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DEVELOPMENT OF MINING INFORMATION SYSTEM (MIS) IN EGYPT: COMPUTER AIDED

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Abstract

The fast growth of computer applications has imposed a challenge on mining research in Egypt to modernize the mining industry. Many Egyptian mines, companies, and authorities have started to use computer software's or developed their own ones to determine the ore reserves, to plan, develop, and to manage their mining projects. However, there is a lack of information required for research workers and investors to carry out effectively the aimed development.

The main objective of this paper is to design a suitable database for Egyptian mines and quarries. Such database would involve not only the names of mines, locations, current mining operations, machines, economics and environmental issues associated with mining, but also extend to be a system provided by geological maps, simple methods for preliminary calculations of the main mining operations through the Internet for investors and researchers.

The main problem is to gather both the attributes and maps in one database or system. Alike the Geographic Information System (GIS), this paper aims to use Oracle 9.0.0 database to develop a Mining Information System (MIS). Hence, the necessary information could be stored, retrieved and updated easily in an accurate and fast manner (Burrough, 1986).

The paper introduces a framework for building the first Egyptian mining database using El Maghara coal mine, located in Northern Sinai as the first record. The study focuses on overcoming the problems dealing with these special data in a sense of retrieving and interfacing.

It is believed that the developed MIS will be a useful tool for a new era of mining industry in Egypt.

Keywords: Mining Information System, Database, Environmental Issues, GIS, El Maghara Coal Mine

1. INTRODUCTION

Mining information data, whatever, samples, metal content, chemical analysis, topography, co-ordinates (XYZ), geological maps, machines, mining methods, development operations, personals, etc., need an efficient system to combine, access, manipulate, and update the information in a format that is easily accessible and readily communicated to the authorisations, researchers and investors.

The mining management industries have a number of special requirements for development and updating this sector. The fast growth of the computer applications in general and the availability of advanced database system in particular have encouraged the authors to design a special mining database that provide accurate information to support the decision makers in planning and deciding the suitable locations of mining, storage, building societies, selection of transportation paths, and many others.

The data and information needed for such database differ in type, size and nature. The mining data includes the geological maps, sampling points, chemical analysis of the ore or metal contents, the mining method, machines, drilling, blasting, supporting, ventilation, development schemes, economic consideration, etc. These differ from the maps of the residential areas; administration zones, transportation maps, and both are different if compared with the sensitivity thematic maps for environmental hazards and climate variations.

This paper focuses on designing an information system for the Egyptian mines and quarries. The data used throughout this work are related in a way or another to the mining sector. The data and information are considered as spatio-temporal data.

Collecting the required data is one task, however, the main task is to put together the different types of data in one pool and maximise the benefit of data manipulation and interrelation between the different sets of data.

2. Mining Information System

The mining information system (MIS) may be defined as a database system that involves information and data about mining sites in a way that the data can be retrieved, updated and manipulated easily to produce useful information.

As a first step, a review of existing database management systems was conducted revealing the strength and weakness of the commercially available systems as well as the specific requirements of the aimed MIS. The initial work started with listing and categorising the data and information to build the database. The main MIS specifications were decided as being a user friendly; windows based system that should also handle import/export information to existing database program and summarise/report the data in graph and table forms. The two most important requirements are:

* Initiating a frame for suitable database for all the mines with an easy way of mines communication,
* Exporting the data and information in appropriate format for the end user.

Among several available database software's Oracle 9.0.0 software (ORACLE, 2001) was identified as the appropriate environment for the database development and the mining information of El Maghara coal mine, Sinai, Egypt, were used as guidelines.

Figure (1) illustrates a block diagram for the proposed Mining Information System (MIS). The system requires a certain type of information whether in digital format or as attributes about definite locations. The block diagram explains how the database has connected to the Internet via the network diagram at the upper right corner of the figure. The software would have the ability of combining several calculations programs to execute specific tasks as shown in the downright corner of Figure (1). The following types of data were used to form the database tables that hold information about each recorded mine or quarry.

2.1 Geology

Geological maps (hard copies, or digital format), structural geology, sampling boreholes, topographic maps, historical background, petrography …etc.

