure strategies, there were arguments for the adoption of hybrid strategies (Miller, 1992; Hlavacka et al, 2001; Kim et al, 2004; Allen & Helms, 2006)). Thus they show that the combination of the strategies proposed by Porter can create more opportunities for gaining competitive advantages in that it can better address the needs of customers; leading to strategies that may be more difficult to imitate; and generate a more flexible view, wider. Beal and Yasa Ardekani, 2000 and they say these arguments considering that the pursuit of competitive hybrid strategies can help secure more sources of advantage, and thus make it possible to achieve higher levels of performance.

2.2. Company performance

And the concept of performance over time made the subject of much research being issued several opinions opposite the basic terminology used, definitions or important. A conception of business performance focuses the use of financial indicators result that purportedly reflect economic objectives of the company, hence the name of financial performance. Typical of this approach would be tracking indicators such as sales growth, profitability (reflected in reports such as return on investment, return on sales and return on equity), earnings per share, etc. A conceptualization wider business performance would include in addition to financial indicators a focus on indicators of operational performance, meaning nonfinancial such as market share, introducing new products, product quality, marketing effectiveness, value manufacturing added and other measures of technological efficiency in business performance (Yamin et al.,1999).

The results of empirical research suggest that there are significant differences in the configuration variables by organizations adopt different strategies generic. There are also significant differences in performance depending on the types of organizations adopted generic.

2.3. The link between competitive strategies and organizational performance in terms of quality and innovation

As shown in the literature that demonstrated quality performance seems to fit both generic strategies (cost leadership and differentiation) while innovation performance is clearly associated only with differentiation strategy. This conclusion is supported by the research of Prajogo and Sohal, 2002 and Prajogo and Sohal, 2006a, Prajogo and Sohal, 2006b). A company that adopts such differentiation strategy selects one or more attributes or features that customers perceive as important and unique, trying to excel in those attributes that lead to creating a premium price, and quality is the approach that best characterizes often a differentiation strategy. This is because quality creates a competitive advantage through customer loyalty and minimizes customer price sensitivity. On the other hand, in the context of TQM, quality has a direct impact on cost reduction at the operational level, and improves the quality chain concept, and- Deming said that organizations could enhance their competitiveness by improving quality resulting in reduced costs by limiting scrap and reprocessing. This cost reduction will then lead to a higher market share. Crosby and Juran also support this argument with their own concept of quality costs (Yamin et al, 1999). Such research stresses that improving quality leads to a reduction in production costs and hence with the quality of its strategy leader can achieve the objective of cost. On the other hand, the relationship between organizational strategy and innovation is more highlighted because usually there is a positive association between innovation, especially product innovation and differentiation strategy and less cost leader strategy. It is suggested that companies adopt differentiation strategy focus on new products and technology, research and development (R & D). Also significant relationship that may exist between the strategies of differentiation and product quality is quite clear, as quality is an issue of differentiation, with design, style and technological innovation. This argument derives from the fact that the competitive advantage of innovative companies over their competitors is based on superior functional performance rather than the original cost less, and thus these radical innovations tend to offer higher profit margins. In these circumstances, the conclusion that emerges is that the cost leader strategy to oppose innovation of products, firms taking on the role of merely imitators innovation.

3. TQM and performance

Many of today's top performing organizations are implementing TQM strategies in hopes of improving their performance even if these practices did not provide the expected results in some cases, in the opinion of Foley, K. 2004. TQM, according to the philosophy generally accepted, is an integrated management which aims at continuous improvement of products, processes, services to achieve performance across the organization and to achieve and exceed customer expectations, is a concept that is generally W.Edwards attributed to Deming, but to create body of knowledge known today as TQM contributed JM Juran, Philip Crosby, Armand Feigenbaum Kaoru Ishikawa (Rao, Ashok et al, 1996).To drive continuous improvement process, TQM implementation is based on several principles or critical success factors (CSF). Based on review of literature can ascertain take into account various factors that may differ from author to author, but the most commonly used critical factors affecting business performance as customer orientation; leadership; involvement of people; approach as a process; system approach to management; continuous improvement; management based on facts; mutually beneficial relationships with suppliers.

For TQM implementation, literature classified TQM practices in two groups: soft and hard TQM practices (Herzallah 2014; Fotopoulos and Psomas, 2009; Fotopoulos and Psomas, 2010; Leavengood et al., 2012). Soft TQM practices is related to human aspects and associated with management concepts and principles (Leavengood et al., 2012; Vouzas and Psychogios, 2007, Pinho, 2008). They include many practices such as management leadership, customer focus, employee or supplier relations management. Hard TQM practices refer to quality tools and techniques, production and technical aspects (Vouzas and Psychogios, 2007). Hard TQM practices include practices and reporting date such as quality, product / service design and process management. Literature shows that hard TQM practices can mediate the effect of soft TQM practices on quality performance (Herzallah et al, 2014).

The role of TQM in improving the performance has been emphasized in many empirical studies, many researchers pointing out that total quality management allows companies to improve their performance, many studies in the field by establishing a positive correlation between the implementation of TQM and organizational performance (Fotopoulos et al. 2009; Kumar and Choisne, 2009; Feng et al, 2006; Kaynak and Hartley, 2008; Rouhollah and Arumugam, 2011; Sila, 2007; Karuppusami and Gandhinathan, 2006; Prajogo & Sohal, 2006a; Kaynak, 2003).

The question still is who are the main critical factors contributing to the success of efforts to implement TQM in increasing measure each of the variables TQM has a notable impact on organizational performance, particularly in terms of performance quality and performance innovation?

4. The relationship between TQM practices, quality performance, and innovation performance

Prajogo and Sohal, 2003 suggest significantly and positively TQM that relates to both product quality and product innovation performance although it Appears that the magnitude of the relationship is against greater product quality.

Regarding the relationship between TQM and innovation performance can be seen that there are two competing visions supported by two arguments. The first argument suggests that TQM is positively related to performance innovation, because it establishes a system and culture that will provide a fertile environment for organizations to innovate Prajogo and Sohal, 2006a. The other argument argues that the implementation of TQM principles and practices may prevent organizations from being innovative Harari, 1993 Samaha 1996, proponents of these theories claiming that TQM would not be compatible with innovation, because innovation management quality management is fundamentally different.

However there is no consensus, namely that although quality management obviously does not lead directly to innovation or organizations who wish to pursue a high performance innovation must be able to manage the quality requirements of their products. As such, quality management is a prerequisite for innovation management and organizations should not give up the implementation of TQM, which is necessary, though not sufficient for innovation. Therefore we recommend applying TQM techniques along with other practices and related research and development (R & D) and technology management, if the intended purpose of the organization is to excel in innovation.

Many authors suggest that the impact of TQM on innovation depends both on the TQM dimensions considered and on the type of innovation ((research, development and technological innovation; product innovation; process innovation; organizational innovation; management innovation; marketing innovation). **(**Fernandes et al., 2014)

For example customer orientation in TQM philosophy is regarded as having a negative impact on innovation, according to studies published by Slater and Narver (2000). As argued these researchers, adopting the principles of customer focus organizations could be trapped, getting to be captive markets serviced where they will focus on meeting the needs of existing customers and therefore would regard their business only through the eyes of existing customers. As a result, these companies may not seek innovative solutions focusing only on incremental improvements to their current product and service activities thereby ignoring potential unserved market.

5. TQM role of mediator between competitive strategies and organizational performance in terms of quality and innovation

Lately many studies have addressed the relationship between the two competitive strategies, each of them and the organization's performance (Porter 1980; Prajogo and Sohal, 2006; Prajogo, 2007). Most studies in the literature have agreed on the positive relationship between TQM and competitive strategies -differentiation and cost leader (Fuentes et al, 2006; Reed et al., 1996). However, recent studies have found a significant relationship between TQM and cost leader strategy (Jung et al, 2009; Prajogo and Sohal, 2006). This result is justified by the findings suggest that between differentiation strategy and TQM there is a positive relationship and significant in terms of organizational performance (in terms of product quality, product innovation and the innovation process), indicating that TQM can be used as an effective means to implement a differentiation strategy for achieving organizational performance satisfactory, while some have reasoned that obtaining a better quality requires the use of more expensive components and certain management techniques incompatible with achieving reduced costs and this will outweigh the potential benefits that might be expected from this strategy.

The combination of the three variables suggests a harmony between differentiation strategy, TQM practices and organizational performance in terms of quality and innovation. It has been shown that TQM is an effective means of conducting a differentiation strategy. It should be noted, however, that its role is more effective for pursuing differentiation in terms of quality rather than innovation performance. The results obtained by Prajogo and Sohal, 2006 shows that TQM only partially mediates the relationship between differentiation strategy and the three performance variables (product quality, product innovation and process innovation). These authors suggest that the direct effects of a differentiation strategy on both product and process innovation are stronger than between TQM and these two performance measures. What can be inferred from this link is that while TQM is considered as a set of practices through which a differentiation strategy can be implemented, under TQM, however, differentiation is more directed to quality performance rather than innovation performance.

Conclusions

Recognition of TQM as a competitive advantage is widespread throughout the world, especially in Western countries, and today very few companies can afford to ignore long-term TQM. Total quality management plays an important role in the overall strategy adopted by organizations. The major challenge for global organizations is to survive in an increasingly competitive global market. Recent studies have revealed that organizations that adopt Total Quality Management (TQM) and to quality products and processes, they can improve their competitive position, business success, and manage to differentiate their products.

What we can conclude from the above is that TQM could be used in different contexts strategic differentiation strategy including both the leader and the cost is difficult to associate exclusively with either of these two strategies. How the quality fits into a specific strategy it is not particularly clear because "quality" is a term that can be defined in a variety of ways. It also believes that achieving a high quality result creates the potential to both differentiation strategy and cost leader strategy within a market. But even if TQM suggests a direct relationship established between quality and cost, which assumes that improving quality will result in reduced costs, and this requirement appears to be compatible with a strategy leader for cost, however, in the view of some, the balance seems to tilt in favor of differentiation strategy, TQM is seen as an effective way to carry out a strategy of differentiation.

Results of the studies suggest, with few exceptions, that the elements TQM fully mediate the relationship between competitive strategy and organizational performance. This means that organizations need innovative management methodology such as TQM practice in order to achieve competitive strategy to materialize through a high performance. The general opinion is that TQM certainly provides a solid foundation for systematic quality management that organizations can build further capabilities and capacities, as well as other strategies to gain competitive advantage multidimensional, based on quality or innovation.

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Particularities in services quality approach

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Abstract

In terms of a pronounced diversification and rapid renewal of the supply of goods and the globalization of trade, an increase in consumer demand can be noted, product and service quality becoming a determinant of the competitiveness of firms. Technical progress, followed by social and economic progress, has led to an explosive growth of the service sector. In these conditions concerns referring to quality of services have intensified in order to identify ways to improve it. In this paper we propose to deal with several aspects concerning the specificities of the services and their quality.

Keywords: good, service, quality, customer satisfaction, service quality

1. Introduction

Quality is defined by the customer. When a service provider knows how consumers evaluate the quality of its services, it will be more able to influence these evaluations in a desired direction and to relate a service idea to customer benefits.

In present, the marketing key is customer service, and the main competitive advantage is quality. The challenge is to determine what customers want and whether they are satisfied with the company and its service. Knowing quality determinants could mean the difference between retaining or losing customers.

2. Goods vs services

A framework for isolating differences in consumer evaluation processes between goods and services is based on the classification of properties distinguished among three categories (Parasuraman, Zeithaml, and Berry 1985; Zeithaml 1981).

Search properties - attributes that a consumer can determine before buying a service (as price and physical facilities).

Experience properties – attributes that can only be discerned after purchase or during use (as courtesy of employees).

Credence properties - characteristics that the consumer may find impossible to assess even after purchase and use (as medical properly performance). Credence properties dominate in many services, especially those provided by professionals and specialists (e.g., auto repair).

In general, offerings high in search properties are easiest to evaluate even before purchase. Offerings high in experience properties are more difficult to evaluate because they must be bought and consumed before assessment is possible. Offerings high in credence properties are hardest to evaluate because the consumer may be unaware of or may lack sufficient knowledge to appraise whether the offerings satisfy given wants or needs even after consumption (example: possess medical, mechanical or law skills sufficient to evaluate whether these services are necessary or are performed properly).

As a consequence, quality control principles and practices that are pertinent to evaluate and ensure goods quality, are inadequate for understanding goods quality. This inadequacy is due to the three fundamental ways services differ from goods in term of how they are produced, consumed and evaluated.

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3. Services' Characteristics

Distinguishing services' characteristics of intangibility, heterogeneity, and inseparability make them more difficult to evaluate than goods.

First, most services are intangible. 'They cannot be seen, felt, tasted, or touched in the same manner in which goods can be sensed. They cannot be counted, measured, inventoried, tested, and verified before sale to assure quality. Services cannot be displayed, physically demonstrated or illustrated; therefore they possess few search properties and many experience properties. Because of intangibility, it is difficult to understand how consumers perceive services and evaluate service quality (Bitner 1990; Cowell 1989; Lovelock 1984; Parasuraman, Zeithaml, and Berry 1985; Zeithaml 1981).

Second, services are heterogeneous: their performance often varies from producer to producer, from customer to customer, and from day to day. Since service cannot be inventoried, performance depends to some extent on the level of demand. What the firms intend to deliver may be entirely different from what the consumer receives. Heterogeneity results in high experience qualities, for consumers cannot be certain about performance on any given day, even if they use the same service provider on a regular basis (Cowell 1989; Lovelock 1984; Parasuraman, Zeithaml, and Berry 1985; Zeithaml 1981).

Third, production and consumption of many services are inseparable. Tangible goods are produced, sold and then consumed separately. But in services, the final elements of the service assembly process usually take place simultaneously with consumption, so that the customer is much more likely to meet the service production process in operation. Due to this inseparability, the buyer usually participates in producing the service, thereby affecting the performance and quality of the service. The service firm may have less managerial control over quality in labor intensive services, and services where consumer participation is intense (Bitner 1990; Cowell 1989; Lovelock 1984; Parasuraman, Zeithaml, and Berry 1985; Zeithaml 1981).

In sum, the intangibility, heterogeneity, and inseparability of services lead them to possess few search qualities and many experience qualities. Additionally, service marketers most often have limited influence over the delivery of the service and therefore have limited control over service quality. The situation is similar to a good's marketer trying to promote, position, or define an always changing product that the customer has not yet seen.

4. Service quality and customer satisfaction

The literature on quality is predominantly good-oriented, but there are some contributions focused on service quality. We find in these writings the following items (Zeithaml, Valarie A., Parasuraman, A., Leonard Berry, 1990):

- Service quality is more difficult for customers to evaluate than goods quality; in these circumstances the criteria customers use to evaluate service quality is difficult for the marketer to comprehend.
- Customers do not evaluate service quality solely on the outcome of a service, they also consider the process of service delivery.
- The only criteria that count in evaluating service quality are defined by customers; only customers judge quality, only other judgments are irrelevant.

The judgments of high and low service quality depend on how customers perceive the actual service performance in the context of what they expected. Therefore, service quality is defined as the extent of discrepancy between customers' expectations or desires and their perceptions.

4.1.Factors that influence expectations

There are several key factors that may shape customers expectations:

1. What customers hear from other customers is a potential determinant of expectations.
2. Customers' expectations depends on their individual characteristics and circumstances, suggesting that personal needs of customers might moderate their expectations to a certain degree.
3. The extent of past experience with using a service could influence customers' expectations level.
4. External communications from service providers have a key role in shaping customers' expectations. Under external communications are included a variety of direct and indirect messages conveyed by service firms to customers.
   One factor whose influence on expectations is considered under the influence of external communications is price. It plays an important role in shaping expectations, particularly those of prospective customers of a service.

4.2. Customer satisfaction and service quality

Since customer satisfaction has been considered to be based on the customer's experience on a particular service encounter, (Cronin & Taylor, 1992) it is in line with the fact that service quality is a determinant of customer satisfaction, because service quality comes from outcome of the services from service providers in organizations. Other authors stated in his theory that "definitions of consumer satisfaction relate to a specific transaction (the difference between predicted service and perceived service) in contrast with 'attitudes', which are more enduring and less situational-oriented". This is in line with the idea of Zeithaml et al (2006). Regarding the relationship between customer satisfaction and service quality, Oliver (1993) first suggested that service quality would be antecedent to customer satisfaction regardless of whether these constructs were cumulative or transaction-specific. Some researchers have found empirical supports for the view of the point mentioned above (Anderson & Sullivan, 1993; Fornell et al 1996), where customer satisfaction came as a result of service quality. In relating customer satisfaction and service quality, researchers have been more precise about the meaning and measurements of satisfaction and service quality. Satisfaction and service quality have certain things in common, but satisfaction generally is a broader concept, whereas service quality focuses specifically on dimensions of service (Wilson et al., 2008). Although it is stated that other factors such as price and product quality can affect customer satisfaction, perceived service quality is a component of customer satisfaction (Zeithaml et al., 2006). This theory complies with the idea of Wilson et al. (2008) and has been confirmed by the definition of customer satisfaction presented by other researchers.

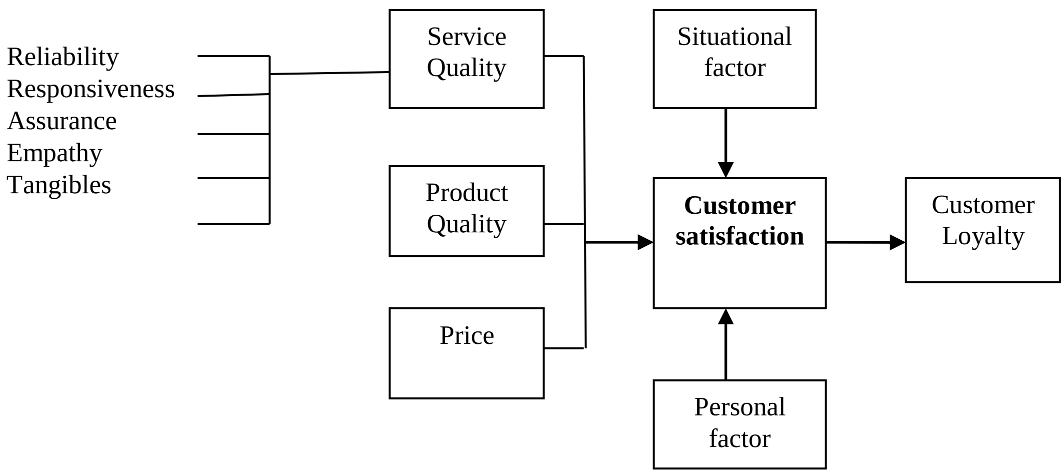

Fig 1. Customer perceptions of quality and customer satisfaction (Wilson et al., 2008)

The above figure shows the relationship between customer satisfaction and service quality. The author presented a situation that service quality is a focused evaluation that reflects the customer's perception of reliability, assurance, responsiveness, empathy and tangibility while satisfaction is more inclusive and it is influenced by perceptions of service quality, product quality and price, also situational factors and personal factors (Wilson, 2008). It has been proven from past researches on service quality and customer satisfaction that customer satisfaction and service quality are related from their definitions to their relationships with other aspects in business. Some authors have agreed to the fact that service quality determines customer satisfaction. Parasuraman et al., (1985) in their study, proposed that when perceived service quality is high, then it will lead to increase in customer satisfaction. Some other authors did comprehend with the idea brought up by Parasuraman (1995) and they acknowledged that "Customer satisfaction is based upon the level of service quality that is provided by the service providers" (Saravana & Rao, 2007; Lee et al., 2000). Looking into figure 1, relating it to these authors' views, it is evident that definition of customer satisfaction involves predicted and perceived service; since service quality acted as one of the factors that influence satisfaction. More evidence of this relationship has been proven by past researches.

Conclusion

Services' characteristics of intangibility, heterogeneity, and inseparability make them more difficult to evaluate than goods. Customers do not evaluate only service quality, they evaluate the entire process of service delivery. In these circumstances, the only criteria that count in evaluating service quality are defined by customers; only customers judge quality and only other judgments are irrelevant.

Many researchers have studied the relationship between service quality and customer satisfaction. Service quality is considered by some authors a determinant of customer satisfaction. Other authors affirm that satisfaction and service quality have certain things in common, but satisfaction generally is a broader concept, whereas service quality focuses specifically on dimensions of service. Perceived service quality is considered a component of customer satisfaction, theory confirmed by the definition of customer satisfaction presented by other researchers.

All authors have agreed to the fact that service quality determines customer satisfaction.

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Innovation and quality - partnership for sustainable development. Check4Green Startup Case

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Abstract

Innovation is the word that best describes the world of startups. The innovative ideas and creative work are the glue that bring together enthusiastic people with different backgrounds and make it possible to go accelerated from concept to product. As part of the sustainable development trend through waste management we present in this paper the Check4Green startup case. The second element of the partnership, quality, is contained in the development model that we propose in order to evaluate the current state of startup development.

Keywords: waste management; Quality Function Deployment (QFD); 3D spiral model

1. Startups – from Idea Generation to Business Development

Nowadays we are witnessing an accelerated development of IT related technologies. All these bring novelty that improves the quality of life. In this context, the startups, formally associated only with Silicon Valley, conquered the entire world and created a global innovation hub. In the present world, in which the engine of development is the IT field, the startups are surely the fuel.

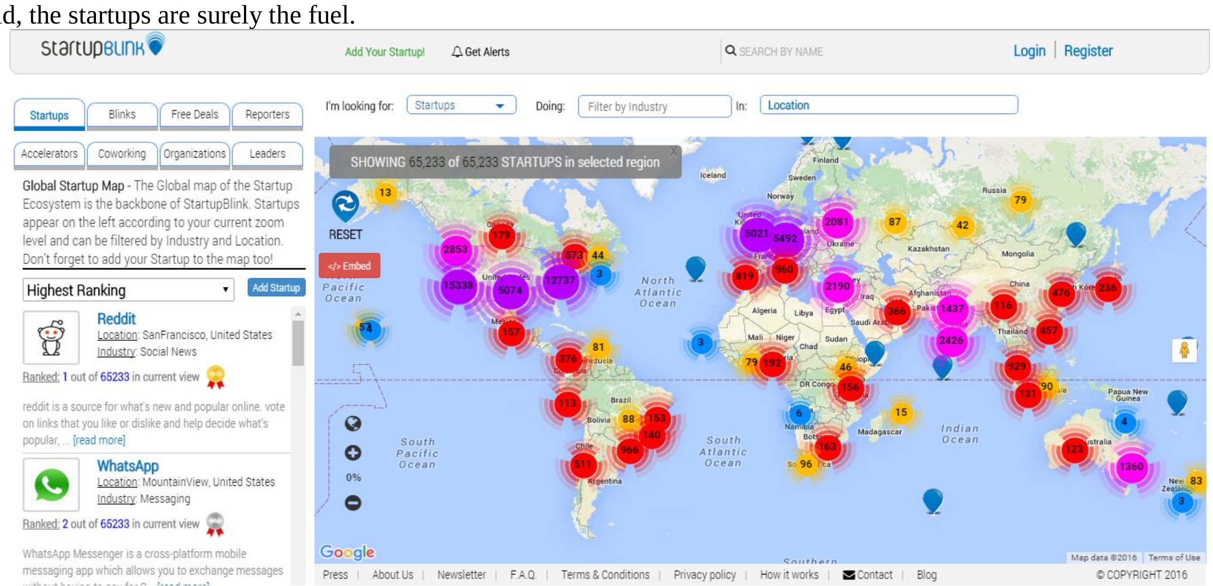

Fig 1. Startups map (http://www.startupblink.com/startups)

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The startups world reflects the present times dynamics both from the business model perspective and the innovative technical products and services perspective. We are witnessing an explosion in startups worldwide. The startups map that is presented in figure 1 is the evidence for this trend.

Romania enrolls in this evolution, as can be seen in figure 2, and, according to Forbes magazine, it was predicted a significant success in this area. Coleman (2014) said that “Romania has the highest number of technology workers per capita, close to 64,000 specialist IT workers. The Romanian startup ecosystem now boasts numerous incubators, co-working spaces and dedicated events to help emerging entrepreneurs. In Romania, people are used to starting with nothing and growing something from that. We’ve had no government initiatives to help us set up our businesses. The future is definitely bright for the Romanian startup scene. The number of people involved in startups is growing every year, more and more kids are showing an interest, and of course we’re creating more successes. The more of those we have, the better our chances of taking on London, Berlin, and yes, even Silicon Valley.”

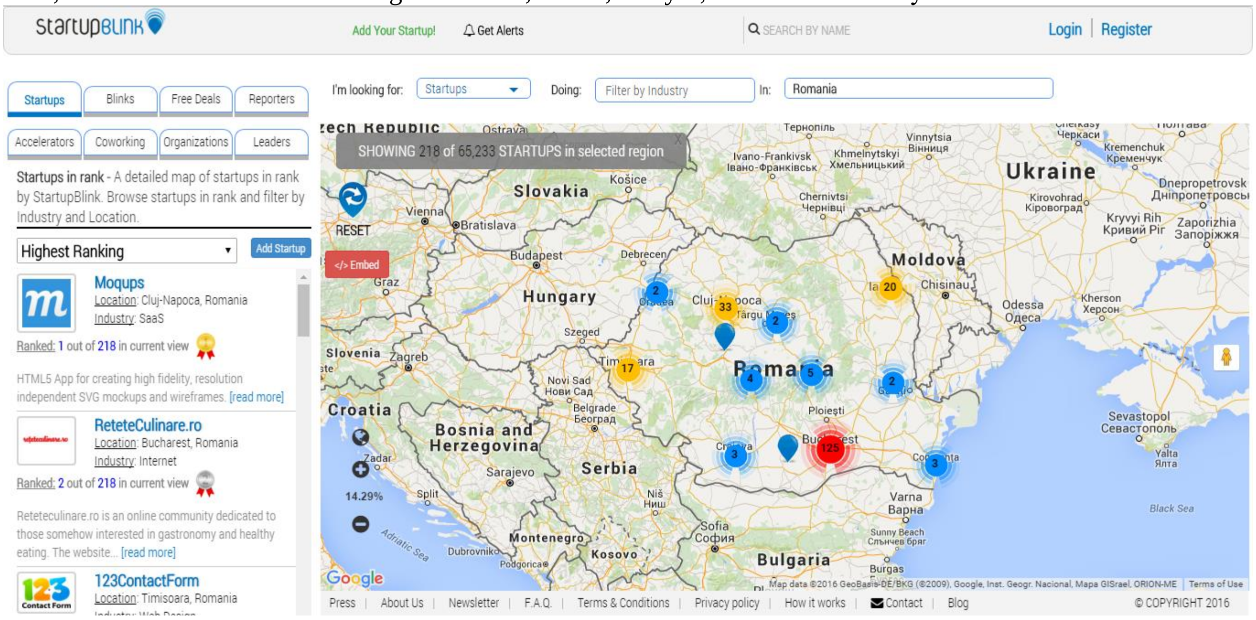

Fig 2. Romanian startups map (http://www.startupblink.com/startups)

Paul Graham (2012) says that "A startup is a company designed to grow fast. Being newly founded does not in itself make a company a startup. Nor is it necessary for a startup to work on technology, or take venture funding, or have some sort of "exit." The only essential thing is growth. Everything else we associate with startups follows from growth." Graham added that an entrepreneur starting a startup is committing to solve a harder type of problem than ordinary businesses do. "You're committing to search for one of the rare ideas that generate rapid growth."

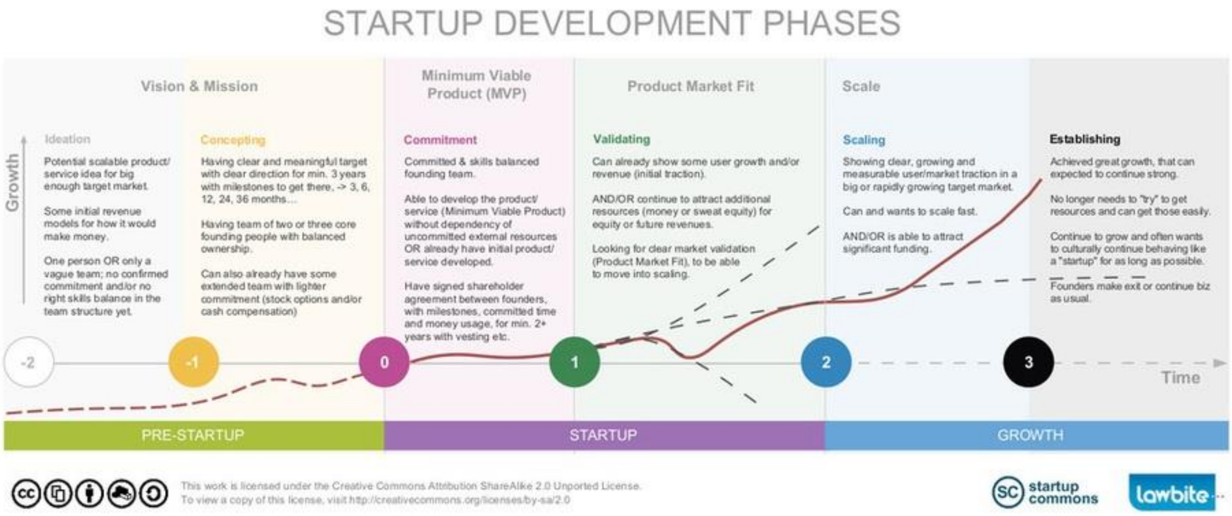

Fig 3. Startup development phases (www.startupcommons.org)

Getting a business off the ground and into profitability, going from “idea to product” and “team to company” typically involves a number of stages, going through concept, pre-seed, seed/startup, early stage, growth and maturity, as seen in figure 3.

Businesses can obviously fail too, and this is most likely to occur in the early stages, when the company is funded by seed capital, angel investors and/or 'friends, family and fools' (FFF), and is yet to generate significant revenue.

Assuming the business survives, various early-stage and later-stage financing rounds may then be negotiated, allowing the products to mature and penetrate their markets. Many promising companies are acquired during this period; if they're not, the next major milestone is often the IPO (Initial Public Offering). Not all IPOs go as planned, however, and many startups choose to remain in private hands if they have the means to finance their growth plans. Occasionally, public companies return to private ownership.

2. Check4Green startup development stages

In the context of the startup world, Check4Green is a startup for monitoring the recycling of electronic devices and equipment. Daily there are spent a lot of resources to build electronic devices and in the blink of an eye they become obsolete. Taking into account that these electronics have a long time impact on the environment, a waste management system must be embedded in the lifecycle of the electronic products. Check4green startup covers the waste management specific issues to manage and reduce electronics waste from collection to disposal while recovering valuable materials and component parts. Check4green stores all the information regarding the recycling process, like: takeover date and time, name of the collector, waste type, quantity and location.

The research objective, by the proposed solution, is to meet the requirements of the Directive 2006/66/EC regarding the collection of portable primary and rechargeable batteries in Europe.

The prerequisites for our research are related to the statistics provided by the "Study on Waste for Portable Batteries EPBA Collection Rates - Update Dec-14" (EPBA, 2016) and the place Romania occupies in the recycling field, in general, and specifically batteries. Batteries Directive 2006/66/EC requires the 30 EEA member countries to achieve minimum collection rates for portable batteries of 25% in 2012 and 45% in 2016.

