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Study on application of geographic information system (GIS) for management of minerals exploration and extraction

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Abstract

The information technology (IT) has been developed greatly in recent years. Most of the types of information including sound and images are now can be digitised, stored, analysed and distributed to numerous application purposes. The exploration and extraction of mineral resources have always faced with the efficient management and processing of huge mining data which need to be updated regularly. Recently, the application of advanced IT into mining operations has significantly required. This paper develops a solution for the improved management of the mining database based on the application of Geographic Information System (GIS). The new solution not only supports the governmental departments in approving and governing the mining activities but also provides the domestic companies an easy-to-use tool for mining design.

Keywords: GIS, Management of Minerals.

1. Introduction

It is reported that to the end of the year 2013, there were approximately 3000 companies and individuals from all economic backgrounds participating in the mining exploration and extraction with 4.320 licenses approved by the Vietnamese central and local governments. The number of mining leases approved by the Ministry of Natural Resources and Environment (MONRE) is 559 including 64 areas for exploration and 495 areas for extraction over 51 provinces in Vietnam [1]. To improve the management task, the advanced information technologies (IT) have been equipped for the government officials such as computers and training courses. The laptop connecting to mobile server has been also provided for the requirement of distance-based business. However, the management of these licenses, in general, has been in difficulty and complexity. The application of IT to manage the mining data is mostly implemented manually. The database are stored and extracted unsystematically and incoherently. The improvement of IT application for mining activities, therefore, is the inevitable process that would greatly improve the store and search ability as well as the processing time for the authorisation of mining projects.

2. Development of database

A set of input parameters required for the database development are proposed based on the Mineral Laws promulgated by the MONRE. There are two major groups of information that listed in Table 1 and Table 2.

Table 1. General information

General information	
Overall site information	Name of site
	Type of mineral
	Location of site
	Area of site
	Coordinates of site
	Investor/company
	Contact of investor
	Operational situation
	Plan for exploration
	Plan for provisional prohibition/prohibition
Plan for auction/non-auction	
Exploration and reserves approval	Policy for exploration projects from government
	Exploration license
	Document for approved reserves
	Reserves information
Supplement information	Certification document on investment of company
	Certification document on business registration of company
	Verification document on economic-technical investment report and mineral processing report
	Approval document on economical-technical investment report and mineral processing report
Products of mining	Types of products
	Codes of products
Mining design, plan and superintendent	Number of extraction license
	Design files
	Announcement on superintendent
	Plan for extraction

Table 2. Management information

Management information	
Procedure regarding land	Approved document on mining lease
	Term of lease
	Compensation and resettlement
	Charge for land lease
Protection of environment	Approval document on Environment Impact Assessment (EIA)
	Approved mining rehabilitation project
	Deposit for mining rehabilitation
Prices and financial duty	Announcement of products price
	Charge for mining lease
	Charge for land lease
	Charge for tax and other fees
Operational mining report	
Mine closure	
Mine inspections	

3. Software features and functions

The web-based Geographic Information System (GIS) has been adopted to develop a solution for application in mining management. The software provides a range of prominent features compared to conventional management in terms of: saving store space, storing files completely and systematically; extracting information timely, quickly and accurately; integrating data attributes with space then providing an overview of sites; supporting print with users-required layers properties; eliminating the duplication and confliction by synchronising input database. In addition, the solution is an open system which enables the users to update database, monitor the operational situation and receive the periodic reports from companies. Furthermore, the system is capable of connecting the mineral and environment database with that in other areas.

The Geodatabase has been developed to govern the spatial and attributes data and the relation between them. Geodatabase supports the object-oriented functionality and is managed through a base management system.

For the new system, the geodatabase has been incorporated with mineral site layers and map layers on national wide. The GIS technology adopted in the system is the ArcGIS developed by Environmental Systems Research Institute (ESRI). The basic functions are presented in Table 3.

Table 3. Basic functions of system

Group	Function	User authorisation	Requirement	Steps
Updating map	Support users to import maps from existent sources	System administrator. The users must be authorised for access and correction	Map files are in Micostationformat (*.dgn)	1- Users connect to system 2- Choose map layer to import 3- Select import function 4- Choose map to add database 5- If structure and format are correct, map is imported.