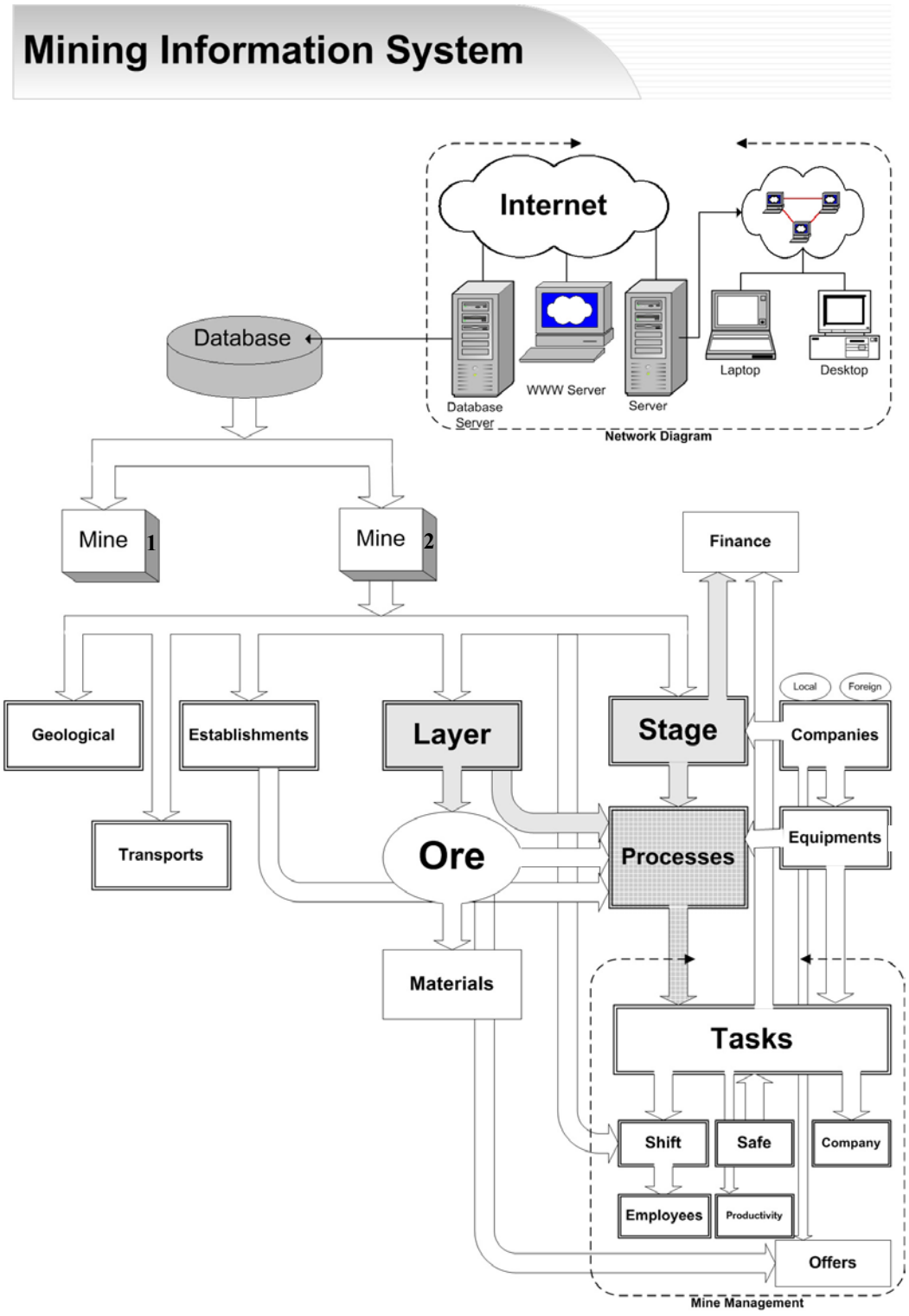

Figure 1: A block diagram for the proposed Mining Information System (MIS).

2.2 Ore reserves

Determination of overburden and estimation of ore reserves, study and monitoring the distribution of the metal content using advanced techniques such as Geostatistics (Issak and Srivastava, 1989) and computer software are included.

2.3 Mining method

A full description of the selected mining method (Room and Pillar, Longwall, etc) at the area has to be provided with the necessary plans and development schemes. In addition, the following information must be given.

2.3.1 Drilling

- A list of all drilling machines.
- A sketch of the drilling pattern to show depth, spacing, and direction of all holes and order of firing.

