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A Guideline for DSS System for Underground Mining Method Selection

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ABSTRACT: Underground mining method selection is an important planning phase which affects project costs. In this phase, there is a need to deal with multiple criteria related to mining method selection and decision makers have some difficulties to reach the right decision in the multiple criteria environment. In this paper, a decision support system for underground mining method selection has been designed to lake into account all problem criteria in a scientific base, to research all effects of different scenarios related to the determined criteria and to carry out all necessary sensitive analysis. To produce an acceptable solution alternatives have provided by using Analytic Hierarchy Process (AHP), which is one of the multiple criteria decision-making methods.

I INTRODUCTION

Optimal underground mining method should be primarily selected to make use of underground resources optimally. The basic priorities are performing underground working safely, rising productivity and eliminating production costs and losses. Besides, controlling works on the mining centers, making ventilation be easy, decreasing repairing and maintaining costs of gallery, making mining panels be ready and making underground works be with a good time study and in a good order are also direct related to the selection of underground mining method. Because of those factois, underground mining method selection process is extremely important.

All available criteria should be analyzed carefully for selection of optimal underground mining method. In the method selection process, many factors are available. Some of them are controllable but some of them are not. Known conventional methods may generally be inefficient to reach the optimal choice. Once one method is selected, it is nearly impossible to change that method because of rising costs and mining losses.

in the last two decades. Analytic Hierarchy Process (AHP) has been frequently used for helping to solve the problems in multiple criteria environment and also used in selection of underground mining method. In this paper, a decision support system (DSS) is designed to help the decision makers who have to solve underground mining method selection problem that is one of the multiple criteria decision making problem. To produce a solution, the DSS uses AHP.

2 ANALYTIC HIERARCHY PROCESS

Analytic hierarchy process (AHP) is a framework of logic and problem-solving that spans the spectrum from the instant awareness to fully integrated consciousness by organizing perceptions, feelings, judgments and memories into a hierarchy of forces that influence decision results. The AHP is based on the innate human ability to use information and experience to estimate relative magnitudes through paired comparisons. These comparisons are used to construct ratio scales on a variety of dimensions both tangible and intangible. Arranging these dimensions in a hierarchic or network structure allows a systematic procedure to organize our basic reasoning and intuition by breaking down a problem into its smaller constituent parts. The AHP thus leads from simple pairwise comparison judgments to the priorities in the hierarchy (Saaty 2000).

3 THE DECISION SUPPORT SYSTEM FOR UNDERGROUND MINING METHOD SELECTION

Designed decision support system (DSS) includes three subsystems; Database Management Subsystem, Model Management Subsystem and Dialog Subsystem. Database management subsystem is responsible for managing a database in which the data concerning with all technical and processing criteria to be used for selection of underground mining method is stored. Model management subsystem which has an interaction with the database management subsystem provides a decision maker an opportunity to evaluate all available solutions alternatives with the help of Analytic Hierarchy Process (AHP) which is one of the methods foi making a decision in a multiple criteria environment, according to the user inputs. Dialog subsystem is the last component of the DSS and includes a user interface which provides an interaction with the decision maker in the decision making process. Before the details of the subsystems of the DSS , underground mining methods and related decision factors will be primarily examined. Basic decision factors related to method selection process are given below.

The basic factors affecting the selection of underground mining method (Saltoglu. 1979):

- The shape of the orebody and wall rock condition,
- Mineral dissemination,
- The distribution of the high grade portions within orebody,
- The mineral and chemical composition of ore,
- The physical properties of the orebody and wall rock,
- Extraction depth,
- The roof wall condition,
- The subsidence,
- The inclination angle in the vein type deposits,
- The thickness of the orebody,
- Market price of the ore,
- The presence ol the methane,
- Orebody condition.

The most important factor affecting mining method selection among these factors is the shape of the orebody. The mining methods that can be used in the tabular type orebodies is given below;

- Advance longwall with caving,
- Advance longwall with backfill,
- Retreat longwall with caving,
- Retreat longwall with backfill,
- Room and pillar with caving,
- Room and pillar with backfill,
- Rill stopes,
- Robbing-caving,
- Top slicing,
- Slicing caving,
- Shortwall.