				If map is invalid, shows error and returns to step 4.
Exporting map	Support users to export map in common files format	System administrator. The users must be authorised for access and correction	Able to export common files format such as Microstation (*.dgn), Autocad (*.dwg), MapInfo ... Able to choose the output layer attributions	1- Users connect to system 2- Choose map layer to export 3- Select export function 4- Choose file and format to export 5- If file is able to export, process is conducted. If file cannot be recorded, shows error and requests to choose other file.
Creating report	Support users to manage reports from companies and report to organism in charge according to Mineral Laws	Users must be authorised to report to MONRE	Full management of all information needed for report. Support to search and check previous reports. All reports must be prepared by governmental document 01/2006/TT-BTNMT	1- Users connect to system 2- Select function “Report to MONRE” 3- Choose period of report 4- Select function “Print report”
Managing and extracting information	Support users to extract detailed information of site	The users must be authorised for access and correction.	Not required	1- Users connect to system 2- Select function “Report statistics and site information” 3- Select criteria for exported statistics 4- Select a mine site 5- Export to file if required

Based on the development of sites database, the initial result of software is shown in Fig .1.

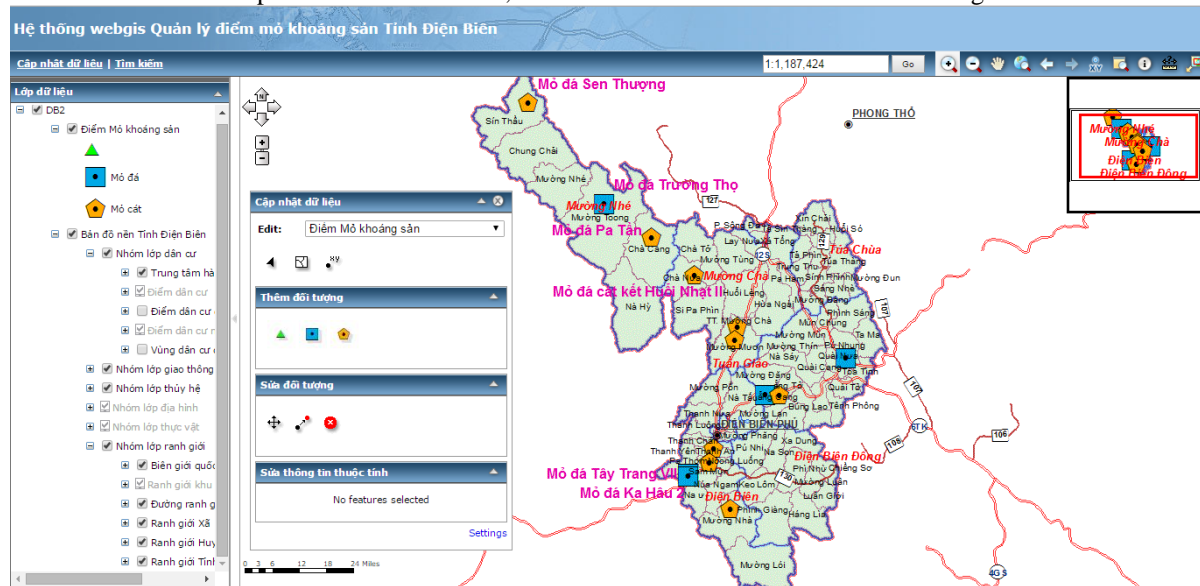


Fig 1. Interface of software

4. Conclusion

The mineral industry plays an important role on the national economy; however, it shows the low sustainable compared with other areas. Thus, this specific area has been strictly managed by the local and central governments. The improvement on mining management is inevitable and corresponds with the national policy: “Sustainable development”.

One of major solution to progress the capability of mining management is the application of advanced IT. A web-based GIS software has been developed exclusively for the governmental officials and mining companies. The software provides various functions which can efficiently support the management tasks regarding mining. For future plan, the system will be kept updating the database and upgraded based on the feedbacks from ongoing applications.

Reference

H. T. Lai, 2014. Mining operations in the year 2013 and solutions towards future green development in Vietnamese mineral industry, in Proceedings of National Conference on scientific and technical mining, Vungtau, Vietnam (in Vietnamese).