2.3.2 Blasting

- Explosives: types, strength, cartridge size, etc.
- Fuses; types, lengths, connecting pattern, ignition method.

2.3.3 Loading

- Shovels: types, size, power supply, rated output per hour or per shift, mobility number of men to operate, etc. and auxiliary equipment used, if any.

2.3.4 Haulage

- Truck types: sizes, power, transmission, how dumped.
- Car types or shop made: sizes, gauge, weight, type of wheel bearings, and dumping mechanism.
- Motors or locomotives types: power, size, gauge, weight, how serviced, etc.

2.4 Beneficiation

- Type of process used (such as crushing and screening, etc).
- Reasons for beneficiating the mine product.
- Beneficiation data:
    - Grade of mill feed
    - Concentration ratio
    - Tons per day of feed
- Tons per day of concentrate:
    - Analysis of feed
    - Analysis of concentrate
    - Analysis of tailing sketch
- Flow sheet – sketch to show size distribution and treatment.

2.4.1 Rock mechanics

- Physical properties of rock type and overburden.
- Mechanical properties of the ore bed/seam and surrounding rocks.
- Anisotropy.
- Dynamic tensile strength of rock.
- Supporting system.
- Design of the opening and roofs.

2.4.2 Mine ventilation

- Fans.
- Air distribution maps.
- Mine dust, if any.
- Mine gasses.

2.7 Groundwater

Quantity and quality of groundwater if existing in the mining area and methods of treatment.

2.8 Environmental pollution

- Soil contamination.
- Water contamination.
- Air pollution.
- Noise.

2.9 Production

- Date of first production.
- Present production rate (ton/year).
- Total output to date.
- Expected future production rate.
- Grade of ore produced from mine.
- Grade of product shipped.
- To whom is the product shipped.
- Market price of product per ton.

2.10 Costs

- Wages: wage rates per hour or per day for miners, technicians, and truck drivers, shovel runners, shot firers, other skilled and unskilled labour.
- Unit costs for partial operation, such as blasting, loading, haulage, hoisting, beneficiation, engineering, etc.
- Equipment cost per unit delivered at mine for new or second-hand items- specifies delivery point and class of equipment.

2.11 Personnel

- Organization chart, if available.
- Number and titles of management staff and miners.
- Number of administrative and office personnel.
- Number in shops and warehouse.

2.12 Marketing

Local and international places to sale the ore.

2.13 Training program

A full record of the annual training program for the staff, workers, and others is required.

2.14 Other activities

3. THE CASE OF EL MAGHARA COAL MINE

In addition to the data used to determine the ore reserves at El Maghara area and the calculations of the grades for the different chemical variables, other information for building the aimed (MIS) are collected and used.

3.1. Examples of input data and information

3.1.1. Mining method and reserve estimation

The coal seam at El Maghara mine is mined using the longwall method, while the reserves were re-estimated using a new software program for **O**re **R**eserve **E**stimation (**O.R.E**). This software has been introduced for the first time by El Tahlawi *at al.* 2004, which is based on the triangular method. Figure (2) shows a capture of the running software.

