Chapter 3
Application of Multi-Criteria Decision-Making Methods for the Underground Mining Method Selection

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ABSTRACT

In mining, there are many complex problems that need to be solved in a limited period of time. When solving these complex tasks, it is necessary to take into account many parameters, all in order to determine the optimal solution for a given problem. The application of multi-criteria decision-making methods (MCDM) is very widely used to solve such complex problems. One of the most complex problems in mining is the underground mining method selection. In order to choose the most appropriate method of mining excavation, it is necessary to take into account a large number of influential parameters according to which we will compare mining methods. This paper will discuss the problem of underground mining method selection using the EDAS method. Also, a comparison of the obtained results will be made for a specific example, when applying several methods for multi-criteria decision-making. After comparing the obtained results, the most suitable mining method for a specific example will be determined.

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INTRODUCTION

With the rapid development of industry in developed and underdeveloped countries, as well as the general increase in living standards, there is an increasing demand for various mineral raw materials, especially for metals and non-metals, as well as for other useful raw materials that represent the basic industry. The increasing demand for useful mineral resources encourages their exploration and the opening of many mines in the world. Apart from the above, the growing environmental awareness of humanity and the impending collapse of the planet Earth are strongly in favor of underground exploitation. Therefore, it can rightly be said that good times are yet to come for the underground exploitation of useful mineral raw materials.

The mining is such an area where many complex problems are encountered that require a solution in a relatively short time. When solving tasks, it is necessary to take into account as many influential parameters as possible, all so that the obtained solution is the most adequate. One of such complex problems is the underground mining method selection. The correct choice of mining method for a specific ore deposit is of great importance, because it has a direct impact on the total costs for the operation of the mine itself.

The mining method selection and the preparation of the stope consists of a series of procedures, the application of which solves the problem. The selection and dimensioning of the stope structure consists in fully harmonizing the dimensions of the stope with the selected equipment, with a constant analysis of its stability, which implies the selection and dimensioning of the support structure as needed. In the case of caving mining methods, it is necessary to make a forecast of the impact of the hanging wall and the terrain surface. At the end, a cost and risk analysis is performed for all solutions, i.e. is. economic assessment of effects as an authoritative criterion for choosing the optimal variant.

Empirical and numerical methods are used in the engineering part to solve the problem of massif management, which includes stability analysis, selection and dimensioning of the support and prediction of the impact of stope on the surrounding massif and the surface. Empirical methods are represented by rock mass classifications, and numerical methods are represented by the finite element method as the most frequently applied and most powerful method for rock mass modeling and simulation of geomechanical processes in the massif.

The selection and design of the excavation method are the most problematic and complex procedure, which is the ultimate skill of mining engineering. To make this decision, it is necessary to have the most reliable data about the ore deposit. Therefore, when solving the problem of underground mining method selection, it is necessary to take into account several influential parameters. Some of the influencing parameters can be calculated or measured (quantitative), while some parameters cannot be calculated or measured (qualitative). The qualitative parameters are defined by descriptive ratings, and then they need to be transformed into numerical values so that they can be used for calculation.

The parameters that influence the underground mining method selection can be divided into three groups: mining - geological, mining - technical and economic parameters (Bogdanovic et al., 2012). Below are the most important parameters for each of the groups:

- mining and geological parameters, such as: geometry of deposit (depth below surface, general shape, plunge, ore thickness), rock mechanics characteristics (ore zone, footwall and hangingwall, i.e. rock substance strength, fracture shear strength, fracture spacing, structures, stability, stress), ore variability (grade distribution, ore uniformity, ore boundaries), quality of resource, etc.