Romania is making the first steps towards recycling of batteries and, in this regard, we propose a monitoring solution, called Check4Green, and an integrated recycling-recovery model to be used in our country (Leba et.al. 2015).

The Check4Green startup is based on an innovative idea that is the use of level sensors connected through a network to an online platform.

The proposed monitoring solution is intended to fulfill the following main tasks: collect used batteries from specific centers, determine weight and update data in the information system, transport to recycling centers, sort and storage, recycle (figure 4).

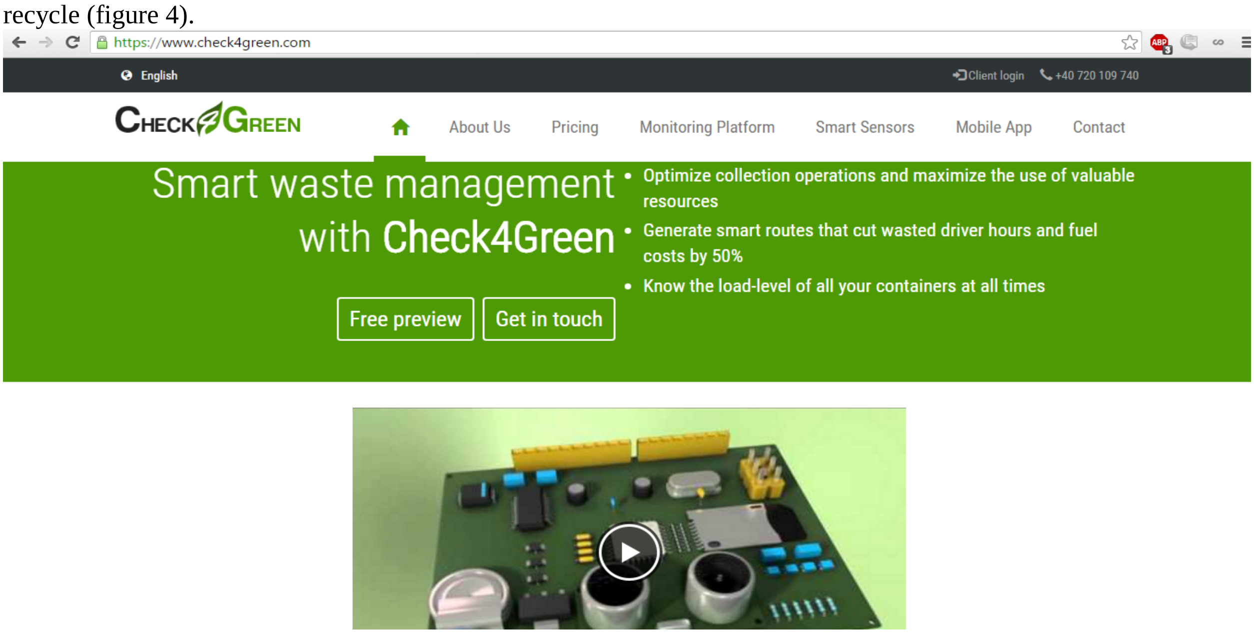

Fig 4. Check4Green startup

The online platform of this system presents the location and batteries level in each container, as seen in figure 5.

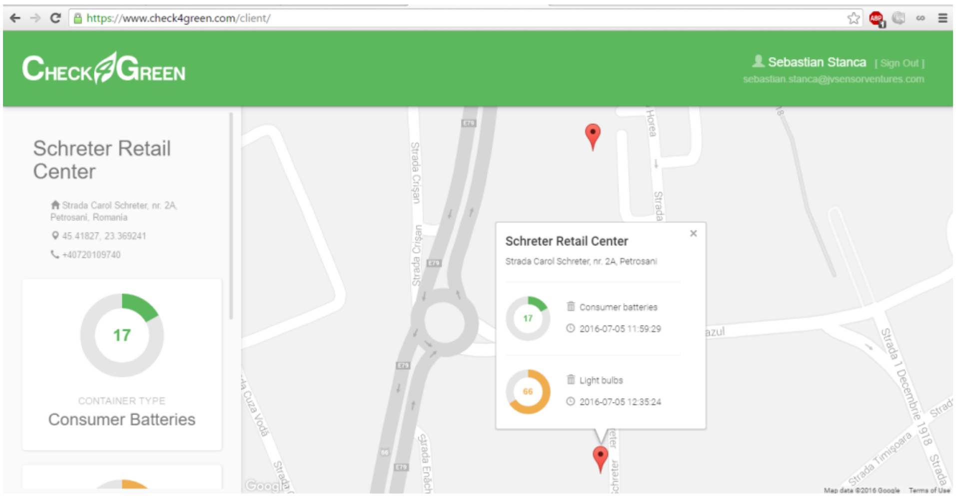

Fig 5. Check4Green online platform

3. QFD based 3D Spiral Model applied on Check4Green

There are well-known business models canvases for startups. We make a step forward and introduce a 3D spiral lifecycle model (Boehm, 1988) for startups development that includes a version development control and a link between the technical part and the business part, achieved by QFD (Quality Function Deployment) method (Chan and Wu, 2002).

In our previous research (Ionica and Leba, 2014) we focused on developing a methodology to apply the QFD method for software evaluation. In this paper we present an extension of this methodology for startup development process quality evaluation. We introduced a lifecycle model that includes in its representation the quality part and a life-cycle inspired from software engineering. This new lifecycle has a 3D representation made out of multilevel circles spaced by an offset. The offset value is a comprehensive quantification, based on a mathematical model, of the accomplishment degree of the initial requirements of the product to be developed, either software, hardware or combined. We have developed the first version of the 3D lifecycle QFD embedded model that we applied on the development of an innovative product that is subject of a Romanian startup, called Check4Green.

Our original QFD based 3D spiral lifecycle model (Leba and Ionica, 2012) allows permanent adjustment to market requirements and continuous assessment of the degree of fulfillment of these requirements by the technical characteristics of the product in the current stage of development (figure 6).

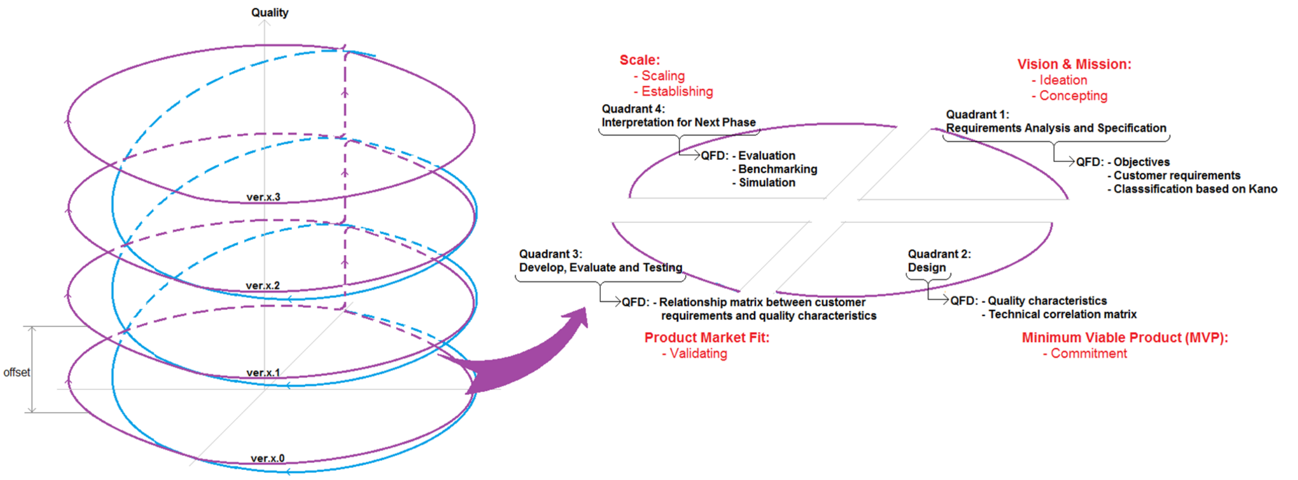

Fig 6. QFD based 3D lifecycle model for startup development

The development phases of startups are grouped in the model's phases, as follows:

- Vision & Mission corresponds to: Objectives, Customer Requirements, Classification based on Kano.
- Minimum Viable Product (MVP) corresponds to: Quality Characteristics, Technical Correlation Matrix
- Product Market Fit corresponds to: Relationship Matrix between Customer Requirements and Quality Characteristics
- Scale corresponds to: Evaluation, Benchmarking and Simulation

The QFD based 3D lifecycle model is made out of multilevel plane circles spaced by the offset. Each plane circle represents a version in the development of the startup and has its own radius representing the development costs involved in the version, related to the cofounders and venture angels, starting from own funding, through Crowd, Angel, VC (Venture Capital) funds all the way to IPO (Initial Public Offering) investors.

The development of this innovative product follows the well-known lifecycle, consisting in requirements capture, system design, development and implementation of the system (hardware and software), testing. The research methodology was based on the collaboration between specialists from different fields, like computer engineering, electronics, quality management, waste management and potential users, and led to the objective achievement, the waste management system first for batteries only and subsequent, by refining the requirements and enlarging the target group, for any type of electronics waste.

The main findings resulted from our research are related to the evaluation of the product developed in different versions.

The model includes the rerun of the phase involved in the development of startups in order to improve the product and go through from one version to another. For each version there are run the phases shown in Figure 6.

There were taken into account the changes in model inputs both at the requirements and technical characteristics level, resulting in the string of versions from prototype to current state.

Each version is built on the refinement and the update of the initial requirements.

Also, for each version was made a public presentation and feedback was collected from users via: contact form and social media. (www.check4green.com)

The version 1 is characterized from the hardware point of view by the following: Atmel microcontroller prototyping system with GSM board (Cioca et.al., 2008), ultrasonic sensor and power supply. From the software point of view, the solution was simple; it only transmitted to a phone number the current level of batteries in the container.

For version 1 we determined the offset value as 28.7%. This value, representing the degree of requirements achievement by the technical characteristics of the product, is not acceptable, but encouraging for the development of a second improved version.

The version 2 is characterized from the hardware point of view by the following: dedicated Atmel microcontroller hardware with GSM controller, ultrasonic sensor and batteries. From the software point of view, the solution integrated an html gateway that connected the information received from the sensors to a database.

The result was a non-significant improvement, only 3%, resulting in a global offset of 31.7%, mainly because of the hardware part, big power consumer and microcontroller software development limitations.

Version 3 is the current version and is characterized from the hardware point of view by the replacement of the microcontroller with an ARM Cortex solution and hardware optimization to reduce power consumption. From the software point of view, the solution is more complex, integrating a dedicated API, a complex database and a multi-user web interface. The target offset for this version is 80%.

Conclusions

Startups are sources of society progress through innovation, with an average success rate of only 10% (Coleman, 2014). Even if we are witnessing an explosion of startups, 9 out of 10 startups fail, and of these 42% due to the lack of correlation with the market requirements. Applying the QFD based 3D lifecycle model for startups would increase the rate of success because of the continuous correlation between the user requirements and the technical characteristics. The model introduces a quantifiable element, called offset, showing the progress of the product developed by the startup. Based on this offset there can be set targets, considering the time horizon, which is essential for startups.

It is good to be known that from idea generation to the beginning of scaling a maximum of one year is required. In this time of fast running phases, we have 6 months for a first draft and possibly the first of its refining, followed by about 6 months of accelerated growth and release of new versions. During acceleration it is very important to have a monitoring tool to make the connection with existing market requirements.

Our results show how the model was used and the characteristics of the three versions that define the path of Check4Green startup up to date.

In the first 6 months were launched version 1 with an offset of 28.7% and then immediately version 2 with an offset of 31.7% with an insignificant increase, but with conceptual changes that have prepared the version 3. The six month period represent the Seed period. Currently in version 3 we are targeting an 80% offset. The objectives during this period are: get funded by venture capital, angel investors, crowdfunding and / or 'friends, family and fools' (FFF); attending events such as HowToWeb; increase revenue, by selling the product and the support services; intellectual property, by getting an international patent for the product.

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The another point of view on sustainable management

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Abstract

The structure of sustainable management can be introduced in different ways. One of such ways is the tables used in structural analyses, which take into consideration organisational social and technological divisions or determine directions of sustainable management with use of simulation methods. All methods that optimise decisions can be introduced as right structural models. It is necessary to think whether for sustainable management system there is possibility to create universal structure, which allows to build sustainable management t structure model. The model has to fulfil certain requirement at the same time as simple as possible to implement to management computer systems as a module of integrated system. It is necessary to remember, while creating this model, that some individual streams of elements, which allows to form sustainable management and decision streams influence one another. In this paper, it is a trial of introducing of such model, which take into consideration streams of sustainable management elements and decision streams and their interaction. This model consists of matrix mutual connections elements of sustainable management and decisions. Those decisions can be divided into external decisions with influence on sustainable management, such as decisions about import limits, barrier duties and internal decisions connected with sustainable management

Keywords: sustainable management, matrix, demography, technology, computer systems

1. Introduction

In these days, more and more attention in being paid to environment and ecology protection. Political, social and economic actions are much better seen, when decisions are taken in harmony with the natural environment. People began to realize the importance of the environment, they began to appreciate the actions of those, who do care about, and condemn those who don’t. Then, sustainable development was defined as "the right to meet the development aspirations of the present generation, without limiting the rights of future generations". (Smith et al 1998),.So, the current economic development should not affect, adversely, the economic development of future generations. Environment destruction and, the endless and only sometimes, use of scarce natural resources, without any thoughts, by the present generation, may lead to a situation, in which these resources will not be enough for future generations.

On the one hand, it can be assumed that it is about a process of development of individual countries and cities, on the other hand, the definition can be seen from the broader business, that definitely makes the synthesis of the needs of the present generation, with the ability to meet the needs of future generations (Grabara, 2013).

Sustainable development is defined as "a sequence of changes in which, the use of resources, the structure of investments, orientation of technological progress and institutional structures can be carried out in such a way, that there will be no contradiction between the future and present needs" (Sztumski 2006). According to the definition proposed by T. Boris "Sustainable development is a process of change (development), which implements the feature of balance assessed positively in terms of at least anthropocentric system of values or less, less precisely though – it is development with the sustainability attribute" (Borys 2008).

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All definitions of sustainable development, despite some differences, emphasize the need for unconditional desire to maintain a balance between the modern and future times.Currently, we are dealing with two concepts of development. The first one is called the development of conventional thinking and is based on a scale of one generation, all actions are taken in order to achieve material success. In this concept, the prerequisite for the development of social and economic development, is a high rate of economic growth. The following issues, that are not covered by simple economics calculation, such as the ecological consequences of industrial expansion are associated with it. Sustainable development based on this concept, focused its attention primarily on environmental threats and then focused on the equally important social issues. In this case, the main assumptions of this approach, is to increase prosperity, seen through the lens of environmental conditions of life. The objective of sustainable development is to increase, not only the level, but also the quality of life.

Sustainable development refers to the process of human development, in which, resource use aims to meet human needs, and takes place at the same time, ensuring the stability of natural systems and the environment. This is done in such a way, that the requirements can be meet in present and in the future (Bold et al, 2015). Sustainable development focuses on both, use the resources of the natural environment in 100 percent on the one hand, and on the other hand, in a rational manner and as little as possible. So the assumption is that with the least amount of resources, create as much as products, with maximum utilization and a minimum of waste (Budica, 2015).

The concept of sustainable development is closely related to the eco-development (Pachura and Ociepa-Kubicka, 2014). Analyzing the concept of sustainable development, it can be seen that sustainable development, in this case, is defined as a balance between wildlife issues, economics and culture. According to this concept, the economic development should not seriously impact on the environment in which man lives and lead to the degradation of the environment. Sustainable development is development which owned heritage environment is maintained in undisturbed state for a period of time, thus allowing future generations to enjoy these gifts of nature.

There are many definitions of sustainability, and we can distinguish some of the most common. The first one says "Sustainability is conducting any business in harmony with nature, so not to cause irreversible changes in the nature or the management of environmentally acceptable, socially desirable and economically viable" (Sadowski 2008) Another defines sustainable development as "socio-economic development harmonized with the natural environment, both local and wider - including the various ecosystems and resources, and the structure of soil, water, geological and atmospheric and generally understood the beauty of the landscape in order to preserve their values in the longest possible time intervals". According to another definition "sustainability is a comprehensive harmonization of economic activities with the possibilities of the natural environment" (Bojarski 1988).

In pursuit of sustainable development, development of environmental awareness is extremely important. "The awareness term determined the relationship of man to nature, the team of the information and beliefs about it, and the system of values, which is directed against him on in his ways" (Moraru et al. 2014).

In the past, the concept of sustainable development was made up of three components, namely, the protection of the environment, sustainable economic development and social and political stability. Recently has been suggested, however, that would be a more appropriate distribution of the four main areas of sustainable development, economic, environmental, political and cultural.Nowadays both, broad and narrow approach functions to the concept of sustainable development (Ślusarczyk et al. 2016). The narrow definition of sustainable development relates to the protection of the environment, and generally also apply to the general development of the institutional and political governance.

The theory of sustainable development is growing, mainly in the environmental economics frame. This concept is interdisciplinary. Sustainable development is seen in several ways. As the process of civilization, that is the idea of social and philosophical, as well as the direction of economic development. In this case, the division of sustainable development in several dimensions - economic, environmental, psychological, social, demographic, spatial, inter temporal, takes place. Then, this development was seen as the direction of research.

2. The concept of ethical paradox in sustainable development

In sustainable development concept occurs so called. 'Ethical paradox'. On the one hand sustainable development is seen as a feature of the process or condition that can be maintained indefinitely. On the other hand, the development is associated with some kind of modification of the environment, and requires intervention in nature and use of natural resources which, unfortunately, are limited.

The concept of sustainable existence belongs to the field of ecology, refers to the capacity of the ecosystem, which spans centuries, without any changes. Since the concept has been combined with the development, it cannot be seen from the point of view of environmental protection only, but also from the society and the economy. This paradox is presented by the most common definition of sustainable development, from the Brundtland Report, which reduces pressure on the environment, emphasizing human needs realized through development. Accordingly, the first part is defined as a "logo" of the environment, and the other as a "logo" of the economy. The objective of sustainable development is to alleviate and moderate paradox between these two objectives. (Brzeziński et al 2013)

Sustainable development attracts many supporters, because it seems to strive to combine ecological and economic interests. Its assumptions are able to deal with the environmental crisis, without affecting economic relations between countries' governments. Capitalism and ecology do not contradict, when they are combined under the banner of sustainable development. "Limits to Growth" has become negotiable and enforceable.

The concept of sustainable development is defined as "discourse ethics", which defines a man in relation to good and evil. "Human survival and well-being may depend on the success of raising the sustainable development of the global ethics". Therefore, people urgently need a shared vision of basic values, to provide an ethical basis for the emerging global community.

Although there is no one agreed definition of sustainable development, it is virtually all definitions are related to the tension between the economic and the environment, with a preference for achieving economic growth. It covers the development of progressive transformation of economy and society. Paradoxical relationship of stability and development are associated with different ideological spectrum, which ranges between two radically different ethical concepts "domination of nature" and "the inherent right of nature". The first concept is represented by the so-called doctrine. "Light ecology", and the other by the doctrine of "deep ecology". Both of these doctrines apply many methods to solve this paradox and to find a balance between environmental and economic objectives.

2.1. The concept of natural capital

This concept represents a natural development of tangible assets. These resources are defined as "all the resources of the natural resources of oil in the ground, water and soil, groundwater, fish stocks in the ocean around the world, the recyclability and carbon sequestration". Equity includes all the natural advantages: people can modify and expand the opportunities for its use, however, these goods cannot be produced by humans. Natural capital is usually divided into three categories: non-renewable resources, such as mineral resources, renewable resources such as crops. The third group is the natural systems, that have the ability to absorb pollutants resulting from human activities, without incurring losses due to their harmful effects. In the discussion on sustainable development a natural capital has been often determined as its criterion. The rules should be kept on the same level all the time. Thus concepts are being developed, which are aimed at the exploitation of natural resources in the way to suffice them for future generations. Thus, the green economy is to emphasize the importance of non-replacing natural capital and its role in the further development. (Jabareen 2012) Some researchers argue, that maintaining something that exists in the environment during its continuous change, is both logical and functional. For them, sustainable development rules of conduct, on both to maintain a certain resistance to change, on the other, to adapt to changing internal and external conditions. What's more, there is no such thing as a universal state of balance, which is wrongly affirm by many researchers, who even have a set of indicators for this type of measurement. (Kohn et al 2001),

2.2. The concept of equality

The concept of equality represents the social aspect of sustainable development. The social dimension is critical, because it is unlikely, that the unjust society respected the principles of sustainable development, continuously over a long time. The very notion of equality includes a variety of other concepts, such as the environment, social and economic justice, equal rights to development, quality of life, freedom and democracy. Everywhere in the world, where there is destruction and degradation of the environment, questions about social justice, equality, human rights and quality of life in a somewhat broader sense, are put. It is believed that a sustainable society is one, in which questions about the need for social justice, prosperity and economic opportunities are integrally related to the limits imposed on them in order to support the ecosystem. Many researchers, environmentalists and governments agree that sustainable development can be achieved through an effective balance of social, economic and environmental objectives. Most often quoted definition of sustainable development comes from WCED, highlights the issue of equity between generations. Most often quoted definition of sustainable development comes from WCED, highlights the issue of equity between generations.(Kohn et al 2001), There are two types of equity related to sustainable development, intergenerational and intergenerational. Intergenerational equity refers to the fair allocation of resources between present and future generations. It is a development that "meets the needs of the present without compromising the ability of society for future generations". It is important here such action and decision-making, that does not damage the prospects for maintaining or improving the conditions of life in the future. This means that our current economic systems should be managed in such a way that we can use the "dividend" of our resources, and thus, that future generations will enjoy them as much. It is a concept, which comes to the ability to share wealth between generations. However, intra-generational equity in terms of fairness in the allocation of resources between competing interests at the moment. In the literature, much less attention is devoted to this type of equality, although it is also an important aspect of sustainable development, as more equitable and thoughtful allocation of resources and power can contribute to the improvement of environmental quality. Greater inequality of power leads to greater environmental degradation. Therefore, before we focus on intergenerational equity, we should first obtain the equality of the current generation.

2.3. The concept of eco-form

This concept is related to the form and structure of human habitats, such as urban space, buildings or houses. This concept focuses on the design and definition of urban environmental companies to help protect the environment and creating buildings more environmentally friendly than the current. According to the researchers that "energy efficiency" is the key to achieving organic forms by designing buildings, cities and regions. Better design helps to reduce air pollution, but also increase energy efficiency. Under this concept, it is the architects are more responsible for the world's consumption of fossil fuels, global warming and natural gas production. The literature review also indicates that sustainable development can be achieved through proper planning at the local and regional level. By proper design of habitats can be solved a lot of problems, because they often arise precisely from improperly designed urban system.

2.4. The concept of management integrity

This concept represents the integration of sustainability aspects relating to economic growth and environmental protection. It is believed that, in order to achieve sustainable development and ecological integrity, the preservation of natural capital must be integrative together with holistic approach to management. Economic goals, such as poverty reduction growth, should take precedence over the protection of the environment at the same time stating that, a healthy environment is a prerequisite for economic and social success (Kot, 2014). What's more, it is believed that poverty and environmental degradation affect global crisis, and the choice between the environment and development should be pursued, in order to achieve sustainable development.

From a policy perspective, the concept of integration of management, emphasizes the importance of maintaining a safe minimum for all living and non-living activity needed to maintain ecosystem functions, and at least representative of all forms of living natural resources. Thus, conservation should be an integral part of the development process. The current decision-making systems, in many countries still tend to separate economic, social and environmental factors on policy, planning and management levels, which affect the operation of all sections of society, the development of performance and stability. Therefore, the proposed integrated management system should ensure consideration of environmental, social and economic together in the framework of sustainable development. Were identified four areas of work:

• integration of environment and development policy, planning and management levels,
• providing effective legal and regulatory framework for the development,
• effective use of economic instruments and market,
• establishment of an integrated environmental and economic accounting.

2.5 The concept of utopia

The concept of utopia predicts the development of human settlements (communities, cities, regions), based on the concepts of sustainable development. Usually utopias of sustainable development represent a perfect society, where justice prevails, people are happy to live and develop with nature in harmony, and life goes on smoothly, without fraud and loss. Power utopian thinking is properly understood as a vision of a new society, which challenging now all considered assumptions. This is due to the inherent ability to see the future in terms of radically new forms and values.

Utopian thought is important in the search for environmentally responsible society. Utopian vision is necessary inspiration, which should draw activists. The so-called. "Greens reformers" radically need an alternative image of post-industrial society, far-reaching ecological vision, delusions study sustainable community, and paradoxically also need the so-called. brought to the Earth and remind them of the limitations of growth.

2.6. The concept of global political order

This concept presents a new global discourse, that has been renovated and inspired by the ideas of sustainable development. This concept takes the earth as a single world and aims to address global environmental problems at their core, and to provide to a developing country tools and resources, needed to equal opportunities and enable them to address urgent problems such as deforestation, climate change, loss of biodiversity, the increase in the number of population, disease, etc.

3. Sustainable Management and Mathematical Approach

All these definitions and elements included in the area of sustainable development requires appropriate management actions. It should be remembered that all the time we move in a closed (limited) area of the system which the Earth is. Therefore, the options are limited because the action in one of the areas have an impact in other areas, these effects are often irreversible.

To be able to manage sustainable development must be addressed in a comprehensive manner to this issue.

Speaking of sustainable management, it should be divided into the following elements of management:
• Policy supporting sustainable management,
• Development of legislation for stimulating sustainable development,
• Monitoring the permanent state of equilibrium; Technologies that support sustainable management,
• The human factor (Demographics).
Of course one can refine specific areas such as in the case of the supporting policy, it refers to global solutions. Since the measures taken by individual countries or groups of countries of the European Union members, for example, cause or may cause effects in other countries or regions of the world.
The same applies to the legislative process concerning sustainable development. As for monitoring the permanent state of equilibrium, one should find an objective method that can not be none of the parties to "tweak", to improve statistics and results. At this point, it should be recalled method used in coal mining where the miners took with them cages with canaries. When the canary was dying was a sign of the maximum standards of methane in the drifts. This method, although archaic is an extremely effective and objective. In the case of technical equipment for the detection of methane, there were cases of such regulation to indicate the level of methane lower than it actually is.
Assistive technologies are the most frequently mentioned item and actually many institutions the problem is. While the last of the elements of the human factor is the biggest problem management process sustainable development, both in terms of quantity and quality.

Sustainable management present itself as formal arrangement composed from ordered two elements of systems A and set R of their characteristics or relation between them.

$$S - (A,R)$$

where:

$$A = \{a_1, a_2, ..., a_n\} \quad R = \{r_1, r_2, ..., r_n\} \tag{1}$$

If R^p means p – reasoned relation set between elements of set A, that ensure inclusion

$$R^p \subset A^p \cap R \tag{2}$$

where:
$A^p = A \times A \times ... \times A$ means p times Cartesian product of set A by itself, so p – is Cartesian power.

The most interesting in sustainable management S are R^1 and R^2 sets 1- reasoned relation (the characteristics of elements) and 2- reasoned relation, that is links of A set elements in two elements, so the characteristics of two elements.

In sustainable management special part falls to computer science technicians. For basic conditions of using information and computing in sustainable management information as a subject of logistic processes,
- inflow of development of computer science to model of sustainable management,
- interaction of computer systems to sustainable management.

To judge the information as an object of flow thereby it is placed in sustainable management. Processes of information flow are identified with processes of management. Engaged equipment, which makes possible accumulating, processing and sending information is more efficient but costs of buying its are high. Moreover not large experience of sustainable management enterprises, which sending information cause that nowadays it's very hard to call aforementioned information as a "splendid good" flowing in sustainable management. The works are conducted systematically and lead to improve the computing techniques using in sustainable management. Working out computer programmes in which basic parameters that describe sustainable management are taken into consideration and conduct to improvement of venture in this domain.

The using of original internal sources can concern in particular
- Policies supporting sustainable management,
- The creation of laws that stimulate sustainable development,
- Permanent monitoring of the equilibrium state,
- Technologies that support sustainable management and human factor.

Connection of effects from carrying out data analysis and obtained information from external and internal sources gives full image of sustainable management. Model of sustainable management was shown in the form of block diagram, but nowadays sciences of management admit this form of projection as insufficient. In order to effective running of analysis, the contemporary tools which assist analysis processes, which using computing technologies have to be taken into consideration. That is way formalisation of records has to very high. Those requirements fulfil method of Matrix Structures Show (EMPEES) of economic systems worked out by W.J. Wesołowski (Wesołowski 1995). Directed matrix record clearly demonstrates the couplings, which have character of feedback. Their records lay symmetrically spread on oppose sides of zero diagonal line. (Unold 1995)

Matrix record of investigated structure will provide identification of those relation as a function of factors in system. It will be relations effecting on particular elements of sustainable development and flowing from blocks detailed determining relation occurred in system. Those relations can be assented to binary record and then present them in graphical way. In this purpose it is possible to apply two – valued Boole's algebra (presented by Shannon in 1938). This algebra is known as algebra of switching system. Boole's algebra is used in practical way to describe systems built from two – state relays. Those relays are able to achieve two states: state of conducting – described as 1 and non – conducting state described as 0. Using this algebra is a consequence of analogy and because of it is, can be made certain

interpretation of Sustainable Management. When all elements and relations of sustainable management are taken into consideration, the function described them (formal record) will equal a value 1 and it means initiating of efficient sustainable management. However if one of elements, which create sustainable management won't be taken into consideration, the value of function is equal 0 and it means lack of sustainable management.
Following matrix can allow for better understanding of the problem:

4. Conclusion

Concluding, the matrix of sustainable management is an interesting proposition as using mathematical modeling can examine the relationship between the variables of sustainable management and optimize its effects on the assumption of changing factors. The presented concept will require the extension of a comprehensive mathematical notation and verification of actual data that can be an interesting direction for further research.

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The quality of the university management, a solution to connect the main actors involved in the educational process

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Abstract

The research aim was to capture the employee views over the possibility of improving the level of communication between education and the business environment, in order to initiate joint projects in the coming years, and also to increase the employability of our university graduates. Also, the purpose of this research is to find solutions to sensitize the students about the need to be actively involved in various professional contexts, to be part of the contexts of work, but also to seek feedback on the work conducted, and to gain a clear and integrated future in the labor market. The study set sights on over 29 of the most important employees from the Jiu Valley, and 39 of the leading graduates of the University of Petroșani. Data were collected in 2016 year, through a survey oriented as well as for the employees and graduates.