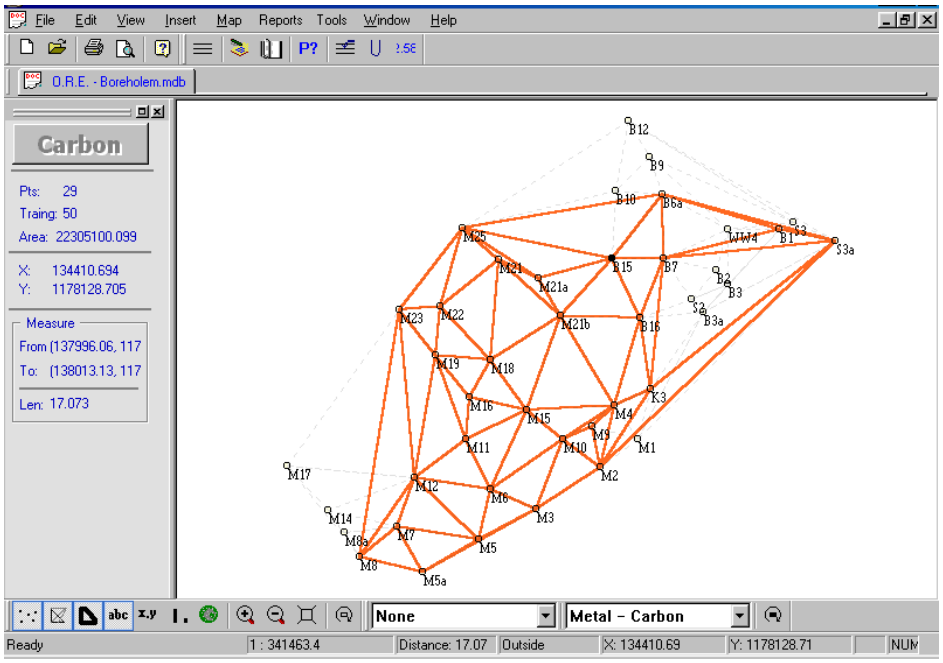

Figure 2: A capture showing the triangulation net for estimating ore reserves using O.R.E.

3.1.2. Machinery

Thirteen different types of equipment have been imported for the El Maghara coal mine. All can be added with their specifications, working conditions, etc, to the MIS. The following are examples of these equipment.

- Tunnel drilling equipment;
- Underground conveyor belts;
- Water purifying units;
- Loaders, bulldozers and general mining equipment;
- Coal preparation and washing unit;

4. RESULTS AND DISCUSSION

Figures (3 and 4) show a capture of several windows taken from the designed Oracle database to build the (MIS). One can note that there is only one record, El Maghara coal mine, Sinai. Other types of information such as the attributes and geological maps are being prepared to complete the task.

Figure 3: A capture of the front window of the MIS.

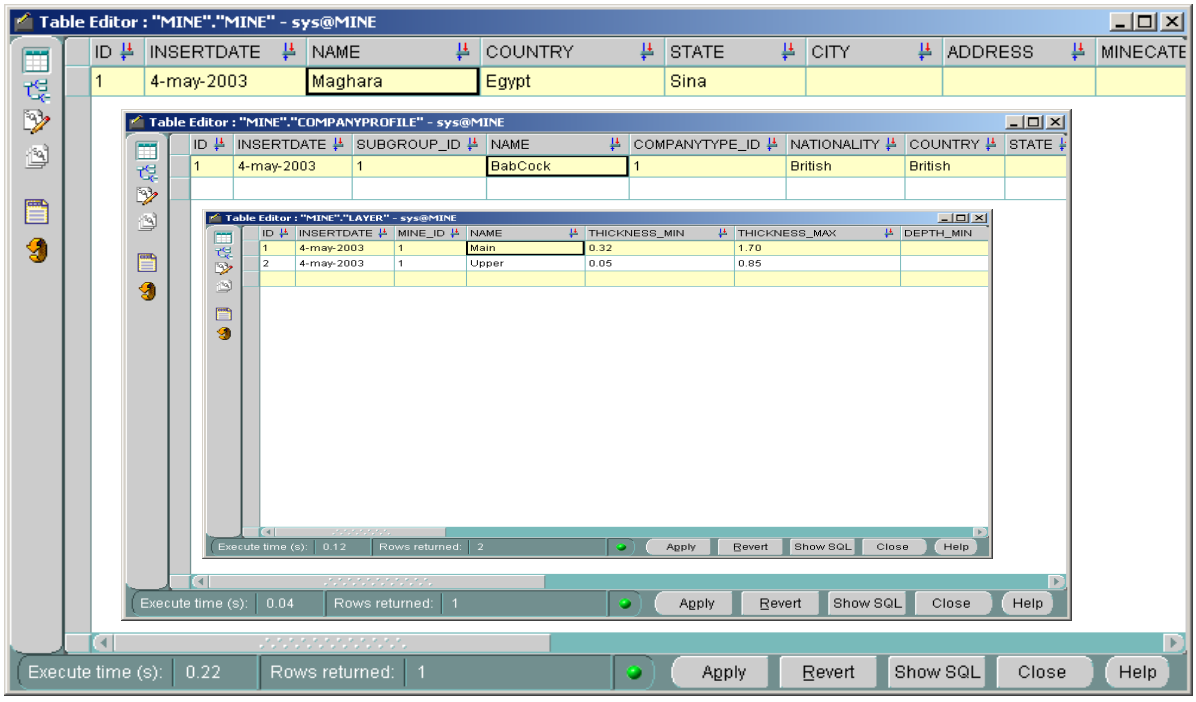

Figure 4: Preliminary database design for MIS using information from El Maghara coal mine.

