ABSTRACT

The concept of University Educator is complex and highly dynamic. This would imply on the one hand the scientific skills and expertise validated by research studies and published articles, in conjunction with the need for perpetual improvement; on the other hand, there can be no idea of educator without authentic mentoring vocation that creates emulation among students, ready to sacrifice on behalf of hard to quantify rewards and is only demonstrated on long term. Developing a solid foundation of research in industrial engineering, with the support of teaching foundation of industrial and occupational safety is a matter of great interest in contemporary society. And this could be achieved primarily through professional and human experience of teaching and research staff involved in this field.

The habilitation thesis is a summary of the author's concerns and scientific activities carried out during the subsequent period after asserting, in 1999, the doctoral thesis entitled "*Contributions to the study of controlled air recycle as a technique for ventilating underground working faces*" under the supervision of Prof. Ph.D.Eng. Ion MATEI. The habilitation thesis is focused mainly on those achievements proving the author's ability to lead scientific research in the field of *Industrial Engineering*, with applications in *Industrial Systems Safety* and *Occupational Safety and Health*.
For the purpose of the ideas set out above, the ***first chapter*** of the thesis is set as a preamble and presents the objectives and a summary of the most important results of post-doctoral work of the author, held since 1999 in the Department of Mining, Surveying and Civil Engineering (formerly the Mining Engineering and Industrial Safety Department).

Within my academic / educational activity I supported as tenured professor and coordinator the disciplines: "*Occupational safety and health*", "*Methods and techniques of occupational risk assessment*", "Risk management", "*Risk assessment in mining industry*", "*Elements of probability theory applied in industrial risk analysis* "(bachelor degree, master degree, postgraduate training and continuing professional development courses). I was coordinator of diploma projects (80 projects), M.Sc. dissertations (over 120) and official reviewer in 15 commissions for doctoral thesis public submission in the field of "*Industrial Engineering*" and "*Mines, oil and gas*." I set up and coordinate the program of undergraduate studies in "*Industrial Safety Engineering*" in the field of "*Industrial Engineering*" and the Master's Degree Program "*Occupational Health and Safety Management*".

During 2001-2006 I coordinated the Research Center "*Industrial Risk Assessment*", CNCSIS accredited center, as deputy - director and since 2014 I am the director of the Research Center "*Risk assessment in industry*" institutionally accredited by the University of Petroşani Senate Decision. In the 15 years of post-doctoral activity I have accumulated rich experience in the following areas of research: *Occupational Health and Safety*; *Risk Analysis and Assessment in Industry*; *Risk Management*; *Ventilation and Safety in Industry/Mining*. The first section, which is the most consistent one, of my habilitation thesis summarizes the main results which were published in journals that are in the mainstream scientific journals (Web of Science or other international databases).

Thus, ***Chapter 2*** is devoted to the most relevant contributions focused on the development, implementation and optimization of occupational risk analysis tools in the industry. Integrating human errors in industrial risk analysis is an ongoing challenge for experts and research purposes aimed at defining and the first research work was aimed at introducing the concept of *boundary situations tolerated in operation* and defining indicators that allow a comparison between the prescribed and actual work load of the human operator. The study of technical components and human error failure modes was completed by exploring ways to suppress or bypass safety measures,

to this end proposing an algorithm targeted for boundary situations tolerated in operation integration in the framework of industrial risk analysis processes [A1; A2].

Developing and operating a model of human reliability in specific dispatching activity was a natural continuation of our studies. Operator reliability model development as a linear function of additive factors of reliability was based on expert judgments method. The model developed was applied to estimate human reliability in case of operators working in the coal mines dispatch in normal operation case [A3; A4].

Aiming at determining causal chaining and combinations of events that can generate an undesirable event, Failure Tree Analysis is currently applied in areas such as aerospace, nuclear industry, chemical and petrochemical industries. To investigate the possibilities of extending the applicability of this tool in the study of industrial systems safety research has been devoted to the analysis of a water supply system of an industrial secondary system. Analysis of the results synthesized in the flowchart allowed the determination of critical roads and identify system's [A5; A6; A7].