Keywords: University Management; Employee; Student; Education; Quality; Labor Market

1. Theoretical Framework for the education and labor market in the European Union in 2016

1.1. University Management

The characteristic defects of the current university model extend far beyond the working lives of academics. The organizational logic of the modern university is responsible for other widely observed tendencies concerning its broader social role. Throughout the modern managerial university, pressures to perform and produce make breadth of learning and depth of thinking all but impossible for both students and academics alike. Current practices lead to the neglect of teaching for the sake of research 'outputs'. The emphasis on student fees and enrolments leads to declining educational standards. The emphasis on the quantity of research outputs both undermines the quality of research and distorts its goals. In the humanities, obsession with grant applications and the number of publications encourages specialized research projects of sometimes questionable value. The grant application process undermines the intellectual freedom of researchers, subjecting them to the imperatives of government and an increasingly powerful professoriate. The impoverishment of university learning and education is surely something that must concern us all. (West, 2013), (http://www.demosproject.net/the-managerial-university-a-failed-experiment/)

An education manager may perform the following tasks: provide educational leadership to teachers, principals and administrative officials of education institutions in the development and coordination of educational programs, oversee educational research aimed at providing new directions for the educational system, represent the organization on committees to identify present and future needs within the educational system, develop new courses, organize and conduct workshops and conferences to train teachers in new programs and methods, apply for and manage funding for new educational programs.
(http://www.studyat.uwa.edu.au/careers/education-manager)

The changes that took place in Romania, along with the ones in Europe and in other parts of the world, were many,

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radical as well continuous, and they required essential transformations in the overall educational process. Initiating and implementing these diverse set of reforms and processes at the European or international level, are more relevant for Romania, whose educational system is still undergoing a profound reform.

In order to answer to the nowadays society needs and to create the conditions for “a relevant and responsive educational system to the specific needs of the economy”, UEFISCSU initiated the project “Improving University Management”, its goal is being to promote updated knowledge, modern techniques and actual management instruments for the higher education institutions across Romania. This project objective aims for the improvement of the academic management through the construction and implementation of a viable system of proper and up to date training of the universities representatives with different decisional responsibilities in order to make the management activities more efficient in the higher education institutions.
(http://www.management-universitar.ro/202/section.aspx/83)

1.2. Education and Labor Market in the European Union in 2016

In the developed countries, the educational reform is focused on the need of helping people to adapt to the new requirements of the jobs, students being encouraged to accumulate a broad range of knowledge in order to have many carrier options. In the United Kingdom, for example, the examination systems allow students to choose subjects not only from the general syllabus but also from the vocational ones. In Finland, the government has increased the importance given to vocational training as well as the level of spending in order to sustain the acquirement of some specific knowledge at the working place. (Diaconu, 2014) Despite all these aspects, a study conducted at the beginning of the 21st century shows that developed countries are confronting with a lack of technological and engineering abilities, over a quarter of the university and college graduates graduating from social sciences in the European Union (EU) (Sequeira, 2007).

In a general assessment, there are two contrary perceptions on the Romanians’ level of education. On the one hand, at the individual level, if each of us is allowed to appreciate his professional and intellectual capabilities, which are strictly related to education, the prevailing view is that Romanians are relatively well prepared, especially compared to people from the Western countries. On the other hand, if each of us is asked what his general opinion regarding the level of education of Romanians is, but not compared to others, the criticisms would shortly appear. (Diaconu, 2014) One possible explanation for this downword trend could be the fact that, in Romania, the vocational education and training system is characterised by a high degree of centralisation, a weak school infrastructure (due to under-investment for a long period of time), a lack of well trained administrative personnel in the bodies responsible for vocational education and training, a lack of well prepared teachers and an outdated and narrow curricula in the majority of schools. (Diaconu, 2014) Another explanation for the decreasing number of those who graduated from vocational schools in Romania could be that individuals are more and more tempted to acquire general knowledge in the first stages of education, and then, to become specialists in a certain field. (Diaconu, 2014)

In conclusion we may say that Romanian education should not waste what it already has, a general feature, but it should develop the possibility of doing some practical training, in certain fields. (Diaconu, 2014)

1.3. European Labor Market in 2016

If we consider the employment, activity rates, hours worked and activity rates, the reduction in the working age population was particularly acute in Member States such as Bulgaria, the Baltic states, the Czech Republic, Hungary, Poland and Romania where it was mostly linked to outflow migration but also to low fertility rates. In these countries, activity rates kept rising during the crisis. If we consider the real compensation per employee, productivity and unemployment we can see substantial deviations between growth of real wages and growth of productivity were observed in Cyprus, Greece, Romania and Spain, where the average productivity growth was at least 2 percentage points higher than the average growth in real compensation per employee. In the area of policy actions and active labor market policies we can observe that some Member States introduced measures aimed at easing the recognition of work-related competences obtained informally by jobseekers (e.g. Portugal, Romania and Bulgaria) (European Commission, 2015)

2. Main actors involved in the educational process in the University of Petroșani vision

2.1. The first actor - the Student

Students have positive perceptions of higher education, but also clear expectations in mind of what institutions should provide to support and enable their learning and enhance their career prospects. Students wanted to be challenged in their learning, but also supported by the institution. Students almost exclusively spoke of their educational learning experience in terms of their course. This raises the need for strong course-level management of curriculum, quality and standards, with a clear structure of academic management mirroring undergraduate student-facing aspects, including local feedback and evaluation, module and course review. The trajectories of students into higher education and out of higher education are highly influential in shaping their perspectives. The question of what is 'quality' or 'good' about a particular institution should thus be framed within the contingent question of what a student is looking for in an institution, which may or may not be academic reputation. Whatever the institutional type, institutions need to develop a community and help students transition into it. Staff need to be supported by their institutions to provide the interaction and guidance that is important to students. Across the sector there needs to be a focus on how students can enhance their employability within, related to and beyond their course. Students are investing significant amounts of time and money in their education, and expect institutions to do the same. At the same time, students need to be held responsible for their role in the institution, and further opportunities for students to engage should be encouraged. There is much work to be done across the higher education sector to support students, staff and institutions in this endeavour, working *with* not *for* students. (Kandiko, 2013)

We teachers from the Romanian universities, see students demobilized, European Union wants them not to create more mobile labor market inequalities and economic disparities in Europe. But young people struggling by themselves to thrive in this world extremely hostile to them. Jiu Valley makes life extremely difficult, their prospects are bleak, uncertain future, and we teachers, who should guide them and help them, do almost nothing. It is necessary for everyone to put shoulder to change this perception and affecting their behavior. The education system should be an example for society and for young people, we must adapt to us, not just young people whom I see already adapted, need to be helped, to be closer to them, to guide them.

"Regarding the significance of studies is obvious that without a serious preparation is not possible to conduct a business or as an individual or as a society, a productive activity and equally important, a training in practical terms. For business owners I have a question - What do you expect from the graduates who would employee you? ", says Lucian Oana, student of the Faculty of Sciences at the event UPET of June 15, 2015.
(http://gazetadedimineata.ro/comunitate/triunghiul-care-poate-salva-valea-jiului-mediul-de-afaceri-administratia-locala-si-universitatea-din-Petroșani-la-masa-discutiilor/)

2.2. The second actor – the employer

"What I want from the University of Petroșani is to try to keep young people here and on this basis we can grow. My request is that you have a message for high school graduates, create opportunities for them to stay here, that we will take them after graduating university studies, only to have what to take", said Sorin Apostu, the company's manager VISA SA at the event UPET of June 15, 2015. "I want employees in the firm to be more than more than simple employees. I support them in every way, but unfortunately there are few who have initiative", says company manager Duo EKART at the event UPET of June 15, 2015.

3. Methodology and research - University of Petroșani management priority - Connect the main actors involved in the educational process

One of the motivation of this part of the research is closely linked to the improving of the communication between two areas, the academic area of the University of Petroșani and the economic area of the 29 companies, as well as the opportunities provided by the collaboration between the two environments. The 29 organizations where selected during the workshop organized on 16 of June 2016 by the center for the relation with socio economic environment and the center of counseling and career guidance for students of the University of Petroșani, supervised by the management vice Rector. The socio-economic crisis that crosses the Jiu Valley in recent years, made the three important pillars in the development of this area - business, university and local government - to sit at the discussion table to determine which are business requirements in terms of human resource that provides university and how can local governments to support two media mentioned above, however the idea he wants to lay the foundations for sustainable development of the area Valley Jiu. The main question raised was that young people choose to leave this area to operate in other parts of the country. University requires from the businesses company owners, to create the conditions for young people to stay in Jiu Valley, and from the local governments the requirement was to create a conducive environment for investors that want to do business in this region.

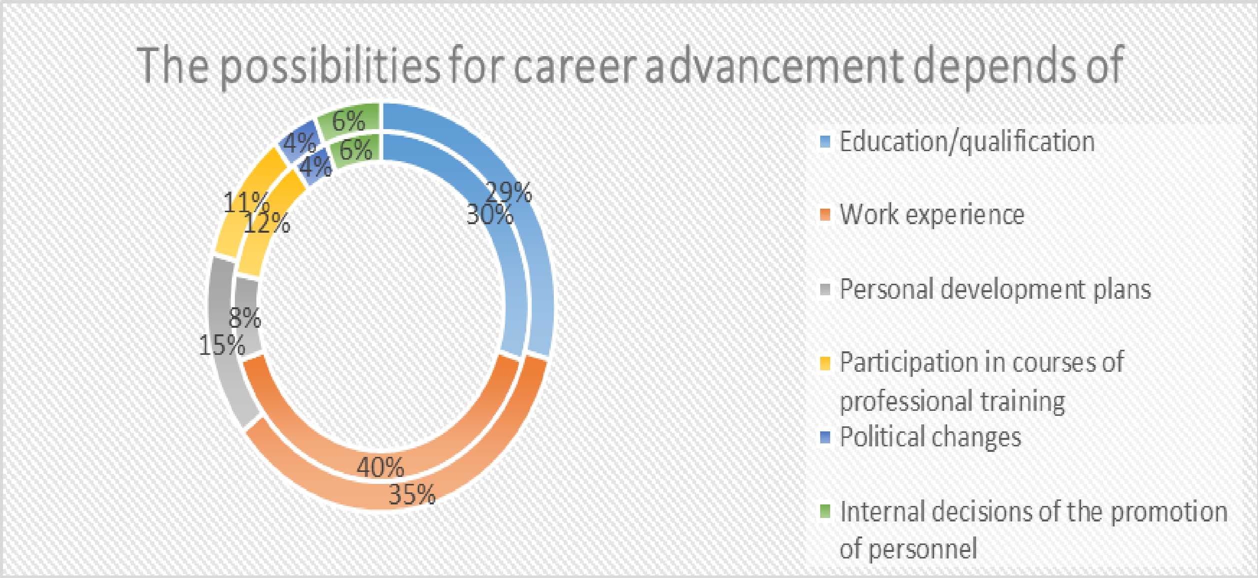

Fig 1. Career advancement in the vision of managers and students

We could make a comparison on the same question linked to the career advancement, between the answers drawn by the students (in the inside area) and the employers (in the outside area), and we can say that the expectation are relatively the same.

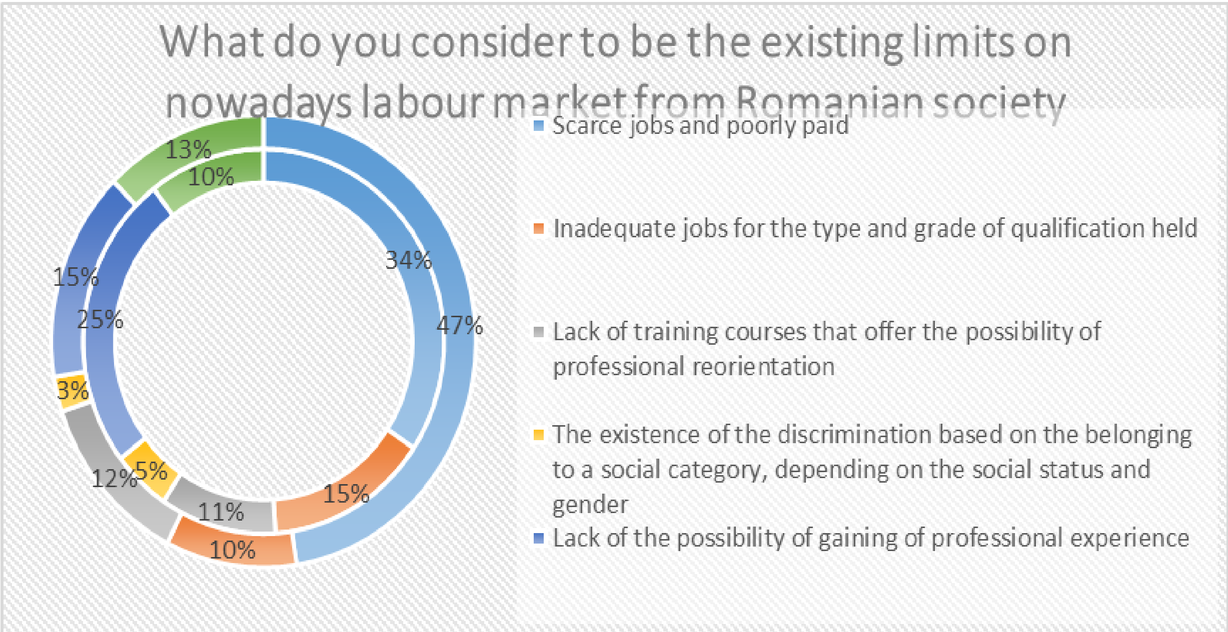

Fig 2. Limits of the Romanian labor market in the vision of managers and students

We could make also a comparison on the same question linked to the limits of the Romanian labor market, between the answers drawn by the students (in the inside area) and the employers (in the outside area), and we can say that the expectation are relatively the same, except the fear of the employers in the problem of scarce jobs and their payment (47%>34%), and the optimism of the graduates in the problem of gaining professional experience.

According to the recruiters, the results of the bachelor degree and the reputation of the University are not important in hiring decision (To what extent do you agree with the following statements?) in the employers vision.

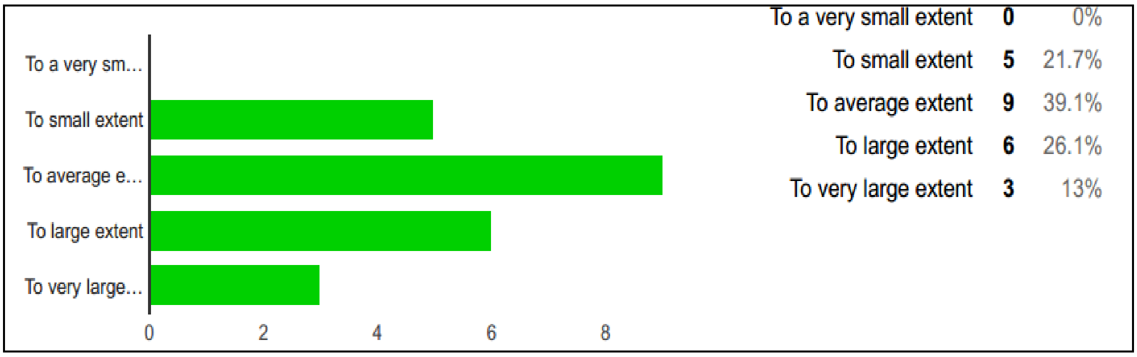

Fig 3. The importance of the bachelor degree and the reputation of the University in the hiring decision in the employer vision

According to the recruiters, the results of the bachelor degree and the reputation of the University are not important in hiring decision (To what extent do you agree with the following statements?) in the students vision.

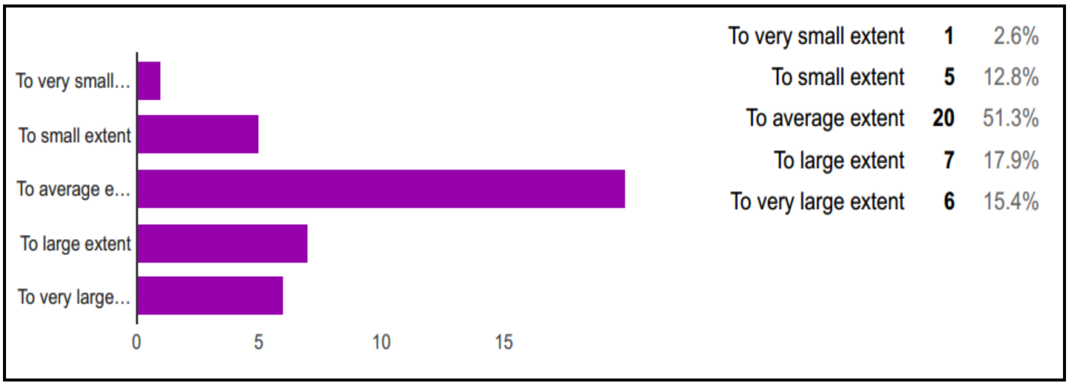

Fig 4. The importance of the bachelor degree and the reputation of the University in the hiring decision in the student vision

According to the recruiters, the level of education and the practical experience have the following importance in the recruiting process.

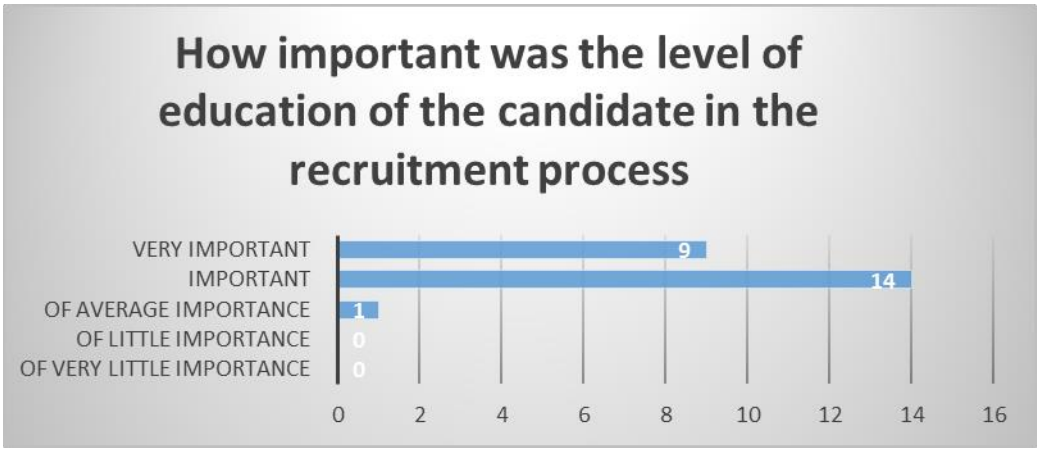

Fig 5. Level of education of the candidate

Figure 6. Practical experience of the candidate

We can conclude that the level of the education of the candidate is more relevant than the practical experience, even the graduates are very afraid of the lack of practical experience.

Conclusions

"We tried to build a triangle that involved most businessmen in the Jiu Valley, local governments, the 6 municipalities who think they are all represented today June 15, 2016 at the University of Petroșani, and coordinators of study programs at the University of Petroșani. It is basically a link between the labor market, education system and local government that can support business and the new university, because many of those born in the Jiu Valley, studying then here, must to stay here in the Jiu Valley, "said Eduard Edelhauser, vice-rector of the University of Petroșani. "It is a priority for the University of Petroșani to bring the University in a dialogue between business as beneficiaries of our work and the result of our work, namely students. We must seek that our students have the necessary knowledge to deal with firms that will employee them. This is the purpose of a normal education, naturally, centered on job offer labor market", said Radu Sorin, rector of the University of Petroșani.

University of Petroșani wants to become a bridge between business and academia, so students trained here, could find a place in the labor market, and this approach management has been declared through the official event organized on June 15, 2016 at the headquarter university.

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International experience in implementing enterprise process redesign

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Abstract

This paper is part of a larger study of the concerns of my research on finding optimal solutions for small and medium enterprises in our country, but particularly those in the Jiu Valley, to adapt successfully to the current business environment, to thrive, to be efficient and achieve business excellence. In this regard, to identify the strengths, the key elements, the limits, the weaknesses, the internal and external decisive factors, the techniques and models associated with process redesign management business and redesigning the company, I found it necessary to study and present the results of the worldwide studies.
I observed the concerns in the Business Process Reengineering (BPR) domain, Change Management, TQM, the various structures and organisms, as well as specialized consultants or recognized professors. In this paper I will present the synthesis and processing of information in the literature on the situation of the redesigning business processes in companies from different regions and countries, of the ways to integrate the processes of change management and TQM in: North America (US and Canada in particular), South America, Asia (China, Japan, Indonesia, India, Korea, Vietnam, Taiwan), Africa (Uganda, Kenya, Ethiopia), Europe and the situation in Romania.

Keyword: management; business; entreprinse; process; quality; redesign; reengineering; change.

1. In America and Europe

Relevant studies belong to associations such as: Association of Business Management International (ABPMP), American Society for Quality Directory, European Foundation for Quality Directory, European Association of Business Process Management; consulting firms such as ProSci (2013), specialists: Majed Al-Mashari and Zahir Irani (2001), Yang and Chang (2003), Mahorta (1998), Mohammed Zairi, Sinclair (1995), etc.

An important part of the research the authors, refers to the p*rinciples and conditions for creating the optimal deployment* of business redesign processes across the organization, and other researches have identified best practices techniques on these processes. The researches conducted by Mashari M., Z. Irani and M. Zairi based on questionnaires distributed to a number of organizations chosen from the U.S. and Europe had the following objectives (Mashari M., Irani Z. and Zairi M, 2001):

- Identifying the degree of change within organizations by applying BPR - the degree of radicalism;
- The techniques and tools used in business process redesign;
- Efforts made to redesign business processes depending on the degree of change;
- Ways to integrate business processes redesign of the type BPR with improvement techniques: CM (Change Management), TQM (Total Quality Management), Benchmarking (Best Practices) and IT.

Conclusions: It has been found that there are differences between American and European organizations regarding: experience, how these BPR type redesign processes are understood, addressed and implemented. Thus:

- US organizations have greater experience in applying redesign processes compared to those in Europe;
- American organizations attach more importance to how reengineering business processes integrate with TQM and with Change Management, and those in Europe believes that the priority is the integration of the BPR reengineering processes with Change Management, followed by benchmarking and then TQM;

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- There were difficulties in terms of establishing a clear link between the targeted areas for the implementation of BPR vision and consolidation of a well planned business strategy;
- European companies have faced greater difficulties in managing the size of changes registered in management systems, organizational structure and culture and employee attitudes;
- The percentage of organizations that have implemented reengineering processes were lower both in the U.S. and Europe (40% of total respondents) compared to those who apply redesign or improving processes of the business (about 60%).

U.S. companies have the largest rate and experience in applying redesigning business processes such as: BPR, Business Process Redesign, Business Process Transformation, because they are open to business excellence principles such as: encouraging of new ideas, leadership, flexibility, innovation and entrepreneurship.

2. Asian countries, particularly China

Business redesign processes after American BPR concepts made their presence felt in companies from Asian countries, although they are characterized by an different organizational and managerial culture, specific to management that promotes in particular the principles of the philosophy of Confucius, Kaizen and Total Quality Management. Thus, in recent years due to globalization and Western influences, redesign techniques and methods among Asian companies such as China, Indonesia, India, Korea, Vietnam, Taiwan, have become increasingly popular. Of relevant work that reflects the situation in China I found it in the works of Xin James He (2005:25-30), which shows that by applying BPR processes, companies in China have become more efficient and effective. Manifestations towards BPR among companies in China are presented in Table 1.

Regarding cultural influence among Asian companies, that although there are some cultural differences between the societies of these countries, there are similarities aimed in particular that the companies that implemented the redesign of the type BPR still faces difficulties towards: power (power distance), collectivism / individualism; how to approach uncertainty; gender aspects (masculine); how performance is addressed.

Table 1. Chinese companies' attitude towards the implementation of BPR

Attitude	China	
Favorable	72% from which:	29% of the companies have implemented or were in the process of implementing BPR
		43% of companies had the intention to adopt a process of the BPR type
Unfavorable (negative or uninterested)	28% from which:	13,6% don't have the intention to implement a process of the BPR type
		4,4% of the companies haven't yet got a decision whether or not to implement BPR
Total studied comapnies (110 companies)	100%	

Among the critical factors that favored success in applying business redesign were, primarily, support from the management team, effective communication and team unity. And of the problems encountered were mainly: resistance to new things and lack of innovations. Unlike US companies where most support the opening and supporting new ideas, leadership, flexibility, innovation and entrepreneurship, Chinese companies are reluctant to new ideas and change, because it derives from their managerial and organizational culture.

Table 2. Critical factors and problems in implementing BPR in Asian companies

Critical factors in BPR success	Problems and Obstacles	BPR Benefts
Support from the management team	A culture resistant to change and new ideas	BPR facilitates communication and improves information sharing
	Lack of a coherent strategy	
The structural unit of the management team	Lack of incentives for innovation in SOEs	BPR imposes competitiveness
		BPR improves corporate strategy
The cohesion and communication unit of the management team	Promoting principles based on seniority and not performance-based	BPR helps improve productivity and reduce costs
	Lack of senior management to support major changes	

3. In Africa

There are few papers that describe how business redesign processes are applied in some countries in Africa, and most of them show these processes implemented at public institutions (government, ministries, universities, etc.). However in the paper that belongs to a group of specialists from Uganda and Tanzania, there are presented examples of BPR processes in Kenya, Uganda and Ethiopia and argues the need that African companies must be open to change management and business process reengineering. (Samali V. Mlay, Irina Zlotnikova, Susan Watundu, 2013).

The Wrigley American company owning subsidiaries in Kenya initiated a BPR project in 2001 and was successfully completed in 2005. The project had objectives that targeted the Supply Chain Management (SCM) and Enterprise Resource Planning (ERP).

Samali V. Mlay, Irina Zlotnikov, Susan Watundu wanted to identify based on the study of successfully implemented projects in five institutions in Ethiopia and Uganda (Makerere University in Uganda, the Ministry of Finance, Planning and Economic Development, Ministry of Internal Affairs, Communication Commission Uganda and the Ministry of Information and Communication Technology) success factors and problems encountered.

In Africa the following situation is registered:

- African companies are far behind compared to companies from developed countries regarding BPR;
- Most projects of the BPR type were initiated after 2000-2004 mainly in state public organizations: ministries, government and universities;
- Even in these public institutions some projects were not completed or had failed;
- Where they have been successful or completed, they consisted mainly in the automation of services, implementation of IT applications and too little accent was placed on work processes and proper BPR understanding of business processes;
- Management felt that the critical factors in successful implementation of BPR were technical and financial issues;
- They have not granted attention to the human factor and sensitive factors on attitudes towards change;
- Also, the lack of experience, complexity and organizational management issues, poor access to IT are causes that contributed to the failure of BPR projects;
- BPR biggest impediment is human factor’s resistance to change.

4. The Situation in Romania

In Romania there is a centralized situation that highlights exactly successful BPR processes implemented in companies or industries. There are found either isolated presentations of companies that submit their story of success in various editorials in annual reports, or analyzations that points out more towards the situation and status of SMEs at national level or regions of the country, such as CNPIMM publications in Romania. Other articles and publications shows the status and level of research and development, degree of innovation at national level, ERP and BPM projects, the implementation of TQM's or techniques that are based on Kaizen strategy. For example, according to Kaizen Institute in Romania, there are numerous well-known companies in the country that have successfully implemented Kaizen techniques and methods such as Murfatlar Romania, Romstal, Automobile Dacia, Transilvania Bank, JTI, etc. (Kaizen Institute România, 2007:7) accessed (http://www.kaizen-competitivity.ro).

However, a study on the national state of relevant remodeling business processes -BPRedesign is conducted by the consulting firm Ensight Management Consulting, in the years 2015, 2010 and 2008. This study was conducted based on questionnaires completed by 40 respondents (Ensight Management Consulting, 2010:3) and aimed mainly at:

- The evolution of Romanian companies performance by optimizing business processes;
- Highlighting and understanding the factors that have sustained success in implementing BPR projects;
- Highlighting and understanding the factors that caused the failure of such projects;
- Benefits to companies after implementing BPRedesign projects;
- Targeted objectives in companies when they applied BPRedesign projects;
- Highlighting best practices for realization of projects BPRedesign.

Businesses in our country are far behind compared to the US and developed countries in Europe, on the state and level of the applied projects redesign and remodeling business. This situation is due to the conjuncture of business environment at the national level, characterized by the European Commission as being slow and unfavorable towards the development of a business (entrepreneurship). Where there were applied projects of remodeling and redesigning business, that is companies which have in majority foreign capital, they were still facing problems related to: inflexible organizational structure, applied management systems, by providing performant IT, human factor (resistance to change), lack of managerial skills and team.

Table 4. The national situation of Business Process Redesign projects in Romanian companies

Strategic targeted objectives	Projects benefits	Determining factor in the success of BPredesign	Problems and obstacles
- Increasing the operational efficiency - Effective control management systems - Increasing the value added to the customer	- Reducing the costs - Orientation towards business processes - Reducing the duration of the execution of business processes - Increased productivity	- The formulation of clear objectives - Competent management team - Knowledge of business processes	- Inflexibility of the organizational structure - Practiced management system - Providing IT performance -Resistance to change - Lack of management skills and project team

Conclusions

The beginnings of this approach in business management - enterprise reengineering BPR- is assigned to companies and professionals in the US, that about three or four decades ago have implemented new programs for effective organization and management that yields significant savings and profits. These programs were designed and made on terms which involved major, even radical, changes, a completely new attitude completely towards the manner in which the business processes were organized and managed, with the support of specialists and consulting firms, most often supported by the newest industrial technologies and information technology, with large investments. This seemed feasible only there, in US companies, where there were academies teaching business management, where entrepreneurship, innovation and creativity were strongly encouraged and supported, etc., with other favorable conditions to adopt such a change in business (brand of "land of endless possibilities. Subsequently, as a result of internationalization and globalization of business, these programs have got in companies in Europe, but they have a predisposition towards moderate changes made to processes and quality management.

Another region of the world distinguished by its approach to process redesign and management of business enterprise, is the Asian region: China, Indonesia, India, Korea, Vietnam, Taiwan. To the whole much discussed phenomenon of globalization and internationalization of the business environment there is ascribed the fact that in the Asian companies, the techniques of American redesign of type BPR are increasingly known and applied. But their basic feature is that very strong cultural influence and it is facing situations related to: power (power distance), collectivism / individualism; approach to uncertainty; the gender (masculinity); how performance is addressed.

In Africa, redesigning business processes appeared and began to be known later, after the years 2000-2004, when, in a number of public institutions (government, ministries, universities) or companies (foreign capital) especially in Uganda Kenya, Tanzania and Ethiopia, have been implemented BPR projects more or less successful in their completion. The basic characteristic of these is that they put special emphasis on computerization and automation of certain business processes or processes / services within public institutions, and the main problems they faced were financing, technological issues and human factor (resistance to change from employees).

Even if there are significant differences by regions of the globe of how they are understood, addressed and implemented these programs and strategies involving changes larger or smaller inside the company, there can be established some general elements based on the factors of success, problems encountered, a number of techniques and tools used as best practices, approach and implementation methodology.

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Aspects of analyzing stress at a managerial level in the energetic field (Part I)

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Abstract

Stress, as an organizational phenomenon affects the individual, the employer, the other employees, the performances of the organization and, finally, the society as a whole. Due to its multiple effects (stress), it has been studied by doctors, psychologists, sociologists, economists, engineers and many more.
This paper presents the partial results of an extensive research that took place in the Company Complexul Energetic Hunedoara S.A. (CEH). We say partial results because:

1. The most relevant aspects related to organizational stress have been analyzed;
2. The research has taken place in the subsidiary of Electric Plant Paroseni (SEP), a component of CEH, one of the producers of electricity and heat from the Complex;
3. The subjects – 101 in total, represent just decisional factors from the entire personnel from the subsidiary, from different managerial levels.