Upon the complete of the aimed database or MIS, not only the data can be retrieved or updated but also the designed system has integrated with O.R.E for the estimation of the ore reserves and generating contour maps and 3D representation of several variables. Appropriate codes were written and compiled using C++ programming (David, 1999) on PC Windows 98 environment in order to conciliate the integration of the O.R.E outputs in the database.

The X and Y coordinates of sampling points as well as the coordinate system covering the study area can be used to carry out different visibility studies for new zones or selection of the best ways to construct new roads. Figures (5 and 6) show the contour map of Carbon% at the main coal seam at El Maghara mine. Not to mention, the changes in the metal content or application in any different case unlikely be a problem.

Environmental sensitivity maps for air pollution, water contamination and noise levels can be generated and introduced upon request at any stage provided that the data are available and the calculating procedure is justified.

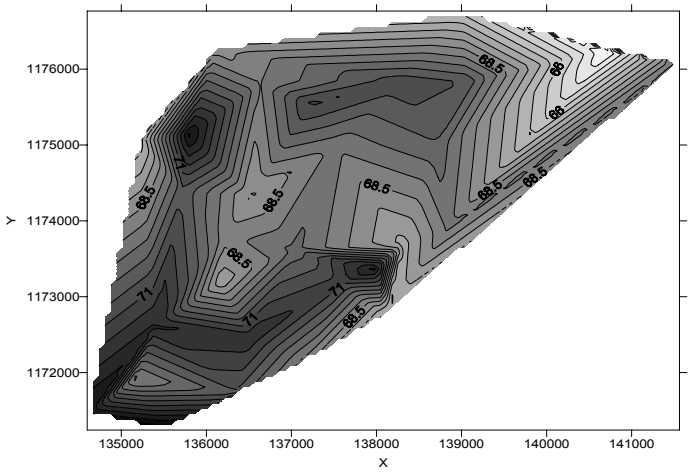

Figure 5: Contour map for Carbon%, using the Triangular method (Plot using Surfer 7).

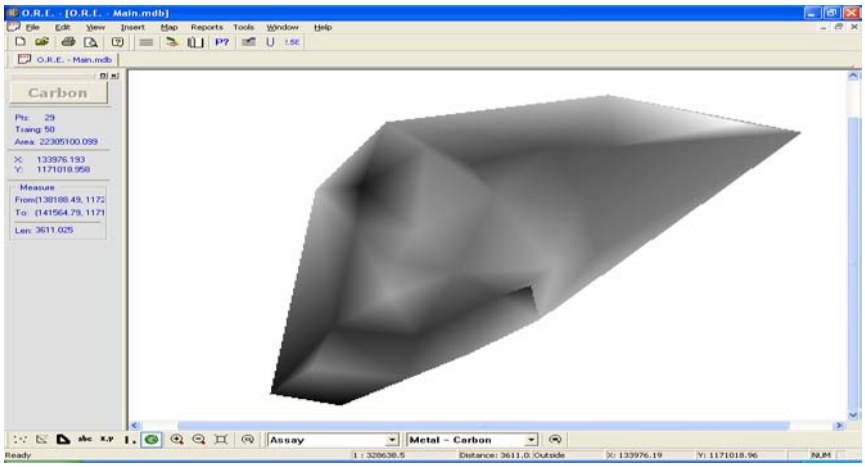

Figure 6: Contour map for Carbon%, using the Triangular method (Plot using O.R.E).

5. CONCLUSIONS

The paper introduced an outline of designing a database for the Egyptian Mines, where the available information of El Maghara Coal Mine was used as the first input record. Other information that is important and required for the aimed database have been determined and listed.

A questionnaire has to be designed and sent to the Egyptian authorities and mining companies to prepare and provide the required information so that a complete database can be created (Mining Information System for Egyptian Mines). It is planned that the MIS structure will be modified according the feedback and needs of different mines.

With the designed system one can easily find the answers for several questions such as: where are all the phosphate mines in Egypt? Also, compare the grade, price, mining method, equipment, etc between several mines at the same time. Researches and investors will find such system a useful tool spatially when it becomes available on a public domain such as the Internet.

6. ACKNOWLEDGEMENTS

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