Given the need for uniform and systematic approach to specific risks, in ***Chapter 3,*** entitled "***New methodologies for assessing and managing risks to health and safety at work***", we have developed a general framework for assessing the risk of explosion in gassy mines, based on quantifying the probability of occurrence and severity of the consequences, by analyzing the Root Cause Tree. The proposed methodology is based on knowledge and understanding of natural hazards, characteristics of combustible materials and engineering principles of thermodynamic processes [A8; A9; A10].

Applying the INCDPM Bucharest method of risk assessment in research contracts with various clients in the country, we have highlighted the limitations and disadvantages of this method, considering it as incomplete, unreliable, with an overly subjective character. From this perspective, we focused to identify the causes of anomalies and determining ways to improve the method so that these anomalies are corrected. Also we have identified the causes of these abnormalities and proposed remedies. The proposed solutions have been validated by means of practical applications [A12; A13].

We also investigated the relationship between different *conceptual categories of risk assessment methods* and *criteria for their selection,* to provide recommendations on how industrial establishments can choose appropriate techniques for a particular situation [A14; A15].

Numerous research studies have been launched and are being implemented to minimize the absence of knowledge about the effects of nanomaterials on health and safety of workers [A16]. To support the development of safe nanotechnologies, both in industry and research, we addressed the main strategic guidelines on hazard identification, assessment and management of risks from synthesis nanoparticles, providing a foundation for the development of good practices [A17; A18].

Based on a thorough analysis of the literature, we aimed to establish the development prerequisites, principles and structure of a psychosocial occupational risk assessment tool, adapted to the needs and circumstances of Romanian companies. The proposed methodology aims to provide proactive guidance for all stakeholders involved in the management of health and safety at work at national level [A33; A34].

Chapter 4 is a synopsis of the results obtained by our research team in ***quantifying the specific risks in industrial systems and optimization of intrinsic safety***. Results are systematized in terms of: quantification, mapping and reducing noise exposure of workers in *offshore* industry [A19; A20]; risk assessment and audit of health and safety in natural gas extraction industry [A21; A22; A23]; risk assessment induced by exhaust emissions of internal combustion engines [A24]; numerical simulation of auxiliary fan parameters in ventilation systems with controlled recirculation [A25]; transducer placement optimization in representative ventilation networks [A26; A27]

Chapter 5 includes a presentation of technical solutions thought to ***minimize the risks associated with the presence of methane*** in the mining industry. Worldwide, extensive research aimed at knowledge of the elements related to the occurrence and prevention of hazard caused by

methane, demonstrates that no price is too high to reward gains in controlling occupational safety level in underground environment. Contextual analysis of work accidents statistics in the last 3 decades in Jiu Valley collieries is particularly indicative of the risk associated with the formation of explosive mixtures while the means to prevent the methane accumulation have not the expected effectiveness [A28].

As a result, one of the priority research directions targeted the methane emission mechanism in stopes [A29], to establish a technical solution for directing methane from exploited spaces [A30]. Developing the methane drainage process before mining operations, safety engineers may obtain simultaneously at least three benefits: a new alternative fuel source by harnessing methane, a reduction of methane emissions as GHG and a reduction in costs of the ventilation process. Using computer simulations (*Computer Fluid Dynamic* software package *ANSYS Multiphysics Fluent*) our research highlighted the differences between the situations that include drainage process and where exploitation is unsafe in the absence of prior methane drainage of coal seams [A31; A32] .

The main issues in the calculation and interpretation of fire indexes are associated with measurement techniques used, related uncertainties, inadequate calculation equations, dilution with other gases in the underground environment. From this perspective, we studied the main problems related to measurement techniques and equations applied to determining the oxygen deficiency. Research has highlighted the limitations and implications associated to this synergistic risk, generating undesirable events with severe consequences [A11].

The second part of the thesis comprises a set of principles and concrete elements that compose my personal development plan academic and scientific and bibliographic references, grouped into specific categories. So, professionally I have as main goal supervision of doctoral thesis in *Industrial Engineering*, involvement and participation in the accreditation and strengthening of this PhD area at the University of Petroşani.

Also I will maintain in forefront the national level development in the field of Industrial Safety Engineering by initiating and consolidating a dynamic consortium including universities and research institutes in the field, and involving the creation of an international network.

In the third part of habilitation thesis references associated with the first two sections are included, on specific categories.

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