The paper has two parts. In first part, the article discusses factual data processing (demographics) of the research. The article then goes on stress analysis with some causal interpretations.

Keywords: organizational stress; energy sector; factual data; managers;

1. Introduction

Health has been defined over the years under various aspects, but the most accepted and utilized definition is the one given by the World Health Organization, through which health is seen as a positive aspect, as a state of well-being physically, psychologically and socially and not only under a negative aspect (the absence of disease).

Stress becomes an issue in three situations:

- Overload of stress, appears when the individual is being confronted or believes that he is being confronted with too many stressing agents. This leads to the overstrain of the body-brain system which interferes with the capacity of reacting efficiently;
- The individual reacts constantly to a multitude of stressing agents being permanently immobilized and not having the necessary time to recover;
- The destructive get-away situation appears when the individual is not capable to free its mobilized energy in a constructive way. Destructive liberation can be done through aggressiveness (verbal and physical) towards the others, towards an object or even towards the self.

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Physiologically speaking, stress is a conscious mobilization generalized by internal energy resources according to Mihaela Vlăsceanu (1993) and Vasile Ciocodeica (2001). „Thus, enzyme secretion causes changes in the connections between brain and body. These modifications are as follows:

- A reorientation of the sanguine flux towards the brain and larger muscle groups
- A more intense sense of alert, perception and knowledge
- Diminishing of some processes and affecting the immune system."(Vlăsceanu, 1993, p.24-25)

Morbidity is considered an essential indicator of the health condition, representing the proportion of illnesses within a community at one point or over the course of time. The study of professional and non-professional morbidity is being made by using statistic data such as: prevalence of occupational diseases, work-related illnesses, and chronic illness and morbidity indicators with temporary disability to work.

Important institutions such as The International Labour Organization (ILO), the European Agency for Safety and Health at Work (EU-OSHA), and World Health Organization show a great importance to occupational stress. Thus, "prevention of stress at the working place is one of the main aspects of the fundamental objectives of the ILO in order to promote as many opportunities as possible for women and men in order to obtain a decent and productive working place, having conditions of freedom, equity, security and human dignity. Only in the EU stress at the working place affects 40 million employees and produces annual losses of approximately 20 billion dollars." (EU_OHSA, 2015, p.1)

Organizational stress presents difficulties when being measured and defined. In literature the term "stress" designates both the aggressor agent, the causative factors and the individual experimental reaction (Selye, 1955; Golu, 1981; Holt, 1982; Bodea, 2002). Another definition considers stress as „the set of reactions of the body to the external action of the causative agent (physical, chemical, biological and psychological) consisting of morphological and functional changes, often endocrine changes" (http://ro.wikipedia.org/wiki/Stres). It is underlined the fact that mental stress can be of two types: primary and secondary. It has a "primary" character when it is the result of an aggression received within the psyche (conflicts and mental overload mediated by verbal stimuli and realized by focusing on the persistence of some images, feelings, etc) and a "secondary" character when it is an accompanying reaction or even a realization of a physical stress which awarded a significance of threat.

This paper analyses occupational stress as an existing phenomenon in the energy sector for the decision staff from the 'Subsidiary Electric Plant Paroseni' (SEP).

2. General presentation of the 'Subsidiary Electric Plant Paroseni' (SEP)

CEH is a commercial society with stock owned by state, owned entirely by the Ministry of Economy, the sole shareholder.

The main domains of activity of CEH are „production and distribution of electric and thermic energy based on coal" and "coal extraction and preparation". CEH has in its components two subsidiaries of power plants and one mining branch, respectively the Subsidiary Power Plant Deva, the Subsidiary Power Plant Paroseni and the Mining Branch Division. The technological equipment from the Electric Power Plant Paroseni takes into consideration its purpose and necessity:

- producing electric and thermic energy
- providing thermal energy in the form of hot water district heating systems for the towns Petrosani, Lupeni, Vulcan and Paroseni;
- providing thermal energy for some industrial consumers in the area.

3. Methodology and the research field

The study is being developed based on the interpretation of organizational stress questionnaire, which was administered during the 1st of May 2015 and the 15th of June 2015 to the employees of SEP which is a subsidiary of CEH. Our research wishes to investigate the possibility that stress factors can deteriorate the climate and the performance/efficiency of the organization.

The research methodology used as a research tool was the questionnaire. Organizational Stress Questionnaire comprises a battery of seven tests related assessment scale, and each has a different number of test items (in total there are 182 items) (Irimie et al., 2015).

After gathering the applied questionnaires the processing has been done by forming a data base and interpreting the obtained results. The research area is formed of 101 subjects, which have the quality of being decisional factors, quality certified by evaluating the professional risk in the professional risk assessment sheet. The administered questionnaires have been completed correctly, so they are valid for 100 people from the category of decision risk factors, one questionnaire has been completed only partially and it has not been taken into consideration in the statistical processing.

This situation is explicable through the big disadvantage of the sociological investigation based on a questionnaire which is self-administered, method which was used when gathering data.

4. Interpreting the results - processing of factual data

The research area was structured taking into account several criteria: sex, average age, civil status, breadwinners, number of children, level of education, total seniority, seniority at work place, number of working hours required per week, number of actual worked hours per week, the person to whom the decision to work so many hours belongs, post and position held.

- According to the sex criterion the number of subjects of 100 decision factors is divided as follows: 65 male subjects (65%) and 35 female subjects (35%). The share of female staff is due to the inclusion of office workers (TESA) from SEP.
- The age of the decision making staff at the institution is represented in figure 1.

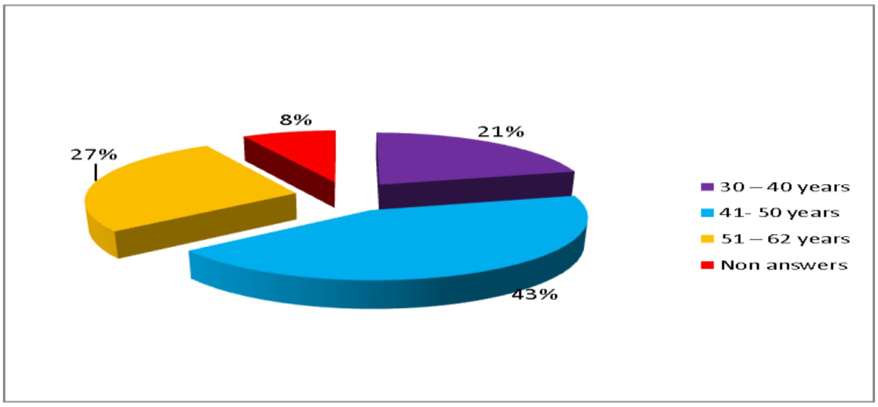

Fig. 1. Age of the decision making staff at SEP
Source: the authors

- The answers regarding civil status show the following distribution/situation: 73 subjects are married (73%), 7 subjects (7%) are in cohabitation with a person, 5 subjects (5%) are not married, 11 subjects (11%) are divorced, 3 subjects (3%) are remarried and 1 subject (1%) is a widower.
- For employees with a partner the question is whether the partner is employed. Thus, 63 subjects (63%) have employed partners, 23 subjects (23%) have unemployed partners, therefore there is only one breadwinner and 14 % are non answer.
- According to the number of children we can notice that 49 subjects (49%) have 1 child, 25 subjects (25%) have 2 children, 5 subjects (5%) have 3 children, 17 subjects (17%) have no children and the rest 4% are non answers. The situation of supported children is presented in Table 1.

Table 1. Number of supported children

Item No.	Item	Total Nr. %
6.1	Not applicable	31
6.2	All are pre-school children	7
6.3	Pre-school and school children	2
6.4	All are school children	31
6.5	School children and graduates	5
6.6	All are graduates	17
	Non answer	7
TOTAL		100

- The level of the decision factors' professional training reflects a good training, 16 subjects (16%) are high school graduates, 57 subjects (57%) have a bachelor's degree, 20 subjects (20%) have a master's degree and 7 subjects (7%) have other education, according to figure 2.
- In respect of the analysed decision factors' seniority with the company we notice the following distribution: 11 subjects (11%) have seniority up to 5 years, 10 subjects (10%) have seniority between 6-10 years, 8 subjects (8%) have seniority between 11-15 years, 11 subjects (11%) have seniority between 16-20 years, 18 subjects (18%) have seniority between 21-25 years, 40 subjects (40%) have seniority above 25 years, which indicates great stability of the staff in the system (figure 3).
- As far as the total seniority of the analysed decision factors is concerned we notice the following distribution (figure 4): 1 subject (1%) has seniority between 0-5 years, 2 subjects (2%) have seniority between 6-10 years, 9 subjects (9%) have seniority between 11-15 years, 14 subjects (14%) have seniority between 16-20 years, 16 subjects (16%)

have seniority between 21-25 years, 56 subjects (56%) have seniority above 25 years and 2% are non answer, which shows us that the great majority is approaching retirement/exit from the system.

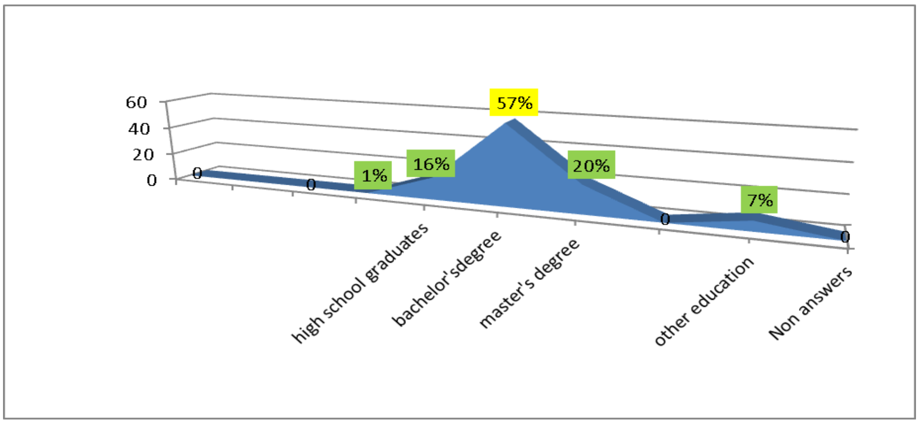

Fig. 2. The level of professional training of the decision factor at SEP
Source: the authors

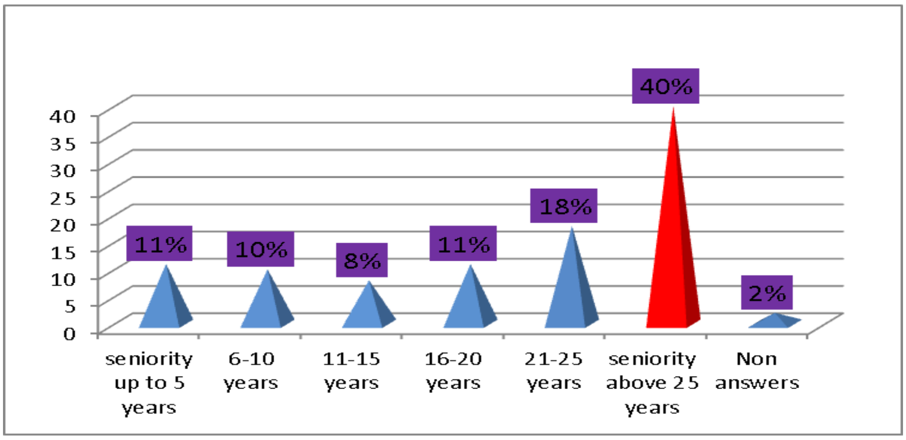

Fig. 3. Seniority with the company of the decision factors' at SEP
Source: the authors

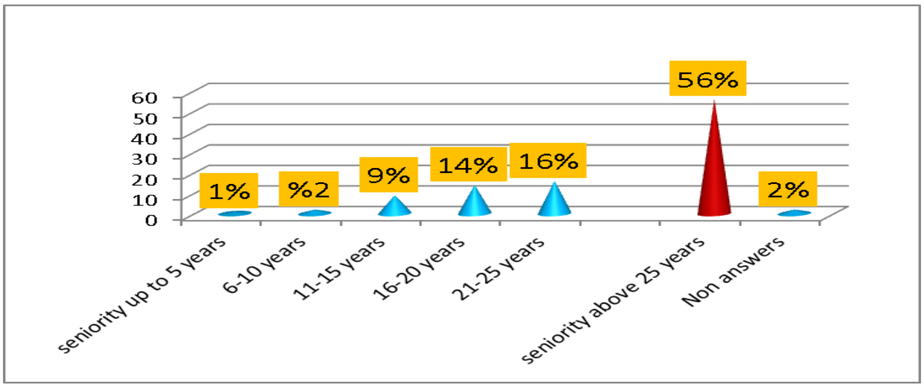

Fig. 4. Total seniority of the decision factors at SEP
Source: the authors

- For the question how many hours you are required to work per week? The answers are presented in Table 2: 84 subjects (84%) claim they are required to work 40 hours per week, 12 subjects (12%) claim they are required to work 48 hours per week and 7% are non answer.

Table 2. Number of required working hours

Item No.	Item	Total Nr. %
10.1	40 hours	84
10.2	48 hours	12
	Non answer	7
TOTAL		100

- In respect of the real number of worked hours per week the subjects stated the following: 75 subjects (75%) claim that they work 40 hours per week, 1 subject (1%) claims that he works 35 hours per week, 1 subject (1%) claims that he works 45 hours per week, 1 subject (1%) claims that he works 46 hours per week, 15 subjects (15%) claim that they work 48 hours per week, 2 subjects (2%) claim that they work 50 hours per week, 2 subjects (2%) claim that they work 56 hours per week and 3% are non answer (Table 3).

Table 3. Number of required working hours

Item No.	Item	Total Nr. %
11.1	35 hours	1
11.2	40 hours	75
11.3	45 hours	1
11.4	46 hours	1
11.5	48 hours	15
11.6	50 hours	2
11.7	56 hours	2
	Non answer	3
TOTAL		100

- In respect of the aspect concerning the person to whom the decision to work so many hours belongs 38 subjects (38%) claim it is their choice, 52 subjects (52%) are asked for this and 10% are non answers (Table 4).

Table 4. Number of required working hours

Item No.	Item	Total Nr. %
12.1	It is my choice	38
12.2	I am asked this thing	52
	Non answer	10
TOTAL		100

- The distribution of the subjects in the decision factors' category per occupied posts is the following: 47 (47%) engineers, 13 (13%) subjects are economists, 1 (1%) network administrator 1 (1%) analyst programmer, 1 (1%) accountant, 1 (1%) union representative, 1 (1%) DSTC specialist, 1 (1%) investment engineer and 1 (1%) main engineer (figure 5).

5. Conclusions

Stress has caused more pain and imbalance of health, in general, than anything else known by modern medicine. Stress is felt upon a human being, having a devastating impact, which is due to the changes that occur in the organizational and social environment. These changes are much more rapid than the power of adaptation of a person.

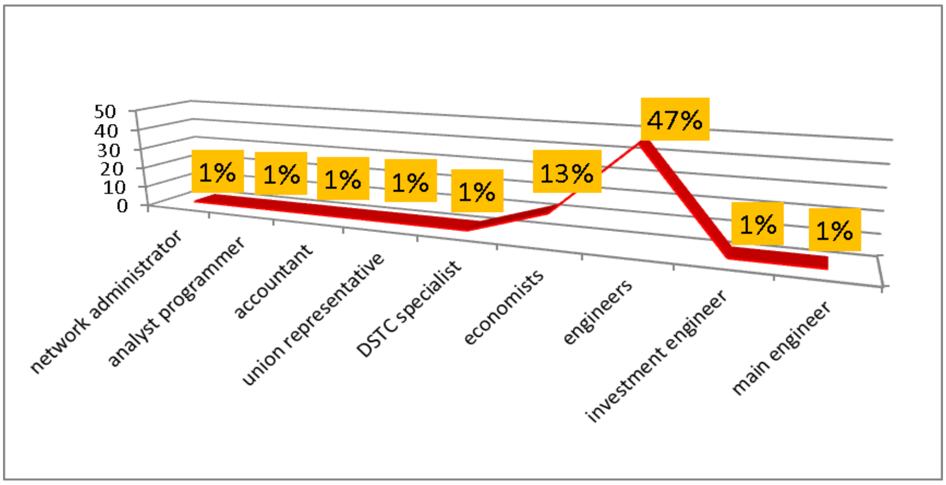

Fig. 5. Distribution of subjects per posts in the category of decision factors at SEP
Source: the authors

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Aspects of analyzing stress at a managerial level in the energetic field (Part II)

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Abstract

Stress, as an organizational phenomenon affects the individual, the employer, the other employees, the performances of the organization and, finally, the society as a whole. Due to its multiple effects (stress), it has been studied by doctors, psychologists, sociologists, economists, engineers and many more.
This paper presents the partial results of an extensive research that took place in the Company Complexul Energetic Hunedoara S.A. (CEH). We say partial results because:

1. The most relevant aspects related to organizational stress have been analyzed;
2. The research has taken place in the subsidiary of 'Electric Plant Paroseni' (SEP), a component of CEH, one of the producers of electricity and heat from the Complex;
3. The subjects – 101 in total, represent just decisional factors from the entire personnel from the subsidiary, from different managerial levels.

The paper has two parts. In first part, the article discusses factual data processing (demographics) of the research. The article then goes on stress analysis with some causal interpretations.

Keywords: organizational stress; energy sector; factual data; managers;

1. The connection between management and stress

Over time the two concepts – management and stress- have evolved continuously adapting to dynamics and the socio-economic context.

In Romania, the concept of management was adopted after 1989, but research and studies have existed being based on synonymous concepts of leadership, coordination, and administration (Burdus, 2005; Nicolescu and Verboncu, 2008; Nicolescu, 2011). Ciocodeica (2001, p.5) states about the concept of leadership that "it is a dynamic process of organization and coordination made by a group in an amount of time and in an organizational context, of other group members of the organization with the purpose of realizing some tasks or different purposes." In this process all the resources – human, financial, informational and technical are integrated and coordinated for obtaining the proposed results.

In the structure of an organization the decisional axe is represented from the view of psychologist Todea Gelu through a model that reflects the possible functions that a person may have in an organizational system (Fig. 1.). Also, the specialist underlines the fact that "the recognition of the human factor, as a decisional and execution factor in the same time in the organizational environment is a condition of testing the competences and performances of both the person and the organization" (Todea, 1994, p.89). This situation appears also at the level of SEP, where the majority of decisional factors qualify as executive decision-making positions. Moreover, the technological characteristics which are

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specific to the energetic industry bring into foreground the necessity that the professional activity of decision-execution factors to acquire from psychology's point of view a new characteristic. The characteristic is that the cognitive factor full fills at the same time two functions: support and instrument which maintain the equilibrium between the physical activity and the behavioral activity, both being part of the human nature.

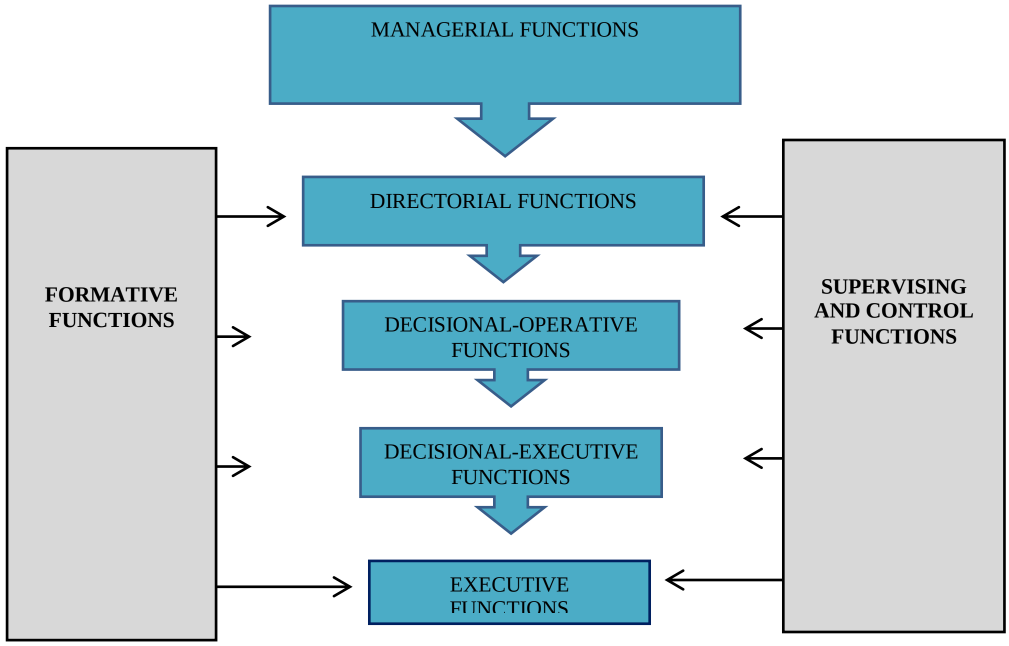

Fig. 1. Classifying model of the functions a person may have in an organizational system (Todea, 1994, p.89)

Dr. Hans Hugo Bruno Selye "father of stress" – „the scientist who is considered the founder of the concept of stress in modern medicine. He was recognized as the 20th century's leading authority on the subject of stress and its impact on human health", (Orsatti, 2012). Even he defined stress in different ways and today there are many definitions (Selye 1955; Selye, 1956; McEwen, 2007; Fink, 2009; Bodea et al., 2015). The first and most generic definition of stress was that proposed by Hans Selye: "Stress is the nonspecific response of the body to any demand" (Fink, 2009, p.549). "The definition of stress is the response to any demand. Even while you sleep, even while you are under anesthesia, you have some stress because you are using some part of your body—your heart pumps, your respiration goes on." (Orsatti, 2012)

Another definition considers stress „as the brain's response to any demand. Many things can trigger this response, including change. Changes can be positive or negative, as well as real or perceived" (NIMH, p.1)

„General adaptation syndrome (GAS) or stress syndrome" (Selye, 1955, p.625) „is the reaction of defense that people exhibit when exposed to excessive pressure. It is a disease. But if it is intense and if it persists for a while, stress can lead to physical and mental health problems (eg.: depression, nervous breakdown, cardiac disorders)" (HSE, 2001).

Also, Selye, „researched and described the GAS, defined as the non-specific response of the body to any demands placed upon it. The syndrome details how stress induces hormonal and autonomic responses and, over time, how these hormonal changes can lead to ulcers, high blood pressure, arteriosclerosis, arthritis, kidney disease, and allergic reactions, to name a few of the diseases stress either causes or contributes to." (AIS, 2013, p.31)

Today, the world of work is concerned about the effects of stress. There is no clear limit between life stress and stress at work (organizational stress), because work is part of people's lives. The data provided by the European Agency for Safety and Health at Work (EU-OSHA, 2015) from Second European Survey of Enterprises on New and Emerging Risks (ESENER-2), states that 79% of European managers are concerned about work-related stress, but less than a third of businesses have introduced procedures for managing this. Four out of five European managers say they are concerned about stress at work, which means that stress at work is as important as workplace accidents for companies.

„The Health and Safety Executive (United Kingdom), for example, calculates that, in 2014/2015, the total number of working days lost due to work-related stress, anxiety and depression was 9.9 million days, with an average of 23 days lost per case (HSE, 2015). The overall costs of psychosocial risks and workrelated stress for businesses and society as a whole — including health care, disability and early retirement, reduced productivity, high staff turnover and other direct and indirect expenses — is estimated to run into billions of euros (EU-OSHA, 2014)." (ESENER 2, 2015, p.39)

2. Interpreting the results - processing the answers of the questionnaire's items

Our analysis refers to decisional factors and follows in succession the chapters of the questionnaire underlining the significant items from the obtained results' point of view.

In the chapter referring to personal satisfaction we take into consideration the following scale of appreciation for all the analyzed items: 1=Very satisfied; 2=Satisfied; 3=Neither satisfied or unsatisfied; 4=Unsatisfied; 5=Very unsatisfied.

The difficult problems which appeared in communicating decisional factors can lead to the feeling of uncontrollability/lack of control or of the perception of threat of personal well-being and safety, feelings that have a huge contribution for the appearing and maintaining of anxiety and stress.

In what concerns communication and the way in which information travels at the working place in SEP, 48% of the correspondents answered that they are satisfied and very satisfied and more than a third answered that they are undecided. However, the communication problem is incurring 14% of decisional factors (Fig. 2). We can state that the capacity of taking a decision at their job does not represent an issue.

The leadership style of the superiors is being cataloged by decisional factors from the middle management hierarchic level as satisfying – more that 39% of the subjects (Fig. 3). For 17% the leadership style is making them unsatisfied and very unsatisfied. Almost half of the investigated population is undecided and one employee did not answer this specific item. This being said, we can affirm that their perception over the current state of facts is socially desirable, that they do not have the courage to state their true beliefs and show fear in not being able to handle the situation. In psychologic language, their purpose is to maintain self-respect and the opinion that we use to have about ourselves, of dismantling psychologically traumatic moments.

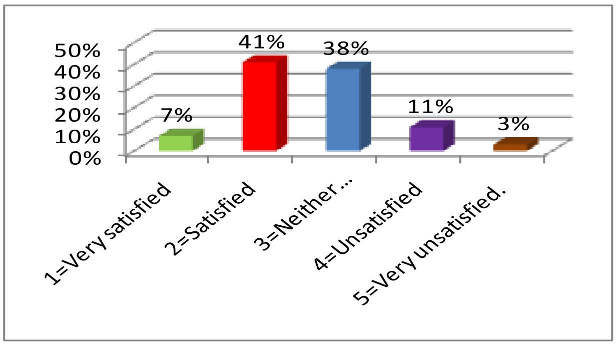

Fig. 2 Perception regarding communication and the way in which information travels at the working place

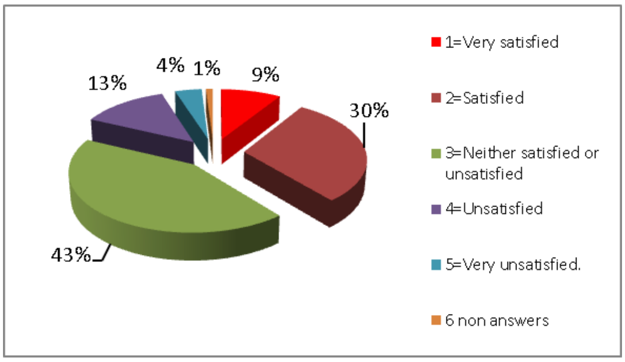

Fig. 3. Appreciating the leadership style used by the supervisors

In what concerns the psychological atmosphere or the existing climate at the working place 48% of the population state that they are satisfied and very satisfied. Less than a quarter (16%) from the category of decisional factors state that they are unsatisfied and very unsatisfied (Fig. 4).

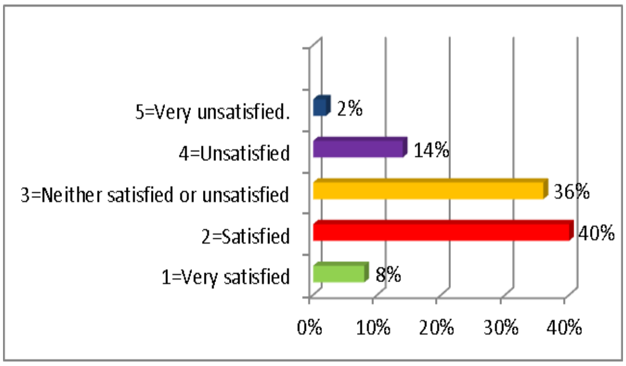

Fig. 4 Psychological atmosphere or the existing climate at your job

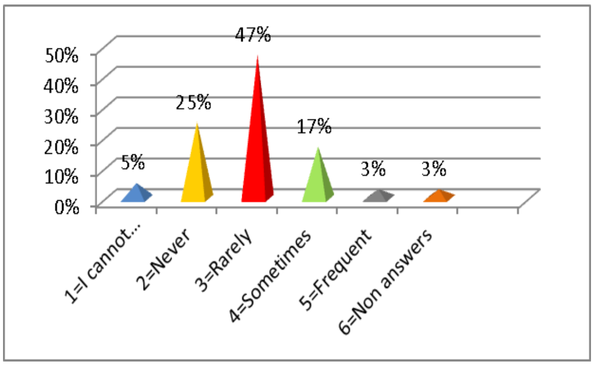

Fig. 5. Perception over tiredness or inexplicable exhaustion

Almost half of the decisional factors which were investigated are satisfied by the way in which information travels at their working place, by the psychological atmosphere and by the leadership method used by the supervisor.

Worth noticing is the number of undecided people, neutral over the situation of their job (item 1.1- 38%; item 1.3- 43%; item 1.10- 36%). We can interpret that there are symptoms that we are not aware of; we mentally distract ourselves from them (voluntarily we think as we want to think). Just because we do not pay attention to psychosomatic manifestations that does not mean that they do not exist or that they are solved. Many times for this type of persons excessive activity is a mechanism for psychosomatic symptoms, which in their turn are defensive mechanisms which can help you not to think at the real problems in your life.

Chapter 2, part B from the questionnaire which refers to the perception of frequency of occurrence of some physical problems which are manifested by the health state with an acceptable precision, taking into consideration, in order to answer, the health state of decisional factors from the last three months. The appreciation scale that was used: 1=I cannot appreciate; 2=Never; 3=Rarely; 4=Sometimes; 5=Frequent.

Regarding the perception of decision factors from SEP which concern the awareness of inexplicable tiredness can be noted that 25% of the subjects have not experienced an inexplicable tiredness/exhaustion, almost half have experienced it rarely, 17% sometimes, 3% frequently and 3% were non answers (Fig. 5). Each individual is a bio-psycho-social entity and uses its own mechanisms of coping in order to adapt to the environment, from here arrive the significant differences in the statistical data obtained in the research.The frequency of manifested physical problems is rarely encountered, in almost half of the subjects (47%), a quarter have never experienced tiredness/inexplicable exhaustion, did not have the tendency to eat, drink and smoke more than usual (49%); more than half of the subjects did not accuse dizziness or suffocation or muscle tremor (66 %) or tingling, stabbing feeling in certain parts of the body.

Almost anything can be a source of tension for someone, at some point. This is the consideration proposed by chapter 4 of the questionnaire and the subjects perceive differently potential states of tension. The appreciation scale for all the items taken into consideration in this chapter is as follows: 1=There definitely is no tension source; 2=In general there is no tension source; 3=Neutral; 4=In general there is a tension source; 5=There definitely is a tension source.

The most important stress related sources determined by the organizational structure and organizational climate refer to burdening with responsibilities, especially responsibilities towards others, lack of social support and lack of decision taking participation. Individuals which are responsible towards others (through responsibility we understand motivation, punishment, rewarding and communicating with their subordinates) present high levels of stress. Surprisingly, today, as other times, few people are aware of the fact that stress represents one of the biggest issues in modern days, most employers and employees considering that stress is normal at the working place. Knowing the situation of the investments in the energetic field, the deterioration of the existing psychological climate at the working place has a primary cause the lack of materials for unfolding its activity in normal conditions (Table 1).

