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DOCTORAL THESIS

(ABSTRACT)

CREATING AN INFORMATIC CONCEPT FOR THE MANAGEMENT OF THE UNDERGROUND TOPOGRAPHIC ACTIVITY

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The main objective of the thesis is the creating an informatic concept about the management and application of geodesic and topographic data and methods for their use in underground mining activities and the technologies needed to achieve this goal.

The achievement of this main objective involves the pursuit of **specific objectives**, which I have considered during the thesis:

- synthesized presentation of the stage of knowledge and the history of the researches, of the fundamental concepts, notions, geodesic and topographic methods and formulas, used in the analysis of the underground mining;
- contributions to the development of geological reserve assessment documentation, as well as to the annual and quarterly assessment of open and prepared reserves;
- contributions to the preparation of general annual and quarterly exploitation programs;
- design of mining works for opening, preparation and exploitation;
- preparation of heritage assessment documentation as well as the purchase of new land;
- conducting studies on the behavior of buildings during constructions, deformations and displacements of the terrestrial surface under the influence of the underground exploitation, as well as the mining pressure;
- designing, preserving and developing topo-geodesic support networks, at surface and underground.

The novelty elements of the thesis are included in the chapters 5 and 6, dedicated to the actual studies (modalities, developed programs, used programs, different methods and applications used) of geodesic and topographic data and consist of:

- implementing and interpreting various vector, raster, etc. formats to process analytical data for obtaining drawings that can be viewed on the screen of the monitor, written on paper and also stored in memory, so that they can be accessed at any time for consultation and especially for updating;

- digitization of underground mining and inclusion of results in geodesic and topographic data files, depending on coordinates and depths;

- the elaboration of calculation procedures and their use in numerical applications regarding the calculation of the analytical expressions of mining areas etc.

Abstract:

This research area has seen tremendous progress, especially over the past 15 years: monitoring campaigns benefit from state-of-the-art technological support, data processing tools that are able to process a considerable amount of geodesic and topographic data.

However, there are still important issues that require special attention from researchers: for example, the parameters estimation techniques; wider applicability and transferability of field data in the form of graphical representations in digital format.

In the context of the above presented, it was necessary to analyze the place and the role of the topography in the management of the mining activities, as well as the structure of the mining topography activities, in which were highlighted the surface and ground topographic works, the data processing, updating and exploiting databases.

Combining the theoretical information, which was indispensable in the realization of this study, with the technological evolution of the measuring equipment and the computing systems, led to the accomplishment of this study on the underground mining activity through certain Geographic Information Systems, but not only.

The present study, entitled "Creating an Informatic Concept for the Management of the Underground Topographic Activity", is the result of the scientific concerns of the undersigned, between 2015 and 2019, as a doctoral student of the Doctoral School at the University of Petroșani, having as objective analysis and implementation of certain Geographic Information Systems (GIS) in support of mining management through geodesic, topographic, geological etc. information on mining activity in the Petroșani coal basin, focusing on the Paroșeni mine.

This involved a high level of documentation on topographic, geodesic, GIS etc. technologies, used in underground mining, subsequently materialized by presenting news from field of topography and geodesy, as well as presenting the advantages and disadvantages of using them.

In the framework of the scientific research activity occasioned by the present work, in parallel with the process of assimilation of information, analysis and synthesis, a series of ideas emerged that ultimately led to a series of personal contributions of the author, of which only a few are mentioned:

- defining the overall concept of the mining topography computer system;
- identifying and classifying the issues related to the overall concept;
- theoretical substantiation, description of procedures and establishment of the structure of mining, analytical and graphical databases for the component problems of the overall concept;

- defining the concepts of a hazard map and a mining subsistence risk map for underground mining areas, in line with international rules for establishing hazard and risk maps at natural risk factors;
- establishing the data set for underground mining activities, necessary for the investigation of the mining phenomenon, identifying the sources and establishing the procedures for obtaining, updating and archiving;
- definition of digital 3D modeling procedures of the terrestrial surface in mining areas, in a timeline that including the underground exploitation period;
- establishing the methods for updating 3D terrestrial surface models after each subsidence monitoring session, correlated with the results of this monitoring;
- defining procedures for the 3D digital modeling of the exploited surfaces and determining the remaining gaps after the operation;
- determination of the 3D models of the underground mining assembly for its delivery, together with the analysis tools, of the mining subsidence specialists.

The mining topography information system, as part of the enterprise information system, has three main roles:

- to ensure the collection, organization, processing and archiving of data from land observations related to the terrestrial surface, the building mining and the underground mining, as well as the geometric and space elements of the deposit;
- to produce the information needed to substantiate the management decisions of the mining activities, in the form of charts, diagrams, reports, plans, detailed drawings etc.;
- to provide the necessary technical assistance for the implementation of the projects.

After the general presentation and then on components of the underground topography information system, research was focused on how this information system can produce, periodically update and provide the data needed to research a phenomenon that has a strong impact on the living environment and activities urban development of the area: mining subsidence.

During the doctoral research program, I participated in national and international conferences on land measurements that resulted in a total of six scientific papers published as author and co-author and three scientific research reports.

Throughout this research, the importance of a rigorous documentation, in a precise timeline, of all underground mining activities, regardless of their nature, has clearly been outlined. This documentation must be done in accordance with the four principles mentioned in §2.2: unity, continuity, operability and compatibility.

The importance of mining information is obvious if we take into account that they accumulate three essential attributes:

- are components of the national geological fund, a component part of the national patrimony;
- are necessary information for the design, programming, management and execution of mining activities;
- are necessary information to substantiate regional and urban development plans, even after mining activities cease.

From this prism we consider that it is very necessary to design and institutionalize a unitary analogue digital transfer system in digital format, archive in analog and digital format, the mining operator hand over to all the existing mining topographic documentation . It is then necessary to verify, evaluate and categorize this documentation and create a mining database for each mining and mineral resource perimeter. It is also very important to institutionalize a system for disseminating the information necessary for the landscaping and urban planning activities, in compliance with the legislation in the field of protected information.

Any delay in making decisions in this regard may cause the loss of valuable information acquired during mining activities over the last hundred years.

The innovative aspect of the thesis is indisputable, the present thesis enlightening in the latest trends, internationally, in the field of mining underground but also with applicability in the contemporary engineering practice.

The main contributions, along with an analysis of the literature on mining topography, are presented along 8 chapters, plus an additional section: conclusions and personal contributions. The quoted references are listed at the end of the thesis, together with terrestrial surface the specialized bibliography. The results obtained in terrestrial surface tis thesis, together with other results related to the use of information management techniques, were presented in 6 articles and 3 scientific research reports, also listed in the thesis.