The mining methods can be used in the massive or irregular type orebodies are given below;

- Shrinkage stoping,
- Cut and fill,
- Square-set stoping,
- Underhand open stoping,
- Pillar caving,
- Pillar mining with filling,
- Top slicing,
- Sub-level caving,
- Breast stoping,
- Room and pillar,
- Chamber mining,
- Sub-level stoping,
- Underground bore hole,
- Mitchell slicing,
- Block mining with square-sets,
- Block caving.

The basic factors concerning the underground mining method selection can be classified, depending on the field condition and geomechamcal properties of the orebody and wall rock. These factors can also be classifed as environmental and economical factors. In this classification, decision factors are defined as (Karadoğan, et al.. 2001);

1. Geometrical shape of the orebody,
2. Vein thickness,
3. Vein inclination,
4. Extraction depth,
5. Physical properties of the orebody and wall rock,
6. Strength of the orebody,
7. The condition of the orebody and wall rock contact,
8. The strength of the roofwall,
9. The strength of the footwall,
10. The subsidence effect,
11. Mineral dissemination,
12. The distribution of the high grade portions within orebody,
13. The mineral and chemical composition of ore
14. Support requirements,
15. Market price of the ore,
16. The chemical properties of the orebody and wall rock,
17. Hydrological conditions,
18. Capital cost,
19. Operating cost.

3 I. Database Management Subsystem

The most important component of database management subsystem is the database in which the data related to different mining methods and decision factors which are classified under 19 entries, is stored. Those factors should be paid attention by the decision makers in the decision process of method selection. Database management subsystem is responsible for managing the database.

3 2. Model Management Subsystem

Model management subsystem with the interaction of database management subsystem, provides the decision makers a help to evaluate different underground mining methods according to the inputs of the decision makers by dialog subsystem. To pei form this task, model management subsystem uses AHP. All pairwise comparisons related to 19 decision factors is primarily performed and all available mining methods are ranked in AHP. This rank is only decision proposal for a decision maker but not a decision. The DSS only guides to the decision makers to make a decision easily and is not a replacement of a decision maker.

3.3. Dialog Subsystem

Dialog subsystem is also named user interface is an application interface to the decision makers can interact with the DSS for providing inputs and outputs and performing necessary tasks in the underground mining method selection process. This user interface should be helpful and useful for pei forming the process for decision makers when one decision makers is unavailable. By using dialog subsystem, it is possible to interact with database management subsystem and model management subsystem and to produce most suitable underground mining method subject to 19 decision factors.

4 RESULTS

In this paper, a decision support system for underground mining method selection has been designed to eliminate the difficulties in taking into consideration the decision factors in the method selection process and to guide the decision maker to select the optimal underground mining method. This decision support system uses analytic hierarchy process which is one of the methods to make a decision in a multiple criteria environment. With the DSS, other decision makers when one decision maker is unavailable, can now evaluate the underground mining method selection problem according to the 19 decision factors and derive a solution subject to the shape of the orebody

REFERENCES

Karadoğaıv A . Basketin. A , Kahnman. A ve Gorgun, S 2(101. *Bulanık Kmıue Teorisinin Yeraltı Uıetım Yöntemi Seçiminde Kullanılabilirliği.* Tuıkıye 17. Madencilik Kongresi ve Sergisi, ss. 95-102

Kose, H . *Madenlerde Yeraltı Üretim Yöntemleri,* 1988. izmir. Dokuz Eylül Üniversitesi Muhendıslık-Mımarlık Fakültesi Yavmları

Sıiaty. T. L. hundamentals of Decision Making and Pıoıuıy Theory Willi The Analytic Hierarchy Piocess. 2000. RWS Publications

Saltoglu, S, Madenlerde Yeraltı Üretim Yöntemleri. 1979. istanbul, istanbul Teknik Üniversitesi Yayınları

Tuıhan. E. *Detıuoıı Suppoıt ami Expert System.* 1990. 2th Edn. Macmıllan Publishing Company