Table 1. Sources of tension at the working place

No. items	Item	1= There definitely is no tension source	2= In general there is no tension source	3= Neutral	4= In general there is a tension source	5= There definitely is a tension source	No answers	Total No. %
4.2	Lack of materials to perform your activity in your sector under normal	6	14	10	51	18	1	100
4.11	Pressure from various information (rumors) that can not be checked	13	31	21	21	14	-	100
4.28	The changes (adding new tasks, due to lack of staff and qualification personnel) in which I do the work requirements	11	35	28	22	4	-	100
4.40	The consequences of the mistakes that you make	5	21	17	45	11	1	100

In what concerns the decisional factors from the energetic field, to conduct or to supervise the work of others is being considered generally (37%) but also categorically (18%) that it is not a source of tension for 55% of the subjects. While more than a quarter of the subjects consider the mentioned situation as a source of tension (29%) or absolutely not 5%. The ambiguity lived by the individuals is different depending on their personality traits, especially their capacity of tolerance. The absence of clarity when defining the role creates both in the individual and the others feelings of insecurity, lack of trust and irritation. The main consequences regarding the ambiguity of the role are: a decrease in motivation for work and of the commitment towards the organization until appears the intention to leave your job, losing the trust in your own strengths and the birth of some strong feelings of dissatisfaction, anxiety and stress (Fig. 6).

This situation – the lack of materials- is being felt by more of two thirds of the subjects (69%) in general and absolutely as a source of tension, and 20% of the decisional factors which were questioned do not consider it a source of tension. Ten percent of those who were questioned show a neutral position or so called indifference, considering that this thing surpasses their capabilities or they lack resources due to independent causes of their will. It is not only about a overload with tasks, but even more, a too big diversity of tasks that must be assimilated due to lack of qualified personnel.

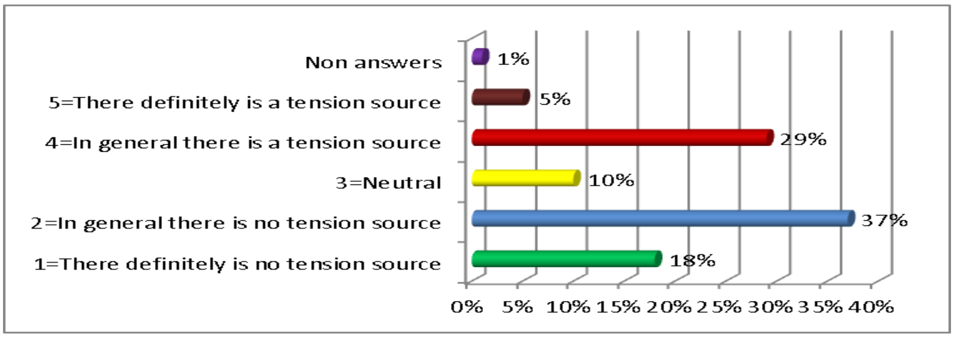

Fig. 6. Perception over the source of tension-Conducting or supervising other's work

In what concerns the growing of the stress condition due to the pressure of different types of information (rumors) which cannot be verified (the bankruptcy of CEH), almost half of the subjects (44%) consider that these rumors are not a source of continuous tension. From this, we can interpret that until now there hasn't been anything concrete to preoccupy them. At the moment, there are decisions taken by the management of CEH, decisions through which the personnel structure shall be reorganized, one of the used criteria being the evaluation of professional performances. Almost a quarter of the subjects (21%), probably due to close retirement or who have other sources of income, adopt a neutral position. However, for more than a third of the questioned decisional factors (35%) there exists a real concern.

Changes (implementing new tasks due to lack of personnel and also qualified staff) in the requirements with which they do their jobs, are not sources of tension for almost 46% and only 26% state firmly that the changes at the working place represent sources of tension. The percentage of those who are undecided is quite large, more than a quarter of the surveyed population. We conclude that the most important stressful factors, determined by the problems of work organization, in this case are not represented by role ambiguity and role's conflicts, accordingly decisional factors know exactly their objectives and tasks, the performances that must be obtained, the expectations that concern the organization, control criteria, evaluation and motivation. For a quarter of decisional factors that state that these changes at the working place cause tension, we assume that the ambiguity refers to lack of clarity concerning the messages given by the role holders and poor or insufficient information.

Noteworthy is the position taken by more than half of the questioned decisional factors concerning the consequences of their mistakes. Consequently, we can state that they are aware that not knowing and respecting security norms can generate serious consequences. In general (45%) and categorical (11%) this represents a source of tension. Even though there are differences in the way in which people react to tension sources and to the effects of stress, in general we all try, in a way or another, consciously or unconsciously, to cope with these difficulties. Less than a quarter of the subjects (21%) adopt a neutral position and 5% state that the repercussions of their mistakes do not represent a source of tension for them.

3. Conclusions

The study aims to analyze the current situation of the staff from the energy sector, of the personnel with decision functions, age, seniority, different training but with a common labor feature which is always „under tension".

Starting with the processing of the gathered data we could notice the emergence of coping mechanisms when completing a questionnaire. This fact and also the obtained results suggested that a possible recommendation for stress relief would be stimulating humor as a coping mechanism, which can induce motivation and an increase of efficiency in fulfilling duties. We refer to psychological defense mechanisms which allow the elimination or specific interpretation of unpleasant information, reducing to minimum the felling of anxiety which appears after acknowledging the interior conflict.

In conclusion, people become ill when they are no longer authentic, when there no longer exists a real purpose in their lives and their lives are full of defensive mechanism. Not lastly we can mention that 15% of the surveyed population state dissatisfaction and very much dissatisfaction towards the activity they are developing in the present. This fact can be interpreted as reducing the human factor to the condition of a simple executant, especially in the professions which involve responsibility and high risk, the result is personal dissatisfaction and not a few times these people take risks over the freedom barrier offered by the restrictive conditions from the organizational system.

The obtained results in our research confirm the conclusions the Health Report in 2015 of the employees from SEP (CEH Report, 2015), according to which the health condition of the employees is good. This is being attested through the analysis of the main indicators of health state: general morbidity with and without the temporary interruption of work, professional morbidity and profession related. The workers are well medically supervised through the service of labor medicine and have reacted positively to the medical recommendations witch they received for individual affections.

If we analyze from a medical and psychological perspective the symptoms of depression (Sadock and Sadock, 2009) regarding item 2.6 B – You are not in the mood to get up in the morning – we can see that 60 % (27%rarely, 30% sometimes, and 3% frequently) of the population have had this feeling at least once until now. Moreover, 3% of the population did not answer this item, which makes us believe that they already have an installed anxiety/fear of admitting that they are dealing with such feelings. In their mind, this fear is triggered by a possible consequence of losing their job. The same symptom can be found in the burnout syndrome, characterized through (Filip, 2014):

- Persistent fatigue that lasts more than two weeks
- Changes in personality, especially in the tendency of becoming furious, impatient or depressed due to the sensation of permanent fatigue
- Low capacity of concentration, difficulty in delivering usual tasks, which other times used to stir enthusiasm.

Thus appears a contradiction between the subjective perception of the population and the analysis of facts (not stressed but burnout?)

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The development of a process tool for improved risk management in local government

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Abstract

The word ‘risk’ is usually used in the context of a potential hazard or the possibility of an unfortunate outcome resulting from a given action. In financial management, the term indicates that there is an expectation that the actual outcome of a project may differ from the expected outcome. The magnitude of the possible difference between these outcomes reflects the scale of the risk. The inception of the Municipal Finance Management Act (MFMA) in 2003 and the Public Sector Risk Management Framework in 2010 forced South African local municipalities to improve the quality of their risk management systems. Risk management is an important aspect of management and aids as a mechanism to prevent or decrease financial losses and improve service delivery. If shortcomings regarding risk management exist within a municipality, it could have a negative effect on sound financial management and the outcome of annual audits. The aim of this article was to develop a process tool that can assist managers as well as employees in better understanding the risk management procedure. The process involved a systematic literature review and case study analysis through evaluating risk related issues such as the environment, strategy, objectives, identifying and accessing risks, reporting and monitoring. This evaluation process can assist in knowing which steps should be taken in order to improve the general level of risk management and possible consequences for not implementing the correct procedure.

Keywords: Risk management; local government; financial management; evaluation process; quality manegemnt.

1. Introduction

Risk is a probable, and in many instances an unavoidable occurrence within day to day activities. Continues changes in political and economic domains, forces organisations to implement proper risk management processes (Kot & Dragon, 2015:130; Ennouri, 2015:57; Taraba et al., 2016: 181). In cases where risk is not appropriately managed, financial losses may occur. Garret (2003:194) points out that risk is associated with actual or probable events that can prevent an institution from achieving its goals and objectives. Risk management is an imperative function within public and private organisations. Van Niekerk (2012:66) states that public institutions such as municipalities should address challenges and constraints in order to improve financial management, risk management as well as internal control responsibilities. This cannot be achieved without effective planning and risk assessment procedures and could lead to serious losses within a municipality. Limited research on risk management within local government has been done. Further research on this topic could not only improve general implementation thereof but also establish to what extent it is being applied. Local government management should be simultaneously responsible for identifying risks and to ensure that appropriate action plans be in place to assess, monitor and mitigate risks (Turnbull Report, 2005). Previously risk management was linked much too financial practice but nowadays a much broader risk framework needs to be managed. Rossouw and van Vuuren (2010:218) assert that all risks could eventually have financial implications for the organisation and therefor proper management thereof is of imperative importance. The aim of this article is to develop

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an evaluation tool that can assist managers as well as employees in better understanding the risk management procedure.

2. Literature Review

Risk management can be defined as the identification, prioritisation and assessment of a risk, or various risks. Furthermore, it can be defined as the consequence of certainty or uncertainty on outcomes, which could be either negative or positive. In addition, risk management can be explained as maximising the allocation of scarce resources in a co-ordinated and economical way (Akrani, 2012:1). This can be done by monitoring and controlling the probability of events occurring (Crockford, 1986:1-18). Spaulding (2005:1) defines risk management as controlling, analysing and avoiding of an event or occurrence in order to minimise or eliminate risks with a negative outcome. This can be done by using advanced techniques such as risk assumption, retention, avoidance, transfer, or any other strategy or combination of strategies (Spaulding, 2005:1). Risk management is associated and linked to financial management as unmanaged risks surely in all instances leads to some form of financial loss. Brigham and Johnson (1980:19) defines financial management as planning, organising, controlling, and directing events in such a way to maximize utilisation of funds for an institution, whether privately owned or public of nature. Financial management applies general management principles in order to reduce risk and maximise increased profit in the public and private sectors as well as improved service delivery in the public sector (Brigham & Johnson 1980:19). Within the management framework the generic management functions is referred to as POSDCORB, (planning, organising, staffing, directing, coordinating, report, and budgeting) (Chalekian, 2013:1). POSDCORB, also referred to as the seven functions of managers or the core pattern of administration, was designed to improve management functions and enhance management structures within an organisation (Gulick & Urwick, 1937). The concepts of financial management and risk management, have shared outcomes.

2.1. South Africa Statutory Framework for financial and risk management

The statutory framework for public financial and risk management in South Africa includes a vast number of legislation and public policies that have a direct impact on the way in which financial and risk management is dealt with in the different spheres of government. Some of the most important financial and risk legislation policies includes the Municipal Finance Management Act, (56 of 2003), (MFMA), Public Finance Management Act, (1 of 1999), (PFMA), and the Public Sector Risk Management Framework (PSRMF). During 2004, the South African National Treasury introduced the MFMA. The MFMA brought major management reforms across government. In some cases the MFMA has been aligned with other local government legislation, such as the Structures Act (117 of 1998), Systems Act (32 of 2000), Property Rates Act (6 of 2004) and their regulations, to form a coherent package. The aims of the MFMA include: modernise budget, accounting and financial management practices; maximise the capacity of municipalities to deliver services to communities; to put in place a sound financial governance framework by clarifying and separating the roles and responsibilities of the council, mayor and officials.

The PFMA focuses specifically on the national and provincial spheres of government. The purpose of the PFMA is as follows: regulate financial management in the national government and provincial governments; ensure that all revenue, expenditure, assets and liabilities of government are managed efficiently and effectively; provide for the responsibilities of persons entrusted with financial management in government.

2.2. Risk management and local government

Many challenges have been identified within context of South African local government (Meyer, 2014:164). This led to the introduction of the Public Sector Risk Management Framework during 2010. The main aim of the framework is to provide guidance on public sector risk management, and it was created in coordination with the PFMA and the MFMA for institutions to maintain efficient, successful and transparent systems of risk management. The framework addresses some of the following issues (South Africa, 2010:1-40): Definitions regarding risk management; how to create an environment for the managing of risks; how to integrate risk management activities; how to identify risks; how to assess risks; how to respond to risks; risk reporting and communication; risk monitoring; risk management functions of various role players and lastly, the evaluation of risk management effectiveness.

3. Methodology

The primary objective of the study was to construct a process tool in order to simplify the risk management procedure to assist managers as well as employees in better understanding risk management. The methodology followed a qualitative approach using a systematic literature review combined with a case study analysis. This was done by analysing several policies and other sources on the topic of local government risk and financial management. From this an extensive literature review was conducted to determine the best risk management process. Several local and international case studies was also analysed to determined best practice and short comings in risk management procedures. It should be noted that the contents of this article form part of a larger study.

4. Risk management process tool

A risk management process tool was created that can assist managers as well as employees in understanding the risk management practice better. This tool will also assist in knowing which steps should be taken in order to improve the risk management process and possible consequences for not doing so. Improvement in overall risk management could consequently lead to better financial management and service delivery. The risk management decision tool is illustrated in Figure 1. The following steps will explain the tool.

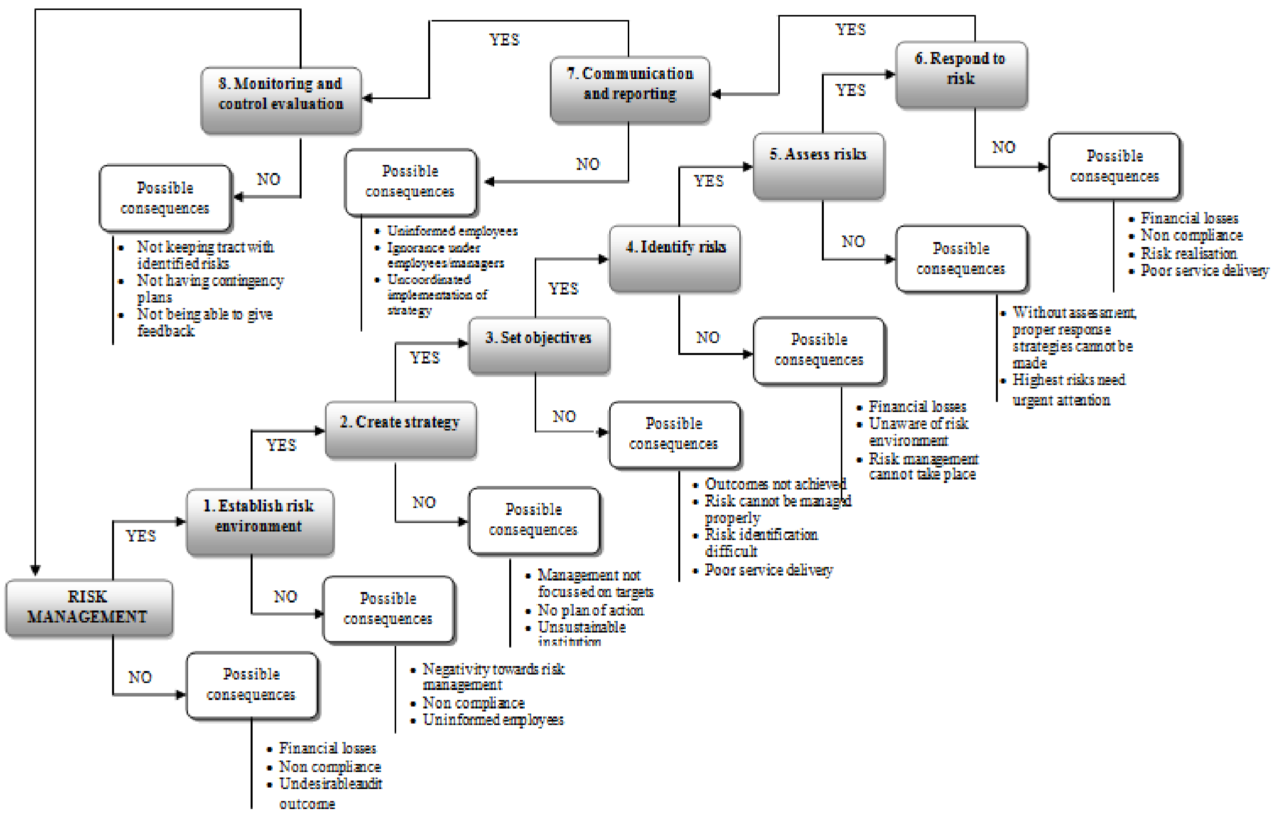

Fig. 1: Risk management process tool

Step 1: Establish risk environment

Step 1 is imperative to a successful risk management process within local government. If a positive risk environment is not created amongst management and staff, the process will most probably not be successful. Management should ensure that the pre-designed risk strategy is understood all role players. This can be done by implementing an integrated approach and by adopting a common process, language and methodology to ensure that a risk management culture is established across all levels and spheres of management and operations (Ekurhuleni Metropolitan Municipality, 2009:4). It is important that an on-going risk management environment must be maintained within the municipality (Queensland Government, 2002:12).

Step 2: Create a strategy

A strategy can be defined as a set of actions taken by an organisation in order to develop or maintain resources, and use these resources to deliver products or services in such a way that it meets the organisation's financial and other objectives with the least risk imposed. This can happen either by accident or by design (Haberberg & Rieple, 2008:1-10). This simply means that a strategy can be formulated either as a precaution or as implementation of certain policies or plans, or that a strategy may be born out of simple trial and error occurring within a certain policy or plan (Haberberg & Rieple, 2008:50-60). According to the PSRMF a risk management strategy needs to be developed for a specific organisation. Financial management works together with risk management, where the focus of attention should be on applied strategy setting across the whole enterprise and not just in various sectors or sections of the organisation (Frigo & Anderson, 2011:21-22, 61). The risk strategy would include the development of a specific plan or project plan for the specific risk assessment activity. (Queensland Government, 2002:13-20). The risk management strategy should address some of the following important issues (Queensland Government, 2002:1-12): an analysis of acceptable and non-acceptable risks; responsibilities for financial risk management; objectives and basis for financial risk management within the municipality; range the extent of financial risk management and link between financial risk management and the strategic planning process.

Step 3: Set objectives

From the strategy, certain objective need to be formulated. A financial or risk manager must weigh the positives and negatives of each option against each other in order to make an informed decision. For an effective decision to be made, a manager must be able to forecast the outcome of each alternative option and determine the degree or magnitude of risk involved. Most managers view the optimal allocation of scarce resources of key importance to the success of an organisation. This requires the prioritisation of objectives (Doya & Shadlen, 2012:911-913).

Step 4: Identify risks

Risk identification forms the basis of risk management as it identifies the specific risks that need to be managed. The major issues regarding risk identification is listed below (South Africa, 2010:30-33):

- Managers, officials and employees must understand risk identification and more specifically risks within their particular mandate and position;
- All department should create and maintain a comprehensive risk inventory;
- Risk management should be an on-going and continuous process;
- All risks should be identified, not only the risks that are in the direct control of the department;
- All officials should identify risks and not just managers or directors;
- Regular risk management workshops should be schedules to identify new risks

Step 5: Assess risks

Risk assessment involves systematically quantifying and qualifying the various levels of risks. The major issues regarding risk assessment is the prioritisation of risks according to most important down to least important, assessing risks according the predicted likelihood of the risk occurring and the impact of the risks actually occurring (South Africa, 2010:34-35).

Step 6: Respond to risks

Risk response involves creating strategies in order to eliminate or reduce risk creating events. The major issues regarding risk response includes the identification of possible mitigation options. These responses involve deciding on strategies such as avoiding risk, transferring risk, treating risk, and accepting risk. Internal control such as preventative measures, detective measures, and corrective measures should be developed by managers (South Africa, 2010: 36-39; Queensland Government, 2002:13-20). The level of risk acceptable by the specific organisation will determine the tolerance level and response decided on (Ekurhuleni Metropolitan Municipality, 2009:10).

Step 7: Communication and reporting

Risk communication and reporting involves creating strategies in order to timeously and in a proper manner, communicate issues relevant to risk management to the responsible mandate. The provision of quality information though communication is an important aspect of accountability (Coy & Dixon, 2004:79-106; Rutherford, 1992:265). The main outcomes regarding risk communication and reporting includes assisting and enhancing in the decision making procedures in order to improve knowledge and information management (South Africa, 2010:40; Ekurhuleni Metropolitan Municipality, 2009:4).

Step 8: Monitoring and control evaluation

The last step in the process involves monitoring the situation. This is done by creating strategies in order to check, on a regular basis, if risk management procedure implemented, are actually being used, and if they are reducing risks from occurring. The main issues regarding risk monitoring includes evaluating if responsibilities allocated to various officials and employees are being effectively and properly executed and if the response strategies producing the outcome as initially planned or anticipated (South Africa, 2010:41). This step also should include the 'Test and maintain' procedure. This includes reporting and spot testing to ensure that the risk management strategy will actually address the possible losses that might occur before they actually realise. (Queensland Government, 2002:13-20).

5. Conclusion

The aim of this study was to develop an evaluation tool that can assist managers as well as employees in better understanding the risk management procedure. The importance of proper risk management has been highlighted not only by other researchers but mostly by government, thus the existence of many laws and policies surrounding this concept. Although the tool was development from South African legislation, many international case studies were consulted. In most cases, the risk process was the same or very similar. The conclusion can therefore be made that this tool may be used on an international level. Possible limitation might be that he tool is too generic, but this can be overcome by customizing aspects to suite individual organisations specific need and priorities. The tool can be custom designed to include possible consequences relevant to the specific organisation. Future research could include testing the tool on various local government institutions. The evaluation tool could assist risk managers to better explain and follow the process surrounding risk management.

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The improvement of the physical shape of the students at the University of Petroșani by implementing a physical training program outside classes

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Abstract

This research paper studies the physical improvement of students for the increasing of physical potential and health. The main goal is that on the basis of scientific research, the progress of students must be highlighted, through the implementation of the program that should increase health through a better functioning of the locomotive apparatus and the improvement of individual physical performance for each individual. In this research, we aimed to analyze the following aspects: the initial physical shape of a group of 20 students, the performance students individually and in groups, carrying out a program of activities driving health. Specifically, we investigated the following sub-themes: perception students to sports, objectives and motivation of students to perform sports activities, ability to objective comparison with other similar groups, attitude towards their performance and attitude towards group performance.

Keyword : heart rate monitors, training, students, exercises, capacity, progress

1. Introduction

The study of scientific data has broadened the possibility to deepen the theme by conducting a research from different points of view: anatomical, physiological, psychological and pedagogical.

2. Purpose and research tasks

This research study seeks to improve the physical conditions of studying human operators to increase physical potential and health. The fundamental aim is that, on the basis of relevant scientific research, the progress made by students should be highlighted by implementing the training program to increase health with a better functioning of the locomotor system and to improve the individual physical performance of each subject. In recognizing that each investigative methods and techniques has its own specific limits in empirical research, the convergent application of investigative procedures is necessary to lead to the truth. Methodological analysis to verify compliance with this principle and, especially, trying to establish optimal articulation methods, techniques and research tools is an effective strategy.

3. Hypotheses

1. Through the permanent evaluation of the students’ physical preparation, together with the elaboration and application of physical training frameworks, the physical practice will continuously be adjusted, which will generally improve physical fitness.
2. Permanent monitoring of the level of development of the effort capacity through the use of Polar system, combined with the elaboration of physical training frameworks for each of the steps and phases of physical training will lead to obtaining superior results at the working place.

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4. Methods and techniques of research

The methods used in order to conduct the research, are bibliographical documentation, observation, the experiment, and the interview.

For a program to be effective and to avoid any risk inherent involved changing lifestyle (from sedentary to active) it is required to follow certain rules and principles:

1 Perform an analysis of the health and lifestyle through a medical examination or investigation by a specialist in cardiology followed by own investigations regarding body mass index, adiposity, physical activity index, previous motor experience and the drive area.

2 Adapt each program content from one individual to another (daily / weekly) based on their medical history.

3.Structure a phased program with a sufficient duration for each step, so to make slow transitions based on the accumulation of the previous stage.(1)

I have documented the problems I researched form a theoretical and methodical point of view.

The observation as a research method was used by observing the level of physical development and the manifestation of the dynamic qualities of the subjects.(2)

The exercising psycho-pedagogical experiment is the most important method I have used and it implied a direct and active intervention on my part.

The evaluation of the subjects' physical exercise **.**(3)

- May – November 2014 – initial tests and final test were carried out for the 1st and 2nd groups. The subjects were 20 miners, aged 20 to 40, and they were tested according to their age.
- During the same period a group made up of 20 subjects was divided into two groups. The 1st group only carried out two tests, at the beginning, and in the end.

The second group carried out both tests, but they also exercised, according to a personal program.

The Experimental Research. Starting from the premises and hypothesis of the research, I have prepared several experimental longitudinal research on the 20 subjects, in order to prove the hypothesis. Location of the research: The Campus of the University of Petroșani

Stages of the research:

- January 2016 – the initial evaluation for both groups (as shown below).
- January – June 2016 – the second group exercised weekly, according to the program shown below, while the first group didn't exercise at all.
- June 2016 – both groups were tested.

I have applied an exercise program designed by us, as it will be shown in the content of the experiment.

The Content of the Experiment. The experiment was divided into several stages, as shown above. During these stages I conducted an evaluation of the physical status and I adjusted it by implementing exercise model, by permanently using the Polar system. From here on we will present our own exercise model, as well as other means and methods put in practice, inspired by other specialized works.

5. The following tests were used in our research:

1. A course on an inclined, variable terrain (including steps) resembling a work front, was taken by the second group once a week.

2. A 10 minutes aerobic jog (Polar monitored) in a close environment – a small gymnasium.

3. Once a week, the second group practiced a game of their choice (which was football) for half an hour (divided into two halves).

Results' analysis and interpretation. We will use statistical techniques to determine the results achieved by subjects regarding the course, the aerobic jog and the game.

Below we have interpreted the results of several subjects after taking the first test, and we correlated the different parameters.

The Polar sport areas provide an easy way to select and monitor the intensity of the exercise and the following of sport areas based on exercise programs.

The exercise is divided into five areas, as shown below, based on the percentages of the maximum heart effort:

1. very easy (50-60% Resistance to max. effort),
2. 2 easy (60-70% Resistance to max. effort),
3. 3. moderate (70-80% Resistance to max. effort),
4. 4. hard (80-90% Resistance to max. effort),
5. 5. maximum (90-100% Resistance to max. effort). (4)

As shown before, we have a few comparative data of B.I., (the data regarding the comparison of the other subjects' effort area is to be found in the Annex), which prove that after exercising for six months, his body responded positively. We noticed that by using the same effort type for different tests, the area of the maximum effort (5. In red) decreased by 15% as compared to the first.

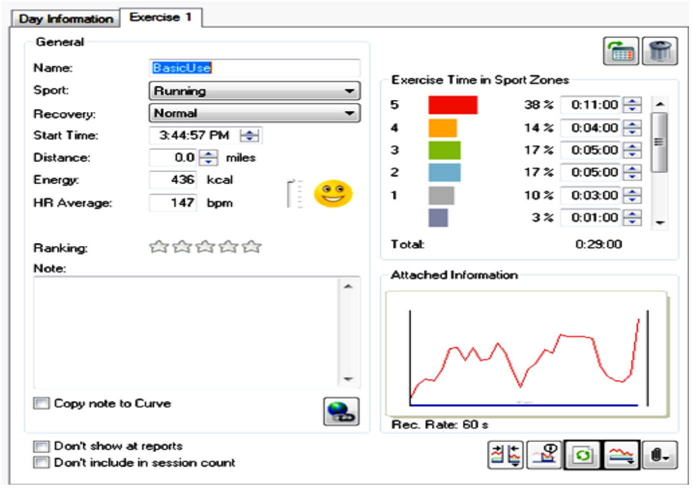

Fig.1.Graphic of the initial effort, subject B.I

Subject BI was in the second group (the subjects which, for a period of six months, completed this course weekly), while the subject below, S.D., was in the first group, the one which completed this course only twice, in May and November).

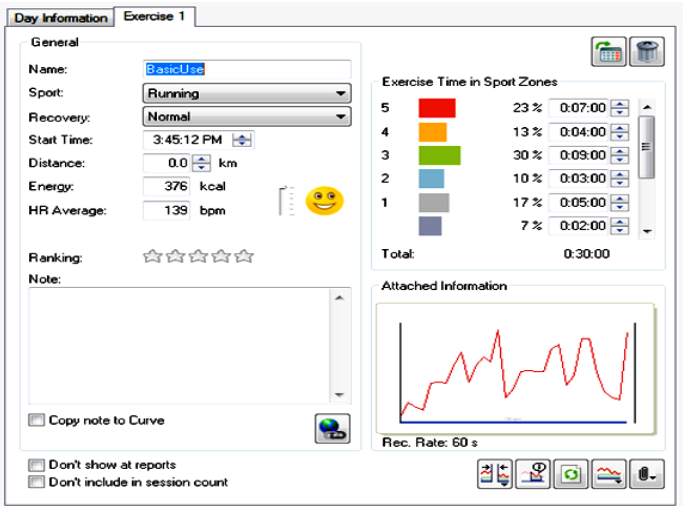

Fig. 2. Graphic of the final effort, subject B.I.

Above we have a few examples of comparative data regarding subject S.D., which show us that after six months without exercise meant to improve effort capacity, his body didn't improve physically. On the contrary, the data regarding the maximum effort area (5. In red) increased by 14% as compared to the first (50% - 36%), which shows that for the same type of effort, after six months, the physical status of his body is more modest.

6. Practical and methodical conclusion of the scientific research

The following conclusions can be taken, based on the scientific research:

1. The hypothesis of the research has been confirmed, meaning that the exercises we included in the training program lead to an improvement in the subjects' effort capacity.

2. The subjects that followed the exercises we devise, for six months, made a superior progress as compared to the other group.

3.The effort capacity registered at the beginning and at the end of the experiment was highly different in the case of the experiment group, as the values show. Therefore, after the implementation of programs, the values increased form medium to good. The improvement of the effort record in the case of the experimental group was superior, and by using the same type of effort for different tests, the maximum effort zone (5. In red) (Fig. 5.1). decreased by 15% as compared to the first (38% - 23%) , which prove the efficiency of the exercise programs;

4. The experimental group showed a significant statistic progress in between the tests,which confirms the hypothesis that physical recreational exercises, combined with the relaxation effect of sports games, reduces stress levels, if they are undertaken systematically, under the supervision of a specialist.

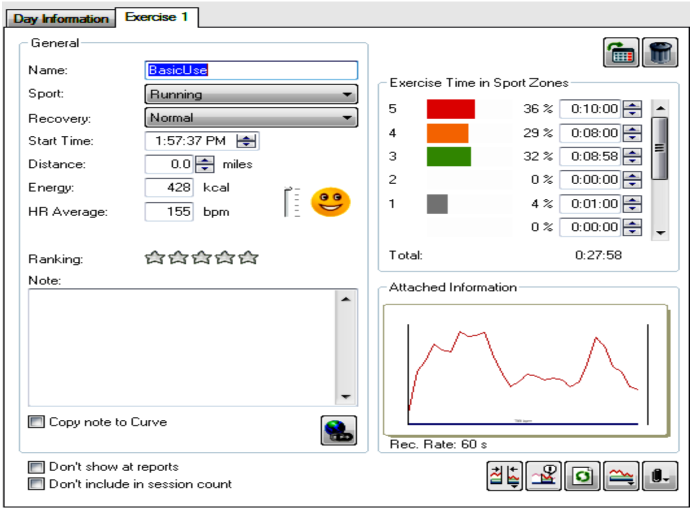

Fig. 3.Graphic of the initial effort, subject S.D.

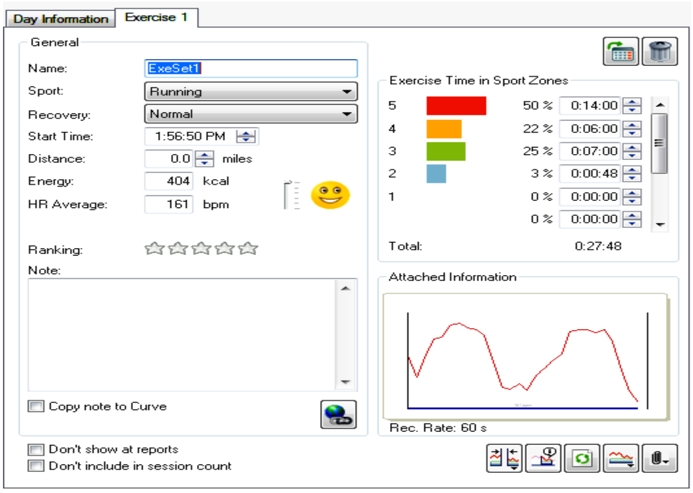

Fig. 4. Graphic of the final effort, subject S.D.

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Emigrant's condition from Jiu Valley at the destination place

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Abstract

The paper aims to show a series of aspects that emigrants from Jiu Valley meet in places of destination where they propose to work. Also, we'll try to detail their contentment rate according to some aspects with socio-demographic character to accomplish a profile more adaptable to the requirements of the emigrant's reception area.

Keywords: emigration, contentment, job, reception area

Introduction

Adressing such topic comes in the context of an social-economical and demographic reality installed in Jiu Valley from long time ago. In many other papers with sociological specific we drew attention to depopulation phenomenon on Valley and its symbolic capital. Furthermore, we showed that „big part of what we call today Jiu Valley population was based on the migration process accompanied by the industralisation , from the years before 1990". Also, using official statistics we could notice how „from 1997 Jiu Valley becomes an emigration region, departures becoming more important that the arrivals, until 1989 it was an region of immigration, attested by the fact that 57% of the fired are from the other parts of the country" (Fulger 2007:pp.26-27).

After Romania's accesion at the European Union, in 2007, the migrational process meet a new impulse, this time an extreme one, due to the fact that romanian were offered with employements opportunities in any of the Union's countries. And that's the purpose of this paper: broadly desciption of condition that they found in the reception area in order to understand better the reasons that stay on the bases of Jiu Valley depopulation mostly through external migration.

Area and research methodology

Research that underlies the elaboration of this article took place in 2015. It was conducted using a representative sample of 793 people for Petrosani municipality's population, built on the priciple of related allowences (age, sex, home area).

The main method was face to face type of investigation, subjects being questioned by students from Sociology and Social Assistance specialty who fullfiled the role of operators on the field. The research tool was printed questionnaire that contained 32 questions. Data processing was made through IBM SPSS Statistics 20 program.

Results

The first aspect that interested us was the one related to the aplitude of migrational phenomenon at Petrosani level. Specifically we were interested to find out how many residents over 18 years old of this city had actually worked abroad.

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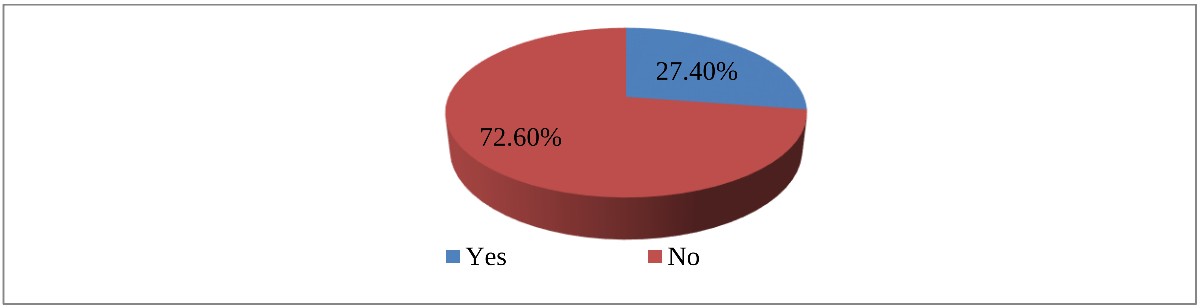

Fig.1. Percentage of people over 18 from Petrosani that worked abroad

A little over a quarter of residences with the age over 18 from Petrosani Municipality (27,4%) had worked at least once abroad for a certain period of time. It's a process that we appreciate as particularly high in conditions in that the level of 2015 the number of population after residence was 43452 people. Among these 36512 persons were over 18 years old. A simple calculation shows us that over 10 thousands of people over 18 years old had worked abroad in the past years. We want to show that the phenomenon proportion is however bigger, because we questioned the ones we found at home, many oher persons having the residence in Petrosani but being established abroad, frequently with the whole family. Besides, the data we obtained are confirmed by different government reports that shows that Petrosani had lost in the period 1990-2012 over 11 thousands of people (http://admin.stiripesurse.ro/media/other/201608/media-147184858950322500.pdf: p.6).

The work abroad, and generally the establishment abroad, are not easy because not anyone can adapt to the new cultural envinronment. Proofs are the periods of time that many of them had spent abroad.

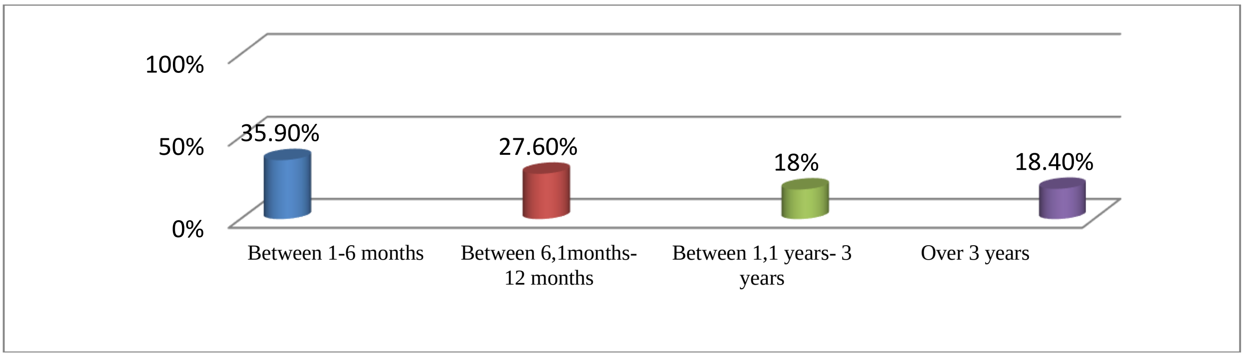

Fig. 2. Periods of time that was worked abroad

Biggest part of the ones who migrated searching a job do not exceed from this point of view one year as period in which they were employed (63.5%,by merging the first two temporary categories). A little under a fifth of them (18,4%) succeed to maintain and manage to be employees abroad on periods that exceed three years.The ones that come back in the country don't employ in Petrosani, even if they have the residence here, but in the other cities, especially Cluj or Timisoara.

It's clearly that not only the lack of jobs from the residence area push them to migrate searching a job, but other aspects that we propose to detail hereinafter.For the best possible viewing, we graphicly exposed their oppinion about the six elements analysed, taken by three:

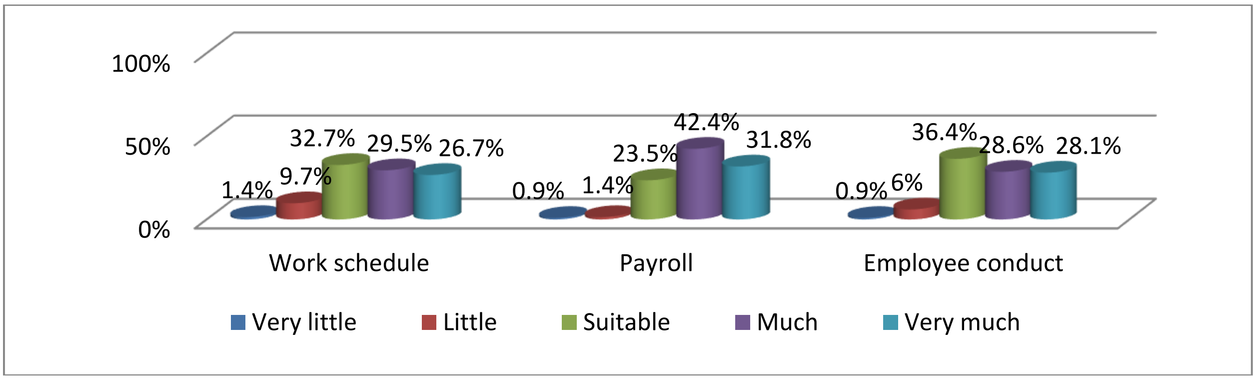

Fig.3. Contentment over diffrent aspects found at job abroad

If we add up oppinions of the ones we questioned that places on the positions *much* and *very much* then we trully have the contentment measure that they felt for each element in part. Except one aspect(possibilities of career affirmation) the percentage of the *content* and very content does not exceed half of them, but it still places on a high enough level (43,8%).

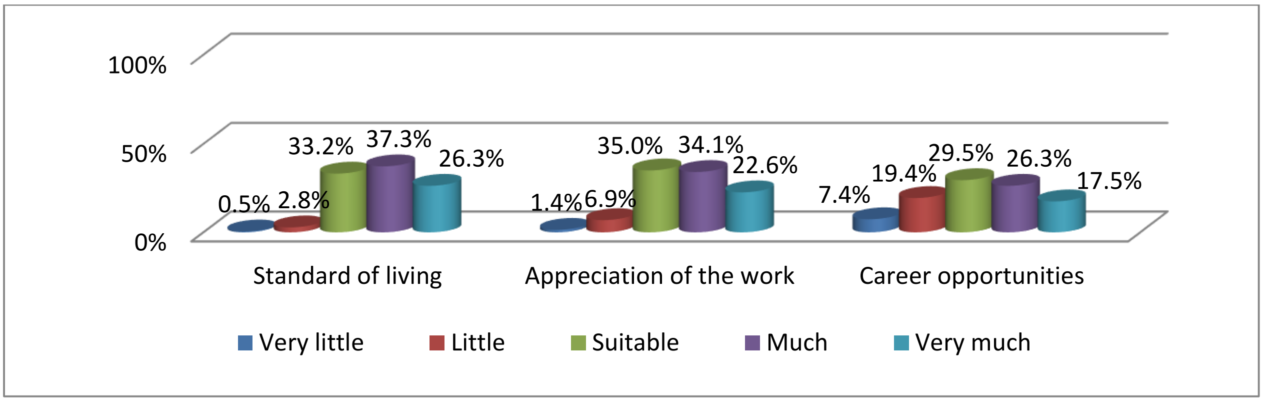

Fig. 4 Contentment over diffrent aspects foundat at the job

Contentment rakings is the following: payroll level (74,2%), standard of living permitted from payroll (63,6%), employer's behaviour and the way their work was appreciated (56,7%), work schedule (56,2%) and opportunities of their career (43,8%).

Career opportunities is on the last place but this position should not be misunderstod, but from the perspective of some objective reason. For example, as you can see in the figure 5, only fifth of them had found a job in their qualification they had in our country, most of them engaging on the jobs they found (65%), the main being the source of income not proffesional achievement:

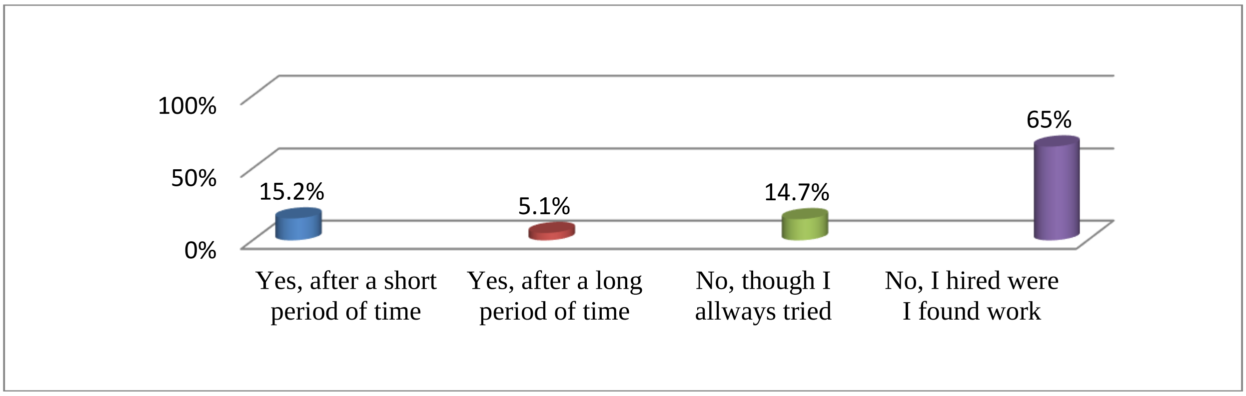

Fig.5. If they worke in their qualification field

It's quite obvious that most of Petrosani residents that migrated had done that not for proffesional accomplishment. Though (by summing) 35% of them searched a job that matched their training. Among these only 20,3% have occupied a job that overlapped their proffesional profile.

An idea often circulated is that romanians are poorly paid than other foreigners who work in european Union occupying inferior jobd with a high embarassing rate. We asked included subject if they felt discriminated at employment or at the job, comparative to other foreigners, only because they come from Romania.

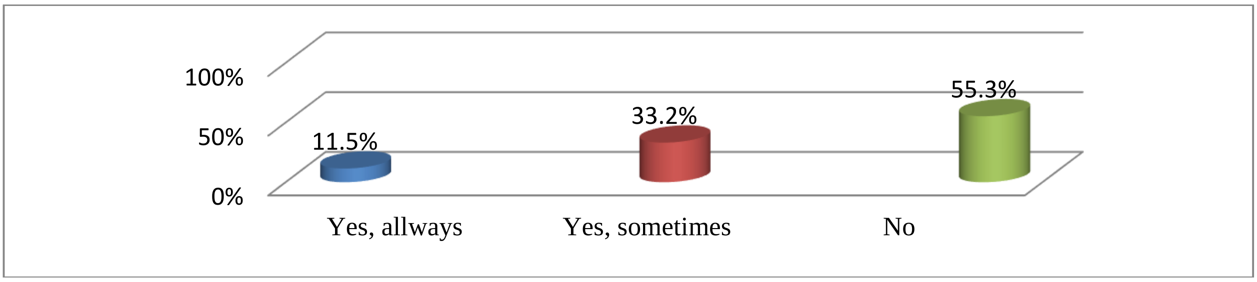

Fig.6 If they felt discriminated comparative to other foreigners only because they are romanians

Even if most of the subjects does not support the idea of discrimination on the etnicity motive (55,3%),there is a consistence of not less than 44,7% that claims the existence of such difference between romanians and other foreigners at employment. Being a reality sustained by so many subjects we can talk about such pressure over romanians but is necessary that it can be properly distributed according to the country they worked in to not achieve a disallowed uniformity and consider that discrimination works everywere.

The last aspect approached, considering all said by now, is one that's straight about proffesional experience of subjects aqcuired abroad. Depending on work experience and life abroad almost 60% of themi (through position cumulations *big* and *very big*) they would urge their family members or closed friends to go abroad. In other words the work experience abroad is perceived highly positive from altmost two thirds of them.

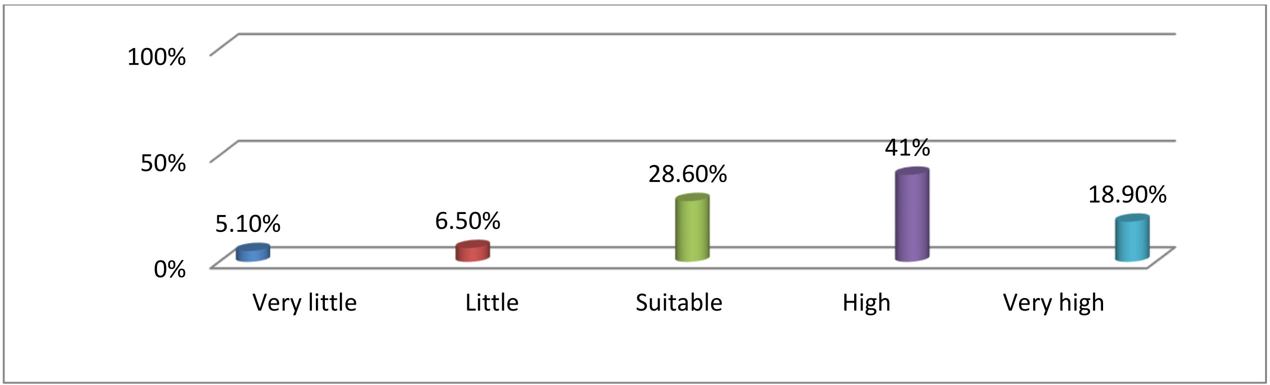

Fig.7. Recomandation for a family member or a friend to work abroad

Conclusions

1. For Petrosani municipality depopulation is a reality that can no longer be contested, being determined by the search of a job, given that the economical area is in a destructuration process from years.Almost 30% of the people over 18 years old from Petrosani (27,4%) worked the past years abroad;
2. For those who foreign countries it's not a final option the longest period they worked passes three years, but they are placed under 20% (18,4%0;
3. Migrational trend will tend to grow or at least to maintain to same quota given that at the destination place romanians find conditions they can't complain about. There's a big satisfaction about the payments abrorad, which is found fully in the high living level allowed in the reception area In particularly high proportion the ones that worked abroad are satisfied with the employee's conduct and the by the fact that they are apreciated for what they do, but also with the work schedule;
4. Very few are getting to work in the range that they are profesionally prepared in the country, here comes a certaine decline of contentment over affirmation posibilities and career construction;
5. Even if most of them(55,3%) affirm that they never confronted etnicity discrimination there is an important percentage that they affirm as a reality;
6. Almost two thirds of those who worked abroad turns into influences relays for those left at home pushing them to hire themselfs in different countries of European Union;
7. Synthetis conclusion is that Petrosani municipality will decrease his economical influence in the landscape of Hunedoara county, the new gouvernment decisions assigning allready a modest role at area level: county secondary pole (http://media.hotnews.ro/media_server1/document-2016-08-18-21233012-0-anexa2:pdf, pp. 6-7)

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Commemorative monuments raised in Jiu Valley during the interwar period, for honoring those who fought in World War One

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Abstract

The theme that we are trying to develop in our study refers to how citizens and authorities from the Jiu Valley have understood, during the interwar period, to honor the memory of those known and unknown, who sacrificed themselves in the battles fought in this region during World War I in the fall of 1916 between the Romanian army and the armies of the Central Powers.

Keywords: World War I, autumn 1916, Jiu Valley, the interwar period, Heroes commemoration, monuments.

Along with the memorial services from churches for those who sacrificed themselves, the organization of cultural manifestations of homage etc., people have thought at forms to rendering eternal the memory of martyrs, either by raising commemorative monuments, or through the creation of cemeteries or ossuaries in which to be buried in Christian tradition, those who fell on the battlefield, soldiers of all armies involved in the conflict being buried together.

Also in the Jiu Valley will be fulfilled these obligations, through the care of the local Committees of ”The graves of fallen heroes of war” Society, of local administrative authorities and with the support of regiments deployed in the Jiu Valley after 1920, there will be rearranged the cemeteries of Heroes from Petroşani, Iscroni, Vulcan/Coroeşti, Paroşeni, that had already been created by the German army in 1917, will be raised monuments to honor the Heroes at Lonea, Vulcan and Lainici, in the Jiu Valley defile.

Heroes' Cemetery at Petrosani, with an area of 618 m^2, located near the „Saint Nicholas” Orthodox Church, was established in 1917 by the German and Austro-Hungarian military commandment.

Fig. 1. Heroes' Cemetery in Petrosani

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The cemetery, which is surrounded by a stone wall and brick and has at its center a monument dedicated to the Unknown Soldier, accommodates the graves of 137 soldiers killed during the fighting in 1916 and four German aviators killed in 1941 in Parang (Aldescu, 2011a).

In July 1934 were found on the hill near the city, the remains of a soldier who died during the war, which were placed in a coffin and buried with military honors in the Heroes' Cemetery (Avântul, 1934).

Heroes' Cemetery at Iscroni/Bărbătenii de Jos - today a township in the Aninoasa town - is located in close proximity to the village cemetery, being arranged as a space distinct from it. We know that „in the spring of 1917 was presented at Vulcan and Iscroni a platoon of the German army under the command of Lieutenant William Haberhauffe with the mission to make a cemetery by which to be honored the memory of the soldiers who died in the fierce battles from Vâlcan Mountains. They made one cemetery in Vulcan, Iscroni and Paroşeni. In these cemeteries were buried Romanian, Hungarian, German, exhumed heroes" (Suciu, 2002).

Fig. 2. Heroes' Cemetery at Iscroni

From Capt. Gregory Boşoldea's report written in Vulcan, from September 1, 1925 we learn that in the Heroes' Cemetery at Iscroni had been buried 51 soldiers, including 20 Romanian, some known, some unknown from regiments from Oltenia and the rest, all known, were from Bavarian regiments. On 6 August 1925 have been reburied in cemetery the remains of seven Romanian soldiers found on the mountains, the captain revealing that „on these mountains are many joint graves with which it is time for us to handle seriously" (Aldescu, 2011b).

Heroes' Cemetery at Vulcan/Coroiesti is located across the road from the Orthodox Church in Coroeşti and was established in 1917 along with the Heroes cemeteries from Iscroni and Paroşeni.

From the report drawn up by Capt. Grigore Boşoldea we learn that Heroes' Cemetery at Coroeşti was composed of 30 graves where were buried only Hungarian and German soldiers who fought in the area in 1916; also there was a common grave where were buried unknown German and Hungarian soldiers, and in 1923 was buried in this cemetery a nun of the Order of Franciscan nuns who cared for the soldiers hospitalized in 1916 in the hospital owned by the „Salgótarján" Mining Company from Vulcan. The cemetery was cared for, until 1925, in an exemplary way by Franciscan nuns working at the hospital, and from now will pass in the care of the soldiers from Vulcan garrison.

Capt. Grigore Boşoldea adds that by „Heroes Day", with the approval of Hunedoara County Prefecture and in cooperation with the local priest and the City Hall of Vulcan Hunedoara from the Mount Straja, in the Vâlcan Step, the remains of 78 soldiers who were reburied with great pomp in Heroes' Cemetery at Vulcan in May 28, 1925 (Aldescu, 2011c).

Fig. 3. Heroes' Cemetery at Vulcan/Coroiesti

Ossuary/Crypt from Paroşeni was arranged in the autumn of 1935 on the site of „Unknown Heroes Cemetery" from here. It is in the Paroşeni village from the Vulcan municipality.

Fig. 4. Ossuary/Crypt from Paroşeni

The cemetery was established in 1917 and was composed of 120 graves of unidentified soldiers, possibly Romanian, with wooden crosses at the head.

In 1935, a delegate of the German Government comes to Paroşeni and proposes the restriction of the cemetery in an area of 360 m^2, gathering here the remains of unknown soldiers who were buried in Paroşeni, but also in villages north of Petrosani toward Haţeg.

Accepting the reorganization of the cemetery, finally under the form of a common crypt guarded by an impressive cross made of reinforced concrete, between October 7 to November 18, 1935 were buried here 637 Romanian, German and Austro-Hungarians heroes, whose bones were exhumed from cemeteries in Paroşeni, Uricani, Pui, Livadia, Crivadia, Merişor, Băniţa, Lupeni, from the mountains Zănoaga, Oboroca, Tulișa, Baiul, Dealu Mare, Șiglău, Foița Coarnele, Negrele, Gura Plaiului, Ţiganca and Ştefului glades (Aldescu, 2011d).

Impressive are, through their meaning and message, three monuments raised by the local communities, with the support of the mining companies or of the authorities, at Lonea, at Vulcan, and by „Cultul Eroilor” Society in the Jiu’s defile, at Lainici.

Mausoleum from Lonea is located in Petrila city. Is a crypt in which two unknown soldiers were buried, a commemorative monument to honor all the fallen heroes in battles fought during the World War I.

Fig. 5. Mausoleum from Lonea

It was built at the expense of „Lonea” mining Society on a plateau situated at 15 meters above the road that comes from Petroșani to Lonea.

The monument, which was sanctified on June 5th 1924, by „Heroes Day” (Gazeta Jiului, 1924; Pop, 1924), is built of brick and plastered in white, and can be likened to an ancient temple, whose roof is supported by six Doric columns, on the pediment being engraved the text: „Homage to Unknown Heroes died for their country. 1916-1918”, either with the ship of an early Christian church or maybe the six columns are the miners, who in the local tradition carry on their shoulders, until the pit, the coffin with the deceased.

Monument of World War I Heroes from Vulcan was unveiled on November 31, 1926, being the work of the sculptor Mihai Onofrei (1896-1980). The monument was „raised on the initiative of some Committee of Romanians from Vulcan in November 1926", at the tenth anniversary of the battles from World War I.

The monument represents a soldier in the advance position, with the weapon in his hand - a bronze sculpture in ronde-bosse technique, 1.90 meters high - sitting on a granite pedestal in four sides, with three bronze plaques on the sides and one at the front. On the frontispiece is the inscription „Pasul Vulcan” and a plaque with the text „Honesty, honor and glory for the mighty Romanian heroes fallen in the war for unifying the nation. 1916-1918. Dulce et decorum est pro patria mori” and on the other three sides, the inscriptions: Jiu, Oboroca, Merişor (Gazeta Jiului, 1926).

Fig. 6. Monument of World War I Heroes from Vulcan

Monument dedicated to General Ion Dragalina (Căzănişteanu et al., 1983), which guards even today, as a symbol of unity retrieved after 1918, the road connecting Transylvania to the Old Kingdom through the Jiu's defile, was inaugurated on 26 October 1927 around the day from 11 years ago - 12/25 October 1916 - and of the place where the hero soldier was fatally shot by a German machine gun, being raised by the Craiova Monuments Society (Gazeta Jiului, 1927).

Fig. 7. Monument dedicated to General Ion Dragalina from Jiu's defile

The monument is composed mainly of a cross made of cement and which rests on a pedestal of white marble. On both sides of the cross is a picture of General Ion Dragalina, the words „Cerna" and „Jiu", the places of the battles at which the General participated in the military campaign in the fall of 1916, and on two sides of the socket marble, the confession „Here I was hurt doing my duty for the nation and country".

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„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Anthropological meanings of contemporary nomadism

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Abstract

The important change that has occurred in European thought, from Nietzsche's turning point until nowadays, is represented by the new spiritual geometry imposed by the social paradigms. Speculative thinking is covered by living works that express a rebellious world. The more profound mixture of populations, determined by an unprecedented nomadism, requires a "new man", different both from the one asserted by Friedrich Nietzsche, and from the one asserted by fascism or communism. For recent history, this represents growth, yet, without the elements of social affirmation. Sciences, including sociology and psychology, are still unprepared because they have to face unparalleled challenges evading experiments and verification. This research attempts at questioning, with an experimental purpose in mind, facts, events, and experiences that might forge a significant portrait of the European man of tomorrow.

Keywords: anthropology; nomadism; new man; spiritual geometry; social paradigms.

1. Introduction

Contemporary nomadism may appear as an inaccurate concept as long as the phenomenon is not precisely and designed. Nonetheless, besides its conceptual definition, the phenomenon itself cannot be denied as it has already determined important changes. Population movements have become broader, while the migrants are interested in reaching the developed countries for a better living, trying to escape poverty. This phenomenon results in a mixture of populations with unimaginable consequences. It is the most powerful phenomenon of this type throughout history, when people exhibiting different religions, mentalities, and cultures share the same living space. It results in an anthropological twist, which tests individuals' adapting capacity to different cultures, civilisations, and ideologies. The phenomenon was partly prepared by the postmodern philosophy through the approach of the relation between the Self and the Other, which implies the suppression of strict identities in favour of alterity. Although the concept of *alterity* seems to define contemporary world better than any other concept, nonetheless it should be understood as a substantial connection between the Self and the Other, owing to the fact that the Other is also a Self in a different hypostasis, a sort of image in a mirror. One of the postmodern philosophers who conceived a complex designing of the concept of alterity is Emmanuel Lévinas. In a dialogue with François Poirié, he asserted that the approach of the Other should be non-indifferent and initiated out of love: "The non-indifferent term might be perceived as an affective commitment, incorporating an intention of love and responsibility within the being, I have previously mentioned. All these bear fruit within love: responsibility defines something serious within the consciousness of alterity. Love moves beyond, representing the connection with the unique. The fact that the other, the loved one, is unique for me in the world represents something belonging to the principle of love." (Lévinas, 2002, p. 15). In the opinion of the French philosopher, non-indifference and responsibility determine the development of the consciousness of alterity. Nonetheless, this consciousness ranges within the boundaries of a "cold", rational stage, where the major issues of alterity are questioned (best displayed nowadays in the context of Europe's invasion by the migrants). The transition to the stage of love, as a superior stage of being, represents the appraisal of the unique, of the one that emerges itself from diversity, without determining rejection and condemnation. At present, anthropological research has to face an unprecedented challenge, while giving coherent and palpable answers to a factual reality. Anthropology should analyze the Other in a nonspecific habitat, different from its natural one, inherited through historical tradition. A new human type emerges from the cohabitation of individuals belonging to different cultures, which should rely on tolerance and a

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management of mutual social needs. Such circumstances require the gradual blur of individualism that always influenced the issue of identities. A “beyond identity, yet, not against identity” specificity is required, owing to the fact that cultural and national identities should be preserved.

2. Nietzsche’s new, unborn man and the symbolism of a series of characters

As far as Friedrich Nietzsche’s “new man” is concerned, the most beautiful phrase might have been given by Nichita Stănescu’s lines: “My sadness hears the unborn dogs / barking the unborn humans”, belonging to the volume called *A right to time*, 1965 (Stănescu, 1985, p. 153). We only have knowledge of what the “new man”, conceived by the German philosopher, is from Zarathustra’s gestures, who merely prepares the coming of the new individual. This is the last man of humanity due to the fact that he is the final station of a form of being, the rational being. The complexity of the last man is given by the multitude of the characters that represent it. A dictionary of the main characters of Nietzsche was briefly displayed by Gilles Deleuze (Deleuze, 1999, pp. 35-40): the Donkey (or Camel), the Spider (or Tarantula), Ariadna (and Theseus), the Buffon (Monkey, Dwarf or Demon), Jesus (Saint Paul and Buddha), Dionysus, Superior people, Zarathustra (and the Lion). The Alter-ego gains an increasingly complex function, where the border between evil and good is no more definite, while the so-called classical values disappear in order to leave room to suppositions or to vacancy and a lack of meaning. The new individual of the German philosopher is far from turning into being. It only represents the continually moving possibility, which is beyond a cultural consciousness. Nietzsche’s new man is a generous ideal, which was unfortunately mutilated during the period when the right and left extremists detained the power upon society. It should have transcended all religions and represented the essence of human being with all its strengths and generous ideals.

Irrespective of the fact that the “new man” was a target of communism or of another type of totalitarianism, it only could come into being through sacrifice. During World War II, fascism sacrificed millions of people with a view to attaining the “pure race”, while, in the communist countries, the “new man” was meant to become a reality through sacrificing several generations. No matter what type of “new man” fascism and communism envisaged, it did not possess the meaning given by Friedrich Nietzsche in his theory of the superman. The question that is frequently asked by the German philosopher is the following one: “*How is man capable of surpassing himself?*” - *Wie wird der Mensch* überwunden? (Friedrich Nietzsche, 1994, p. 352). Zarathustra is not the superman, but the last man belonging to humanity. He represents the human experience that attains its own end. Beyond that, everything would change. And, we would like to believe that everything would change for the better and sacrifices would not be futile.

The main reason Nietzsche’s superman does not overlap the “new man” of the 20th-century political extremes is that the German philosopher conceives a man that is free even from the constraining history itself determines. Unlike Nietzsche’s entity, the “new man” is subordinated to a system, which transforms it into a submissive being. When interpreting Nietzsche, Deleuze asserts an essential fact about the relation between Zarathustra and the Superman: *“The way Dionysus is Superman’s father, in the same way Zarathustra calls Superman his child. Nonetheless, Zarathustra is surpassed by his own children; and he is but the claimant of the ring of the Eternal Return and not its constitutive element. Rather than producing the Superman, he ensures that the human being produces the Superman by providing all the necessary conditions owing to which human beings are able to surpass themselves and to be surpassed and owing to which the Lion becomes a Child*” (Deleuze, 1999, p. 40). Accordingly, Zarathustra is the “father” and represents a meta-consciousness that generates a new world, the world of Superman, yet without being in this world. He provides the access to a much better world despite the fact that this world belongs to a world which is irreversibly under derive.

In the opinion of Gianni Vattimo, Nietzsche’s message is not mainly addressed “*to the philosophy of the future, but especially to the future human society*” (Vattimo, 2001, p. 79). The difficult trajectory human society crossed, beginning with World War I, emphasizes the truth of a succession of changes and the coming out of stagnation. The issue is that society misunderstood Nietzsche’s fertile idea and rather imagined a monster than a Superman to carry further the new ideal of humanity. Philosophy was then required to demonstrate the viability of Nietzsche’s ideas; consequently, a large part the 20th-century philosophy is a commentary of his work. Accordingly, the idea of Superman represents a permanently open anthropological concept that gives free way to the liberty of creation.

3. The new man as a fascist experiment

Fascism brought so much evil to humanity that it could be considered an experiment of human race extinction. Nonetheless, such an assertion was not possible from the beginning. The violence of the first world conflagration resulted in a special ideology in the countries displaying a fragile democracy, defeated on the battlefields and frustrated by the peace treatises. Two political dictatorships mainly occurred: fascism in Italy (1922) and national-socialism (Nazism) in Germany (1933). The fascist ideology is either interpreted as the product of a crisis of liberal individuals and of their confusion determined by the atomized industrial society or as the product of a crisis of a middle-class that fears both proletarian power and communism, but makes capitalism responsible for the degradation of society. Fascism is, as communism, a mass movement; nonetheless, it asserts that inequality is productive as a means of surpassing oneself. Individuals do not represent anything, due to the fact that, through the State, controlled at its turn by political police and the sole party, fascism dictates a single ideology to all, while abolishing fundamental liberties. Fascism, just like communism, targets to design the “new man”. Nation, passed glory, and race represent fascism fundamentals, while history should be re-written according to racial inequality and the fight for the *vital space.* After World War II, this ideology, which made possible the genocide of the Jews and the Gypsies, had become deeply discredited and detested.

Fascism's "new man" was about to become a reality in the "laboratories of death", where unorthodox medical methods were used. Although the utopia of creating the new man according to the example desired by Hitler was not achieved, the psychic and behavioural transformation of a large number of Germans was quite evident since the regime had a lot of supporters. Such a transformation represented the ground of accepting totalitarianism as a political and governing method. According to Martin Kitchen, "In the Western world, during the 1950s and at the beginning of the 1960s, the dominant theory about fascism was totalitarianism, employed for a series of political goals. The essential idea supporting the theory of totalitarianism is that there was a vital structural similitude between the communist and fascist systems, which, at their turn, represent an antithesis of the Western democratic system. This theory and its various versions were turned into a powerful ideological weapon during the Cold War." (Martin Kitchen, 1976, p. 25).

4. The new man as a communist experiment

As a reaction to both capitalism and the deeply inequitable industrial society and to the social drawbacks of liberalism, the 19th century witnessed the development of the socialist ideology, either in its utopian form (Saint Simon, Fourier, Proudhon, Cabet), and in its rather scientific form (Marx, Engels). Socialist ideology is characterized by an optimistic conception on history, while capitalism is denounced as a means of human exploitation. Values may only be created through work; exploitation occurs whenever the salary given to workers represents less than the value of the work they performed, while added value is wrongly and entirely given to the capital owners. Marxism launched the idea of establishing an egalitarian communist society, with a transitory period of proletariat dictatorship, implying the incorporation of production means within collective property, followed by an advanced stage when the State would disappear. The instauration of the communist society would be achieved through a violent insurrection of the working class or through parliamentary and social action worldwide. This evolution included convulsions and doctrinal crises of which the most spectacular was the "revisionist" Kautsky – Bernstein controversy, which accepted parliamentary democracy and supported the idea of moving towards socialism through successive reforms. The most eloquent example of implementing the communist ideology was the Russian Bolshevik Revolution of October 1917. Through its ideological manipulation of the Russian masses, it represented a huge hope for the European movements of the workers failing to revolt (for instance, the German Sparta insurrection).

Unfortunately, Marxism and Leninism also included the cult of the party apparatus, the replacing of the proletarian dictatorship by personal power, and the change of the State into a Police-State. After World War I, as a reaction to Marxism and Leninism, socialist ideology was divided, in Europe, into a "reformist" movement and a communist movement, which advocated an immediate revolution. The several types of European socialism looked for a third path, between liberalism and communism, namely between the market economy and the State's intervention. A social-democratic synthesis occurred in the Northern countries, between 1929 and 1935, in France, beginning with 1936 and continued after 1945. Beginning with 1959, in Germany (The Congress of Bad Godesberg) and with 1984, in France, democratic socialism abandons the Marxist inheritance and creates a bridge towards liberal democracy. Until the 1970s, the Western democracies perceived communism, supported by powerful parties, as it was the case of Italy and France, like a political myth and a symbol of hope. During the years 1980–1990, the Soviets' regime as well as the satellite socialist democracies in Eastern Europe collapsed. The communist parties belonging to the Western democracies confronted with an identity crisis, and the communist regimes in Cuba, China, and Vietnam opened towards the exterior.

Communism was in fact a continuator of fascism and showed that, at least, as far as its extermination methods were concerned, it did not differ from fascism. Nonetheless, all these occurred with a "noble" goal, as communism could not be built by no matter what individuals; it could only be constructed by the "new man", according to the assertion of Louis Aragon: "The communist man, worker, peasant, intellectual, is the man who saw the world so clearly for an instant that he cannot forget it anymore" (Aragon, 1946, cited by Libris, 2013, p. 65). Where normal education (the so-called "scientific" indoctrination) was not possible, re-education, most of the times in penitentiary conditions, should be used. Consequently, the "new man" of communism was the result of a limit-experiment similar to fascism.

5. The new man of the recent history and the anthropological perspective in the era of globalization

A common sense question might be asked: what is recent history, in fact, and where does it range within contemporary history? Contemporary history is considered to begin in 1918, with the end of the Great War. It is the only period of history whose dates are universally applied to all the world's states due to the fact that World War I determined global effects. As far as the term of "recent history" is concerned, it generally regards the period after World War II. In Romania, the most assiduous preoccupation for the recent history began after the 1989 events, when the previous dictatorial communist regime was formally eliminated. This preoccupation came from a series of personalities and institutions. In 2000, the **Romanian Institute for the Recent History (RIRH)** was created, at the initiative of the former ambassador of the Netherlands in Romania (Coen Stork).

The "new man" does not necessarily mean the most complete or the best man. In the case we agree with Leibniz, our world is the best of all the possible worlds. It is obvious that present-day world is much different from the world the great German philosopher lived in, when modernity and rationality fully asserted themselves. As I have already shown in a previous work (Hirghiduş, 2013, pp. 172-175), the era of globalization has brought a new anthropological perspective, due to the fact that new paths allowing the grasping of what man still represents are necessary. Representation creates a globalizing, accurate image. The representation of the human being within the world is mainly an image for the self, a "portrait" of the Ego that is used as a mirror. Within its margins, comparisons and adjustments occur with a view to attaining the purest accuracy. The era of globalization is an age of space expansion, when the individual encapsulated in its spaceship heads for the Cosmos for a possible encounter with a being belonging to another world. Nonetheless, the individuals do not own the capacity of getting free of their own possessions, without dying. They are, in fact, the symbolic materialization of "Heisenberg's man", whom Hannah Arendt speaks of: *"the man who will hardly meet another person, except for himself and his own possessions, becomes eager to eliminate all anthropocentric considerations of his encounter with the non-human world around him.*" (Arendt, 1997, p. 287). No matter if we accept or not the idea of man's loneliness in the universe, we cannot ignore the importance of the *presence* in its relation with the *representation.* The real presence of the human beings in the universe largely overpasses the images of their own representation and may be compared with a translation from psychology to cosmology.

The anthropological perspective in the era of globalization is not clear enough. What would cosmos represent for the human beings who would increasingly claim that they are the owners of the universe? The widening of ownership brings with it an instrumental development that might unify or divide humanity. Globalization hides in itself two tendencies implied by the ownership of the cosmos. Such a thing did not occur until now due to the fact that the human beings are only at the beginning of their cosmic expansion. Nonetheless, in the future, they'll cease being simple tourists and are going to assert their ownership right. In order that the future of the human beings does not range within the area of derisory domination fights, the universalized ownership mentality should change. Such a change has nothing to do with communism or another communitarian conception; it should represent the meaning of human being's liberation from the domination of possessions.

A new anthropological perspective implies, besides a salvation plan of what humanity represents, the reconstruction of the idea of "new man". This idea owns a repugnant past due to the fact that it gave way to the sufferance and mutilation of the collective consciousness. The "new man", besides its metaphoric charge, was also an ideological target for the left and right extremists. An imbalance continually occurs between ideas and things, so that one part may suffer most. An idea may become extremely dangerous for a real world that was preserved according to a certain pattern. Ideas, which may appear extremely "frail", are able to determine, at a particular moment, radical changes of the real world. Such an idea is the idea of the "new man", which was present, during history, in all the reform moments of the society. A new society required the attaining of an ideal of "new man", which, in contrast with the "old man", better suited the transformed milieu. The new society, in the case it is the result of dissolution, may be harmful exactly owing to the novelty it brings. History itself is a long row of society dissolutions, which, nonetheless, hide the stages of the future progress. Accordingly, we may speak about the negative experience of totalitarianism, which, in time, determines its rejection at the level of the collective consciousness.

The opening of a new era of nomadism represents a challenge for contemporary world. Today, this is a largely encountered phenomenon, determined primarily by economic factors. Existential questions come out in connection with this world phenomenon and survival solutions are looked for. The present-day migration of the Muslims to Europe, which, as far as we know, did not result in clear solutions, should be regarded as part of such a context. Nobody is able to know precisely the manner the European human type would evolve under the circumstances of the increase of the number of Muslims. There are gloomy scenarios asserting that a future Europe might become Muslim or dominated by religious conceptions, mentalities, and values that are not its own. The man of the future is going to be the man beyond the boundaries of the theories accepted today as representative.

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Book consumption in Petrosani city

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Abstract

The present communication is the result of an innitiative of one of the two authors who were enthusiastic to organise a Reading Marathon in the Marble Hall of Petroşani. The event was attended by persons intrested in such artistic manifestations and we identified the opportunity to find more about this subject and even further details (such as aspects related to owning a personal library, purchased, read or lent books along the time, preferences for a certain type of book etc. After a keen analysis of the received answers correlated to different environmental, social and demographic variables (such as age , gender, education, present occupation etc.), we reached to the conclusions exposed in this work paper.

Keywords: Reading, traditional book, digital book, library

Introduction

Nowadays all the spheres of the social life are conquered and dominated by the assault of the latest generation technologies. Age is no impediment in adapting to the changes they impose. And it is not only about the macro-structural modifications, but also about those related to the daily behaviour. For example, computerised reading or e-reading - resulted by using a computer, a tablet or a telephone as a ' support device for reading - already represents a common fact, as people consulting this type of informing channel could be seen everywhere. The aggressive invasion of technology in the reading field and the way it is perceived by an addicted reader is a challenge. It cannot be accurately predicted when and how, but we can anticipate that in a short time, digital reading can replace total or at least partially the habit of traditional reading.

Area and reseach method

The aggressive invasion of technology in the reading field and the way it is perceived by an addicted reader is a challenge. It cannot be accurately predicted when and how, but we can anticipate that in a short time, digital reading can replace totally or at least partially the habit of traditional reading. The indirect investigation was used as research method, each subject completing the form once they entered the location. The respondents number was 136 and it was considered eloquent for the investigated phenomenon as the research was classified as complete according to the attendees point of view.

Results

As it was admitted in the opening considerations, today there is a high pressure the e-books manifest upon the traditional printre book. As the old technologies were replaced by the new ones (the computer took the place of the

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typewriter, the classic telephone was substituted by the mobile phone), there are expected changes regarding traditional reading, too.

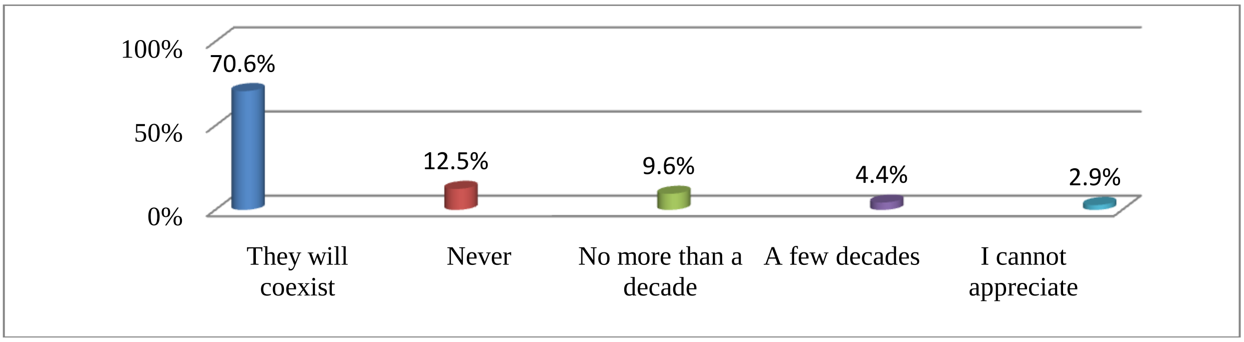

Fig.1. The period of time whwn the electronic book will replace the tradittional one

The obtained answers indicate a cohabitation phenomenon of the two types of books and readings implicitely, rather a close end of the traditional book and reading.Till the end it is about a personal option, so no matter the range of development of the digital phenomenon, traditional book still has and will have loyal friends in the readers' world at every moment. And because we reminded about the personal option of people regarding reading, it can be seen in figure number 2 that most of the subjects prefer traditional book exclusively, rather than the digital one. Detaching from the traditional format of the book is difficult especially for those belonging to the generations instructed and educated in traditional schools. For the ones caught in the formation process, it is much easier, the fact being barely perceived as a detachment. We are talking of course, about the generations raised with the new technologies, for whom these represent the natural normality of their cotidian lives.

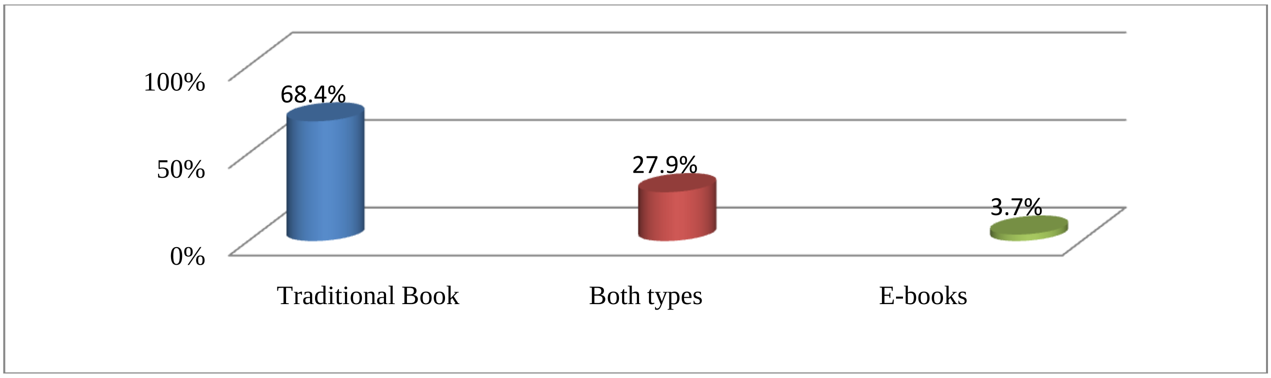

Fig. 2. What subjects prefer

Possessing a personal library is an indicator of both professional and material status, but mainly of a cultural capital of
the owner.

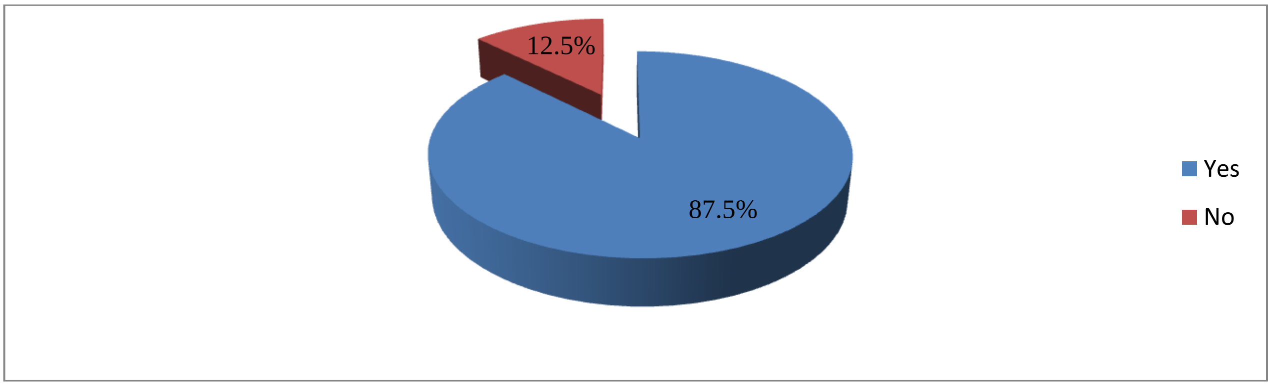

Fig.3. Shares of subjects owning personal libraries

During the investigation we were willing to know how many of the participants owned such libraries and it was clear that only a few (12.5%) as Fig.3 indicates, subjects did not have their personal library , which showed us once again their participation in the event was not a random one, but the result of their interest in reading cultivated along the time through buying books, lending from individual or public libraries. We asked the subjects to indicate the dimensions of the libraries they owned.

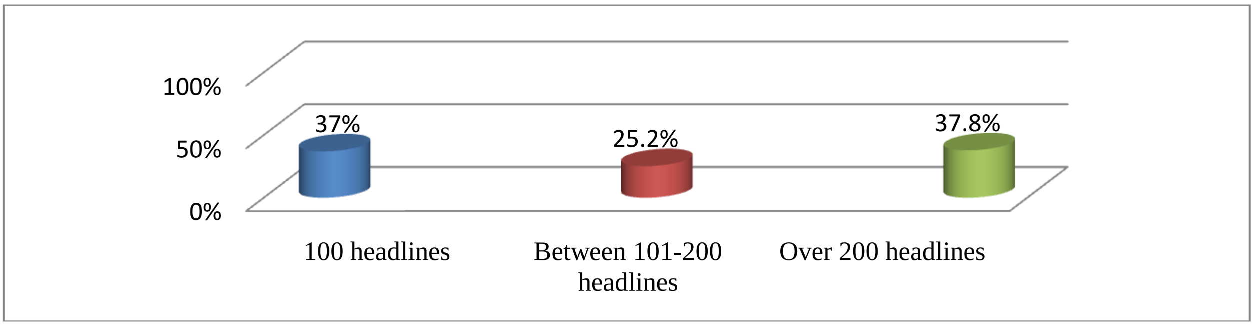

Fig. 4. Number of books present in personal library

In general, the titles included in their personal libraries are numerous. There are, for example, almost 40% (37.8%) libraries containing over 200 titles, which means a lor, taking into account that Petroşani was a powerful working center, dominated by the coal industry, and yet can be compared to other cities with great cultural and strong universitary traditions. The conclusion is the rate of reading is very high and the interest of readers is mantained through buying, changing and lending books.Also , the frequency people read with is illustrated in fig.5.

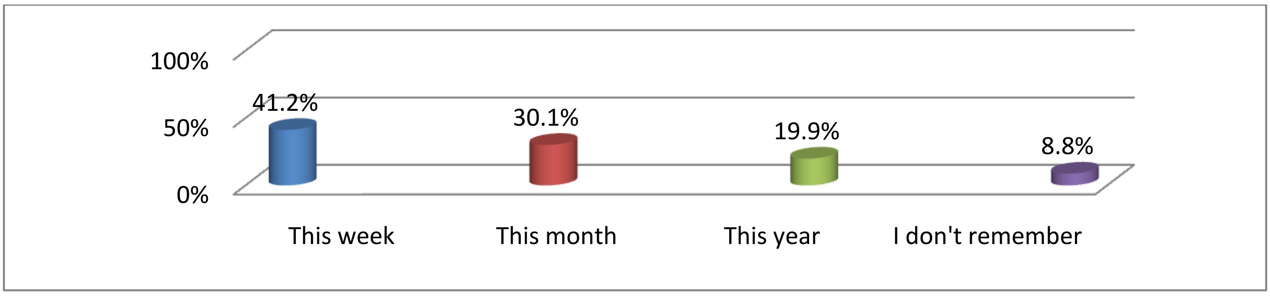

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Fig. 5. When they read the last book

The frequency people read with is very high among those interested in joining the event. No less of two fifths (41.2%) of them finished reading a book during the last week, while a third of them (30.1%) had the same preoccupation during the last month.

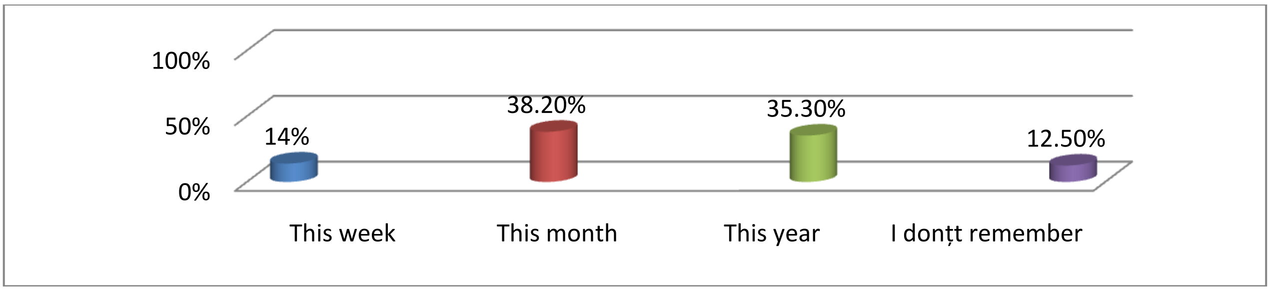

Fig.6. The last time they bought a book was

It’s obviously that the frequency that books are bought is smaller than the the one that they read, because through cumulation if 71,3% of the subjects had read a book in the past month, this time only 52,2% from the same subjects had bought a book in the last month. In such conditions, borrowing of the is a favorable prerequisite to new lecturing: But for reading, one needs new books and that means new aquisitions. This aspect was cleared by questioning the participants about the last book they bought and the frequency of their loan book they opperate.

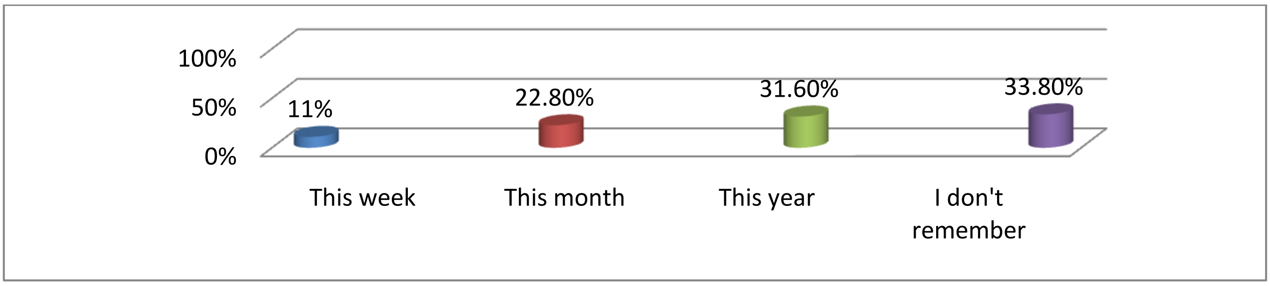

Fig. 7. The period of the last book loan was...

A bit over a third of the interviewed subjects lend at least one book from a person per month (33.8%), aspect that underlines the fact that sharing is very common and represents the basis of this exchange phenomenon in order to vary the readings. But the book loans are not limited to private persons - there are public libraries that can offer quality services in every town. Petroşani, for example, has both a public library and a university one, well equiped and connected to the latest publications .

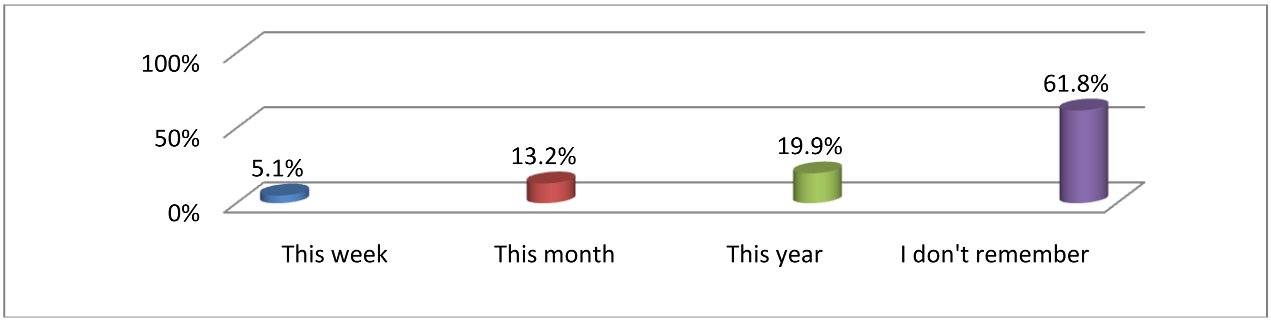

Fig. 8. The last book loan from the Public / Municipal Library

Unfortunately, the number of people using the services of public libraries goes down, being placed a bit over the half of those sharing or exchanging books privately. We consider this negative aspect appeared as a result of lack of involvment in producing an adequate marketing strategy to impose themseves as institutions in the public space or/and advertising the services they offer. Letting people know more about the services they offer may be a strong point in attracting readers, even if in a way, that implies commercialising their services. The last aspect we approach to refers to the disponibility of the subjects in lending books from their own library to others. Those who lend books to others are more numerous (41.2% cumulated in the last month) than the people who borrow reading material.

Conclusions:

1. There is no immediate threat of extinction of the traditional book in favour of the digital one, on the contrary. We can affirm the two forms of the book can coexist, as long as the traditional book is prefered by the the passionate readers to the digital variant.
2. The number of personal libraries owners who are passionate readers is high (almost 90%) and the number of the titles they contain is over 200.
3.The reading frequency is high, as two fifths of the subjects end at least a book per week to read.- 4.Meanwhile, the frequency of buying books is lower compared to that of reading, which is absolutely normal in terms of book loan.
5. Sharing and exchanging books privately happen more frequently than book loaning from public libraries. 6.The readers of traditional books in Petroşani present the same feature as those all over the country , such as the high number of those owning a large library (over 80%) , of over 200 titles (between 100-500 in other Romanian cities.
(http://www.ires.com.ro/articol/171/obiceiurile-de-lectura-ale-romanilor)

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7th International Multidisciplinary Symposium

„SUSTAINABLE DEVELOPMENT THROUGH QUALITY AND INNOVATION IN ENGINEERING AND RESEARCH”

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Social welfare services provided to the residents of the “Grandparents of the Jiu Valley” Care Center for the Elderly in Petroșani

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Abstract

The paper provides an analysis of the social-medical services provided to the elderly institutionalized in the elderly care center ”St. Pantelimon and Nectarie” in Petroşani, as well as an empirical research based on the opinions of specialists in the social-medical field working in the center regarding the improvement of these services.

Keywords: social services; institutionalization of the elderly, care center

1. Social services

The social services, and especially the social welfare services (as a component of the former) play an essential role in the social protection system and their main objective is to maintain, restore and develop the individual capacity to deal with crisis situations. They are professional services provided by qualified persons. They can be community social welfare services, which have a primary and general character, and specialized social welfare services, provided for certain special needs of the assisted, both at their homes or in specialized institutions, such as schools, penitentiaries, hospitals, etc. Among the beneficiaries of the latter category of social services are the elderly. All the social welfare services fulfill the following functions (Zamfir apud Buzducea, 2005, pp. 60-64):

- *development of the capacities* of the individuals, families and communities to solve the problems they face through their own effort;
- *professional support* provided for the solving of personal, family and community problems through counseling, individual or group therapy for those who do not have the personal resources to deal with difficult situations;
- *facilitating the absorption of social support* provided to those in distress by the social welfare system;
- *facilitating and improving the efficiency of social support* by selective and focused use of various forms of social support for persons and families in distress, as well as by ensuring the efficient use of resources allocated for their specific needs;
- *defending the interests and rights of persons in distress* if they are threatened and do not have the capacity to do this on their own;
- *diagnosis of social problems* through which the vulnerable segments of population are identified and recorded by the social welfare services;
- *prevention* through which social welfare services prevent the emergence of pathological social processes.

2. Social welfare services provided to the residents of the Care Center for the Elderly, Association ”Grandparents of the Jiu Valley” in Petroșani

In order to identify and meet the social needs and specific conditions of the elderly as adequately as possible, social services are organized both in local communities and through public-private partnership or non-governmental organizations. These are meant to identify and asses the needs of the elderly, to organize, plan and ensure the financing and co-financing of social services, whereas the public and private providers of social services have the responsibility to provide the benefits by observing the quality standards.

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The assessment of the functional autonomy of the elderly is carried out by a mobile team. In the case of the institutionalized elderly, evaluation can be performed on demand by the individual, their family, the attending doctor or the social system.

The residents of the ”Grandparents of the Jiu Valley” Care Center for the Elderly, managed by the Orthodox Parish ”Holy Prophet Elijah” in Petroșani benefits from specialized care services provided in accordance with their degree of dependence, individual needs, family situation and income. The care services are provided o the elderly in the center according to the *Individual intervention plan* and the Social-medical (geriatric) assessment chart, elaborated by specialized staff, on grounds of the recommendations formulated by the assessment team. The intervention plan and the assessment chart contain a series of information about the elderly residents, such as: personal (identification) information, social, family, economic situation, state of physical and mental health, degree of dependence, etc. According to this information about the elderly, intervention is organized in such a way as to ensure care, socialization and the spending of leisure time.

The ”Grandparents of the Jiu Valley” Care Center for the Elderly, managed by the Orthodox Parish ”Holy Prophet Elijah” in Petroșani houses 27 elderly, aged between 53 and 94. The structure of the elderly in the center according to the gender and age variables is presented in tables 1 and table 2:

Table 1. Structure of the elderly according to the gender variable

	Male	Female	Total
Absolute value	9	18	27
Relative value (%)	33.4	66.6	100

Table 2. Structure of the elderly according to the age variable

	50-60 years old	61-70 years old	71-80 years old	81-90 years old	Over 90 yeas old	Total
Absolute value	1	3	8	13	2	27
Relative value (%)	3.7	11.1	29.6	48.2	7.4	100

The social-psychological-medical assistance is provided by specialized personnel. Thus, the center has 15 employees, namely: a manager; 2 social workers; a doctor; a psychologist; 3 medical assistants; 4 attendants, 2 nurses, an accountant and a premises caretaker.

In order to find out the employees’ opinion regarding the care services provided to the elderly and their suggestions for the improvement of these services, we carried out a research based on direct inquiry, using the questionnaire as a data gathering instrument.

The data analysis and interpretation led to the following conclusions:

1. All the employees of the center confirmed that pastoral activities, such as the Confession, the Eucharist and the Unction Services are attended by all the residents on a regular basis. The only exceptions are the residents of other denominations (Catholics, Jehova’s Witnesses, etc.);
2. Among the religious education methods used to attend to the spiritual needs of the elderly, most of the employees indicated the regular visits of priest Gabriel Bulf (74.1%) and his individual talks with the elderly and the watching of Christian TV shows (22.2%) (see chart 1);

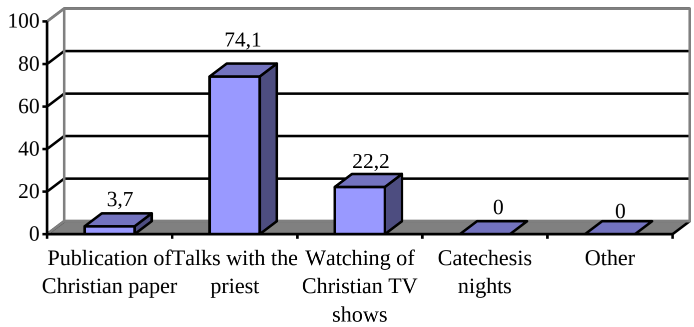

Chart 1: Major catechesis methods applied to attend to the spiritual needs of the residents (%)

3. The Care center for the elderly develops a series of philanthropic activities (listed in order of the options):
   - holiday gifts or packages offered by local believers, consisting of both spiritual gifts and food or personal hygiene items;

- donations from the believers in order to equip the center and ensure its functional character at high quality standards;
- organization of commemoration treats for the deceased relatives of believers in the parish or outside it;
- organization of spiritual and church music concerts;

4. Most of the investigated subjects appreciated the activities organized by the institution so that the residents could socialize both with one another and with the members of the community involved in the adequate operation of the center (see chart 2).

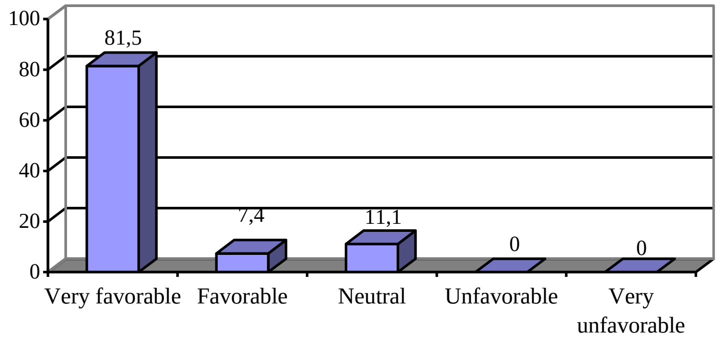

Chart 2: Appreciations regarding the spiritual guidance of the elderly (%)

5. The involvement of the Direction of Social Work in Petroşani in providing social services to the elderly in the center was also appreciated favorably and very favorably in a proportion of 79%;
6. The main activities performed by the residents of the center are the following: walks in the garden of the center, very well kept, where the elderly spend much time communicating among themselves and with the personnel, or relaxing in the rocking chairs; participation to physical activities (gardening, helping in the kitchen, etc.); participation to cultural events; participation to social games (backgammon, cards, etc.); home visits a.o. (see chart 3);

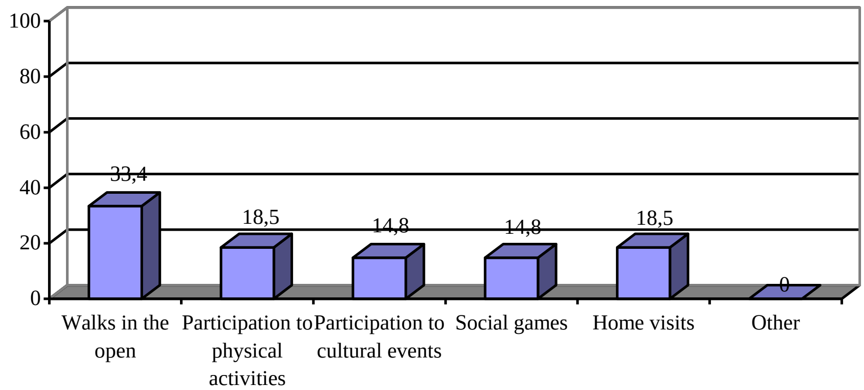

Chart 3: The main activities performed by the elderly in the center (%)

7. Besides the social activities mentioned before, other events re organized in the center, such as: birthday anniversaries of the residents, holiday meals, commemorations of the deceased residents, performances offered by the local children on different occasions, etc.

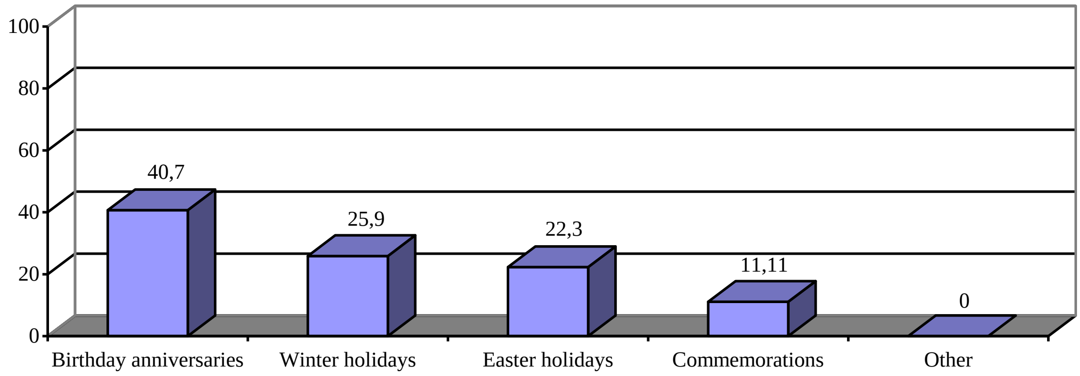

Chart 4: The main activities performed by the elderly in the center (%)

8. Apart from these activities in the care center, the subjects suggest other activities, such as: independence development, maintenance of physical and social skills, etc, meant to help the elderly to keep their (already limited) autonomy capacities;
9. Besides the religious and social assistance provided to the elderly, they also benefit from the following: social care (for feeding, personal hygiene, health maintenance, etc); medical assistance; psychological assistance; counseling , legal assistance.

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Voluntary service - an introduction to professional career

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Abstract

Voluntary service is unpaid, facultative work performed in favour of other people or social groups. It is another opportunity to gain professional experience by young people, particularly those who have never worked professionally. It teaches responsibility, respect for the performed work, helps to make decisions concerning a further educational track. This is especially important in case of secondary school graduates, who have to decide about the following level of education. These are difficult choices made by teenagers who are not familiar with the reality of the labour market and do not have any work experience. The article presents the selected benefits resulting from the voluntary service of secondary school graduates. Such a form of professional activity enables students to develop their skills and abilities and gain professional experience. It also teaches them to cooperate in a group, which is a skill particularly required by employers.

Keywords: voluntary service, professional career, the youth;

1. Introduction

Undertaking professional work is one of more important moments in human life. It is connected with self-realisation, fulfilling ambitions, passion, social status. It also means financial independence, responsibility for managing the household budget and broadly understood planning. The choice of career path is one of more difficult moments in life, particularly of the life of a young person, who, having finished education, has to find his or her place on the labour market. The youth finishing secondary schools of general education are in a difficult situation because the schools are not intended to provide vocational training. Graduates of this type of schools are theoreticians (at least the majority of them) who have never worked, do not know the realities of the labour market, the expectations of employers. One of the possibilities enabling young people to enter the labour market is voluntary service. It enables to gain professional experience, teaches group work, discipline, responsibility, time management, motivates to fulfil goals and tasks. It is also helpful with further professional choices.

When looking for employees, employers assess their soft and hard competencies. Hard competencies primarily include command of foreign languages, driving licence, specialist knowledge, computer skills, etc. Soft competencies concern relationships with people. These are, for example, communication skills, creativity, teamwork skills. Career development professionals employed at schools sensitize young people to these aspects, but without any practice a teenager will not know what he or she is like, what he/she should work on and will not understand the essence of work. Improving qualifications, self-improvement, mobility, lifelong learning - these are challenges that have to be coped with by a young, serious person and a prospective employee who might have to requalify in the future, acquire new skills. Voluntary service can verify young people's plans, change their attitude to learning and paid employment.

The article presents selected benefits brought to secondary school students by voluntary service, without remuneration, but requiring commitment and willingness to help others.

The first part of the article characterises the basic legal acts and documents regulating volunteering in Poland and in the European Union. The second part presents the advantages of such activities.

In Polish schools school volunteer clubs involving students in work in the school, for the school, and outside the school are created. Also teachers are engaged in such activities. Young people very often emphasise that volunteering is an effort without remuneration, therefore, not really satisfying, that is why the sense and the value of such service must be highlighted in this type of activities undertaken by school or non-governmental organisations.

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2. Voluntary service in selected documents and legal acts

In Poland the rules of volunteering are regulated by the Act of 24 April 2003 on Public Benefit and Volunteer Work. Pursuant to Article 3 section 3, a volunteer is "a natural person who voluntary and without remuneration performs services in accordance with the principles set forth in the Act" (Journal of Laws, 2003). According to Article 43 of the Act "a volunteer should have qualifications and fulfil the requirements adequate to the type and scope of the performed services, if the obligation to have such qualifications and fulfil adequate requirements arises from separate regulations (Journal of Laws, 2003). Any person of any age can become a volunteer, unless specific predispositions, completed courses, higher education are needed to perform specific obligations. In the case of minors, parents' consent is required.

A document which is important for the functioning of voluntary service is an elaboration entitled *Długofalowa polityka rozwoju wolontariatu w Polsce* (*The Long-Term Volunteering Development Policy in Poland*), in which it is stressed that volunteer work is a chance for young people, without professional experience, but also for the unemployed, retirees or pensioners, the disabled, people without education.

"Voluntary service is for an individual a significant chance for personal development, gives a possibility to acquire individual, social and professional competences, and the knowledge and experience gained in the course of voluntary activity substantially increases his or her creative, intellectual and cultural potential" (The Long-Term Volunteering, 2011).

Another Polish document referring in its assumptions to the development of society is *Strategia Rozwoju Kapitału Społecznego 2020* (*Social Capital Development Strategy 2020*). In the Area I of the Strategy, entitled *Postawy i kompetencje społeczne* (*Social Attitudes and Competences*), the most important elements are indicated, "which in the educational system and in other forms of learning should have a priority. These are cooperativeness, communication skills and creativity" (Regulation of the Council, 2013). Voluntary service influences the development of those competences and attitudes because it is implemented in practice, most often in work with another man.

The European Union in its assumptions directed especially to young people also stressed the significance of voluntary work, its role in shaping the attitudes of the youth.

Council Decision of 27 November 2009 *on the European Year of Voluntary Activities Promoting Active Citizenship (2011)* stresses that "voluntary activities constitute a rich learning experience, enable the development of social skills and competences and contribute to solidarity. Actions carried out by volunteers of all ages are crucial to the development of democracy, one of the founding principles of the EU" (Council Decision, 2009). Voluntary service eliminates stereotypes, does not differentiate people, prevents broadly understood discrimination.

Another European legal act devoted to the youth is the Council Resolution of 27 November 2009 *on a Renewed Framework for European Cooperation in the Youth Field (2010 - 2018),* which indicates the main areas of the European cooperation for young people. One of them is voluntary activity. "Voluntary activities of the youth should be supported and more and more broadly regarded an important element of non-formal learning. Obstacles hampering voluntary activities should be eliminated and transborder mobility of the youth should be propagated" (Council Resolution, 2009).

Within Erasmus+ programme, Action 1: *Mobilność edukacyjna (Educational Mobility)*, the European Voluntary Service is implemented, enabling to undertake social work by young people outside the country. Owing to such commitment, young people learn the language of the country in which they stay, the new culture, people, they acquire new skills.

All the documents and legal acts devoted to voluntary service of young people stress that it is one of the best forms of learning the reality, society and the world. A lot of universities and colleges search for students and graduates-volunteers to start cooperation with Universities of the Third Age, to work in the projects of the Academy of Young Economist, for example - a programme of economic education for lower-secondary school students. Volunteers work for "Dr Clown Foundation", during the organisation of the Great Orchestra of Christmas Charity, in animal shelters. There are lots of such opportunities, therefore, young people in the school and outside it should be encouraged to such a form of activity.

3. Voluntary service for the youth - benefits

Voluntary service is primarily service to people, developing those to whom it goes and those who help, too. The activity based on altruism, sensitivity, empathy. According to the survey carried out in 2011 by TNS Opinion & Social to the request of the European Parliament, the involvement of Poles in such work is much below the EU average. In Poland it was 9%. For comparison, in the Netherlands 57% of respondents were engaged in voluntary service, in Finland - 39%, in Germany and Slovenia - 34% (Report, 2011).

Voluntary work cannot be perceived by young people as worse or deprived of sense because it is a value which will be used on the next stage of professional life. The significance of such a form of involvement is proven by specific benefits which young people must familiarize with. That is why, a great role in propagating voluntary activities should be played by schools and non-governmental organisations.

Voluntary service develops hard and soft competences of a potential employee, it enhances them.

Hard competences basically include specialist, substantial knowledge from a specific field. Students of secondary school of general education attend classes with extended curriculum in, for example biology and chemistry, psychology, police work, etc. The choice of the class with a specific curriculum means the extension of the syllabus with specific subjects. Students of such schools are mostly theoreticians who, owing to voluntary activities, can confront the theory with practice. Make use of what they have learnt at school, and secondly, answer the question whether in the future they would like to continue education on such studies. Holiday is the best time to make the decision. This eliminates an accidental choice of universities or colleges and majors.

Another very important hard competence is the command of foreign languages. In addition to foreign language courses, students also participate in classes organised by private language schools, they go to language camps. Voluntary service, particularly the European one, will let them use this skill in contact with other people.

An example of the third hard competence, which may be young people's assets when looking for a job, is possessing a driving licence. The ability to drive a car skilfully and safely teaches self-control, calmness, patience. These are qualities necessary to be a volunteer.

Soft competences are basically social skills, cooperation in the group. Just like hard competences, they have to be proven in practice because young people often think that they are communicative, assertive, can work as a part of a team.

"People have different images of themselves, but they are not always adequate, namely corresponding to objective opinions of others. In spite of that, they undertake activities according to their own image of themselves" (Chirkowska-Smolak, Hauziński, Łaciak, 2011).

Soft competences can and must be learnt. For young people, work in the form of voluntary service is a test of what one is like in contacts with other people.

One of soft competences are communication skills, namely clear and understandable expression of one's views, opinions, an ability to listen and answer questions. Communication skills are taught to children from the kindergarten period. Methods activating applied at lessons aim at provoking students to express their views, assess various behaviours. However, a young man can behave differently in the environment he knows. Owing to voluntary service, the youth have an opportunity to check their communication skills in work with elderly people, children, people with various dysfunctions.

Team work, creativity, independence, assertiveness are other soft competences which should be taught at school and used in practice. When deciding to do voluntary work, young people should learn what they should work on and which of these competences to improve.

Volunteers are people who help those who cannot help themselves and as all employees they should be characterised by some qualities. Firstly, man is most important in their work, regardless of age, gender, health, and this assumes sensitivity to suffering of others and openness to people. Improving qualifications and willingness to learn helps understand problems young people can come across every day. Constant self-improvement will let them help others better.

Time management is another skill which is shaped by such a form of activity. Owing to it, a volunteer will organise the working day better. Voluntary service is also a good school of discipline since in addition to rights, a volunteer has also obligations. One of them is to scrupulously follow instructions and to care about the entrusted property.

All those qualities and skills developed by voluntary service will enable a young person to plan his or her career better, to find their way on the labour market faster, to be content with well-organised professional life. It also provides professional experience and the acquisition of new practical skills. In the time perspective, volunteers may get an offer of permanent employment from the employer for whom they performed the entrusted tasks. Obtaining good references is opening the path to career and promotion.

4. Conclusion

In 1985 the United Nations designated 5th December the International Volunteer Day, thus emphasising the significance and importance of such a form of work. Marek Michalak, the Polish Ombudsman for Children, in his Letter to Volunteers wrote "Volunteers offer to us everything that cannot be bought even with the biggest money (...). Voluntary service is an excellent school of character. It enriches both parties - not only the one who takes advantage of help, but also the one who gives support. It teaches living in a team, among people and for people" (Letter of the Polish Ombudsman for Children, 2016). Voluntary service is not only unpaid, unselfish and gratuitous work for others, it is also responsibility for another person, a chance to get to know oneself, often in conflict and difficult situations, get to know one's skills but also weaknesses. It is a good thing if this process takes place at the stage of school because it will enable young people to plan their future better, make self-assessment, learn the motivation to work. Voluntary service eliminates stereotypes about disabled people, children with various dysfunctions, elderly and ill people, etc. "In a broader perspective, it contributes to solving key challenges which Poland and the European Union are facing now. It influences the development of social capital, it constitutes the basis for the creation of the aware civil society and contributes to building the European society and integration of culturally different European societies. However, the integrative function of voluntary service may go outside the borders of the European Union itself" (European Partnership for Volunteering, 2010).

Having finished secondary school, the youth must handle another task related to the choice of education paths or undertaking professional work. Such decisions may influence the whole life and therefore cannot be accidental.

Voluntary service helps understand the essence of work and its significance, appreciate the value of money earned in the future, it organises time of young people reasonably and usefully, influences the development of professional career, which is nowadays defined as "horseshoe-shaped career with career cycles (...) consisting in switching from one job to another every few years based on constantly extended skills and competences gained in the previous places of work" (Portfolio-indeks umiejętności wolontariackich, 2012). Voluntary service is the work raising people's competences and skills, which is particularly important to employers and employees. The labour market dynamics assumes that on a certain stage of career it will be necessary to requalify. For a person who already worked as a student, it should not be a problem. Voluntary activities shape the character of a man and an employee, organise time to him or her, prevent routine and passive leisure, motivate him/her to take up new challenges. Owing to it, a young man will enter the labour market better prepared, he will be more impervious to failure.

A Hungarian psychologist, Mihály Csíkszentmihályi, wrote: "If somebody has not set goals which give him the sense of own existence, if he does not fully use the potential of his mind, wellbeing fills only a fracture of the time given to him" (Porczyńska-Ciszewska, 2013). Having finished education, young people are on the threshold of adult life. It is important to use this time wisely and well, considering students' interests and predispositions. Voluntary service is an introduction to professional work, an invaluable lesson which sometimes cannot be repeated. It is important for the youth to take advantage of it because it will bring benefits to all interested parties.

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Learning and teaching challenges in the 21st century

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Abstract

This article tries to focuses the attention on the need to adapt the educational system to the challenges of the contemporary world, mainly on developing at students the emotional competencies of students, as an important factor for their success in professional life.

Keywords: higher university education, change, colaboration, creation, motivation, competency, Emotional Intelligence

“*Learning is not attained by chance,*
it must be sought for with
ardor and diligence.”
Abigail Adams (1780)

Today, according to Philip Kotler's phrase, "the world is going through a period of rapid and wrenching changes which are making the things become different. These deep mutations lead to significant changes in all areas, so that contemporary society, compared to the previous ones, is characterized by radical changes in all aspects of daily life: behaviour, education, family, production, etc. To exist in such a world, all the actors (economic agents, individual citizens, etc.) are expected to have a high degree of adaptability and courage.

In this study we will focus our attention on issues related to the adjustment of higher education to the contemporary demands.

As noted previously, the higher education system as the other components of the contemporary society are under the influence of deep changes as a result of the globalization process and of the technological revolution. As a result in the higher education system of the XXI century there are multiple trends that require some changes both in its content and organization. Certainly, they are part of progress. Technical innovations lead to change in technological processes, in the management of these processes and finally it leads to changes in training of specialists. It has always been like that, but the magnitude of changes at the end of the twentieth century needs radical changes in the education system, too.

Speaking about the need for change in the educational system, we mention that " for important and justified reasons, educational institutions are deeply and inherently conservative, especially the high school and the university. It is known that the introduction of changes in the university study programs almost always faces resistance in the academic environment. When Thomas Woodrow Wilson was President of the University of Princeton he said that "it's easier to move a cemetery than to change the curriculum." Namely, this phrase became an aphorism which expresses the main contradiction in the development of higher education system nowadays.

This does not mean that the university is a fortress where there is no place for changes. On the contrary, universities from all the times have tended toward the renewal of knowledge, proposing new areas of knowledge. But change is more acute today than ever before and this can be explained, in our view, by the following.

- *First*, there is an exponential increase in the quantity of information, which is a key factor that stimulates changes in higher education. This occurs so fast that the old methods and the education system itself can not cope. A simple increase in the amount of the knowledge acquired leads to a high increase in the teaching load, and this would have a negative impact on students’ health and, of course, the results can’t be the expected ones.

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- *Secondly*, in the Internet world the ways of transmitting knowledge are rapidly changing. Much of the information that should be taught at universities is available for free now. And we, those from the academic world continue to propose them information they do not need, or information they can get without wasting time and attend classes.
- *Third*, we find that a job can change rapidly and the technology may cause some skills to visibly lag behind.Today there are hundreds of new specific job applications which did not even exist five years ago, but the schools continue to prepare students for obsolete jobs and not for current requirements. And students who now begin to study at the university are taught how to handle the jobs today, not how to adapt to a continuously changing environment, not acquiring those skills that would help them get the jobs of the future - jobs that may not even exist now.

A recent study in the Department of Education (USA) shows the problems that companies face in finding and keeping people with a certain type of talent. It is estimated that 60% of all jobs of the XXI century will require skills that only 20% of current employees really have.

- *Fourth*, the university is not a simple actor in the society and in the process of globalization. On the contrary it is playing a central role representing the engine of the technologies (creating knowledge - research) and the technologies represent the engine of globalization. Thus the university has an active and direct impact on globalization, and it is also subject, like other actors, of the globalization effects. Consequently, the responsibility of the university today has increased significantly.
- *Fifth*, the students have changed quite a lot under the influence of many factors, such as the Internet, their international mobility, etc. In recent years, the international mobility of the students is rapidly evolvig as quantity and it is becoming more and more ample. According to UNESCO over the past three decades the students mobility increased by 300% and in 2025 it will register a flow of about 5 million young people. As a result of these changes, students became more independent and informed.
- *And finally*, today there is a fierce competition not only in the economic field but also in the educational one, competition that has already exceeded the boundaries of a state thanks to the liberalization of people movement, on one hand, and the significant increase in the number of universities in the world, on the other hand. Universities in different countries apply various methods for attracting foreign students (scholarships, loans to cover the tuition fees, the launch of many education projects, etc.).

Attracting as many foreign students as possible is becoming a national policy for many states in the world, and that is shown in a book published in France under the title: *Regards sur un XXI e siècle en mouvement*, where Simon Porcher and Benjamin Silverstone write: "the arrival of foreign students in our universities is a chance for French brilliance and for competitiveness of the country, that is why we must not give in to the UK and Canada, which are attracting more and more students. France must remain an attractive country for the best foreign students because **„many of them intend to stay in France to build wealth here"** (- emphasis added).

Certainly there are many other important factors that require radical changes in the higher education system. We don't intend to list all these factors, just the main of them in our view.

Thus, changes in higher education are inevitable. Today when universities, along with the other actors of economic and social life, are forced to adapt to new circumstances, it would be preferable to keep these adjustments in terms of Paradigm and content.

Indeed, Stephen R. Covey, the author of the bestseller "The 7 Habits of Highly Effective People", nominated after a study of the magazine "Chief Executive" as the most influential book of the twentieth century in business, says that "If we want to substantially improve our way of life, we should stop keeping our hands in pockets – concerning the attitudes and behavior – we should start working hard in a different way; in other words, to change our paradigms because our mentality and behaviour are born of them.

We can find that there is a paradigm shift in education. The new paradigm is based on the active use of modern teaching and learning methodologies, keeping, of course, some elements of the previous paradigm. Among the defining characteristics of this New Paradigm we would like to mention that it starts from a model based on the learning where the student is the main agent and the teacher is the guide in this process. In addition, the New Paradigm includes the use of the methods where the student is involved in the problem-solving process and practical work.

A special interest is directed towards the study of the educational culture practiced by some educational institutions, which is radically different from most high schools and universities in the following five aspects:

- *Individual Performance versus collaboration***.** Traditional education is focused on the individual to the detriment of the collective, while the company activity will become more and more collaborative.
- *Specialization versus multidisciplinary learning***.** Nowadays the problems are too complex to be solved using the specific academic tools of a single discipline.
- *Avoiding risks versus the process of attempts, errors and corrections.* In *Leadership Magazine*, J. Wallace Hamilton states: "People are training for success, when they should be training for failure. Failure is far more common than success, poverty is more prevalent than wealth, and disappointment is more normal than arrival. This is one of the main shortcomings in the educational system because there are few courses where students are really encouraged to take intellectual risks and where learning from failures is encouraged.

- *Consumption versus creation***.** Learning today is an extremely passive process. Students do nothing but listen to lectures, thus consuming the knowledge which they often perceive as disparate pieces of random information. Research studies on learning show that students understand and retain much more of what they learn if they have studied and applied knowledge in a context which involves applications. Thus, they go through the experience of being creators rather than consumers. In conclusion the key to success in the future is not about what we know, but if we are able to think and act creatively.
- *Extrinsic motivation versus intrinsic motivation: game, passion and purpose***.** Traditional academic courses are based on extrinsic incentives as a motivation for learning. You learn to get a good grade on the test and have a good overall average. Today the goal must be to strengthen the students intrinsic motivation to be in a continuous learning process, to be architects of their learning, of their careers, to turn their wishes into deeds.

These examples suggest possible ways of changing the educational system in general. Meanwhile, more and more specialists are wondering what kind of education can help children to succeed in today's modern society, that of information and innovation. In the speciality literature there are more and more various research concerning this problem, some of them even proposing concrete lists of necessary skills for future specialists. Tony Wagner, professor of pedagogy and expert at the Laboratory of Innovation at Harvard University, is trying to generalize a number of such lists based also on his own research and concludes that the key qualities of a successful innovator are the following:

- Curiosity, the habit of asking good questions and the desire to reach a deeper understanding;
- Collaboration, which begins by listening and learning from others who have completely different prospects and experiences;
- Associative or integrative thinking;
- A tendency towards action and experimentation.

Thus, we can note that emotional skills (*soft skills*) become more important than the practical ones (*hard skills*). Companies are looking for leadership, organizational, teamwork, listening and counseling skills. A similar result is got in the research conducted in the Department of Education (USA) mentioned above.

No wonder that recently, since 1995 when the American psychologist Daniel Goleman publishes a book simply titled „*Emotional Intelligence"*, which aroused a great interest and soon becomes a bestseller, an increasing attention is paid to emotional intelligence.

Before the publication of this book, the basic doctrine was that IQ is a genetic element that can not be changed by the life experience and the human destiny is largely determined by this skill. In other words, a high level of IQ provides success in people's life.

But according to some research of Howard Gardner and taken over by Daniel Goleman " at most, IQ contributes to only about 20 percent to the factors that determine success - leaving 80 percent to other forces. These forces make up what is called emotional intelligence. We thus conclude that the way we succeed in life is determined by both types of intelligence - not only the IQ is important but the emotional intelligence, too.

However, emotional education is still considered a mystical matter that few companies have tested and that only a few have managed to insert it into their organizational culture practices. At the same time, it is gratifying that emotional intelligence is gradually making a career in business. The fashionable slogan is: „IQ gets you hired, but EQ gets you promoted". Or, as stated by a project leader within an international company, "CEOs are hired for their intellect and experience in business and are dismissed due to lack of emotional intelligence.

We must be aware that the intellectual learning significantly differs from behavioral changes. That is why the ways of education should be absolutely different. If the *classroom* is the best place to acquire intellectual skills, then, in order to change the behavior, life represents the real arena of education. In addition, if intellectual skills can be learned and used in a short time, then the behaviour change requires extensive practice over a long period of time.

From the above we should not understand that social and emotional education in universities is inefficient because of the short learning period. Howard Gardner says that " it is easier to thwart gifted and creative youngsters than it is to encourage their flowering. By including in university curricula some disciplines that contribute to social and emotional education we would encourage young people to understand the need of change in behaviour.

The studies conducted by the psychologist James Prochaska of the University of Rhode Island on a sample of 30,000 people set four stages, people who managed to achieve a positive change of behavior go through:

Unconsciousness: they do not conceive the necessity and possibility of a change.

Reflection: in this stage people realize they must change and begin to think of a way, but do not act.

Preparatory stage: now people start to worry about finding solutions - ways to change for the better. They are mature to develop a detailed plan of action.

Action: there are visible changes of emotional patterns.

In our view, by including some disciplines in the university curricula in order to help educate social and emotional development of young people would mean offering essential help to Students / Master's Students in completing the first three stages mentioned above and in their preparation for the fourth step – *Action*, the one that we develop step-by-step throughout our lives.

We must not forget that the future belongs to emotional skills.

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