

# ROLE OF INFORMATION TECHNOLOGY IN COAL MINING APPLICATION AREAS

Debasish Basak\*

भारत में कोयले के खनन का अंश विभिन्न प्रकार के खनन की गतिविधियों में सबसे अधिक है, तथा राष्ट्रीयकरण के बाद कोयले के उत्पादन में लगातार वृद्धि होती रही है। कोयले की उत्पादकता में वृद्धि हेतु खदानों का पुनर्संघटन, मशीनीकरण, लांगवॉलिंग इत्यादि जैसे प्रत्येक प्रकार के उपाय किये जा रहे हैं, लेकिन आधुनिक सूचना की तकनीक को अच्छी तरह से अपनाने की सर्वथा कमी है। साधारण रूप से सूचना की तकनीकों को तथा विशेषतः कम्प्यूटर का व्यवहार स्वागतयोग्य विकास है। आई. टी. एक बहुमुखी तकनीक है, जो कि प्रभावी एवं कुशल प्रबंधन, बेकार के खर्चों पर नियंत्रण, तकनीक के

व्यवहार से सम्पूर्ण प्रक्रिया सहित गुणवत्ता वाले पदार्थों का उत्पादन एवं प्रकार्यात्मक सत्यनिष्ठा जैसे उपायों द्वारा उत्पादकता में वृद्धि कराता है। खनन की प्रक्रियाओं में कम्प्यूटर को एक प्रमुख भूमिका निभानी है, क्योंकि इसका अनुप्रयोग खनन के प्रत्येक पहलू से एकीकृत है। कम्प्यूटीकरण के कार्यान्वयन में जो भी संभाव्य बाधाएँ हैं उन्हें दूर करने के लिए प्रभावकारी योजना (प्लानिंग) की आवश्यकता है। इस आलेख में कोयला खनन के विभिन्न अनुप्रयोग क्षेत्रों में सूचना की तकनीक की भूमिका के संबंध में चर्चा करने की कोशिश की गई है।

## INTRODUCTION

Coal mining forms the largest fraction of mining activity in India, moreso because the coal sector has been gradually increasing coal production in the country since nationalization of the coal mines. There is every effort to improve the productivity through reorganization of mines, mechanization and longwalling, etc., but lacks in adequate applications of modern information technology. Use of Information Technology (IT) in general and computer in particular is a very welcome development. IT is a multi-faceted technology which enables improving productivity through effective and efficient management, control of wasteful expenditure, as well as, using technology for producing quality goods with complete processes and functional integrity. Computers have a major role to play in the process of mining since its applications are integrated to every aspects of mining. There is a need for effective planning of overcoming all issues that can arise on implementation of computerization. An attempt has been made in this paper to discuss the role of information technology in different coal mining application areas.

Mining as one of the core sector industries plays a positive and significant role in the process of the country's economic development. Nature has endowed India with rich mineral resources and its growing domestic market for

consumption of minerals promises a vast potential for growth of mining industry. Coal and minerals are input to several industries including the generation of power and steel. The process of mechanization of mining industry is being introduced at all stages of mineral production and proper utilization of Information Technology can provide safety and better working condition apart from increasing the production and efficiency in mines.

Coal is the primary source of energy in India. The productivity scenario in Indian coal mines does not offer a very good picture. Productivity levels obtained in Indian mines are several times lower than the prevailing figures in advanced countries. The open cast mining currently responsible for 70% of total coal production, will no doubt play a major role in meeting the demand of coal. Several considerations can be made with respect to improving the overall productivity. The modern mechanized mines are highly productive if the chain of machines from the coal face to the surface can be kept in operation. The adoption of information technology by the coal sector can provide better communication, control and information flow for overall development of mines. Besides, coal mining being the most hazardous industry due to frequent roof falls and the presence of inflammable gas like methane and toxic

\*Scientist, Central Mining Research Institute, Dhanbad

gases like carbon monoxide, sulphur dioxide, etc., in the underground, application of information technology for monitoring and control of these parameters can significantly reduce the mine accidents.

## CHARACTERISTICS/ROLE OF IT

It is essential to manage the huge data generated by day to day mining activities. Computers can be employed for these data which can be stored and retrieved easily as and when required. Computers along with peripherals, communication, network and proper software used for data management can be termed as Information Technology. Managing information in the organizational context has been greatly facilitated by advancements of IT. Today's office has all communication facilities, like Subscriber Trunk Dialing (STD), International Trunk Dialing (ISD), Electronics Telex and Facsimile (FAX). In addition, it has value-added facilities like Voice Mail, Electronic Mail (E-Mail) and Electronic Data Interchange (EDI). E-mail, a faster, cheaper and more secure medium than STD or FAX, is now available in most important places in India.

The advent of mini computers which became widespread in mid 1970s, demonstrated the potential application in various mining and other technical areas. IT may help in developing an effective and efficient maintenance management system. The necessity of adopting systems approach for total maintenance and the role of Information Technology especially Client-Server technology have been emphasized. Computers have a major role to play in the process of mass education since its applications are integrated in every aspect of education.

Information is the vital resource in any decision-making process. Business survival in the 21st century is dependent on the ability of business to manage information, in the way they interact, and in the way they react to changes.

The major challenge in computer-based mining processes is indeed the availability of software. Most of the software so far available is imported. The software available does not suit well with the requirement especially in Indian environment. There is lack of awareness on the educational software available and the scope offered by the computer for effective use of proper software.

The technological revolution taking place all over the world has resulted in three things happening: Computers + Communication and Miniaturization. IT is spreading its influence on every aspect in every function. It is enabling integration of business functions at all levels within and between organizations. Successful application of IT will initiate changes in organization and management styles. The role of IT in tomorrows' business operations is a distinctive one. IT has become a fundamental enabler in creating and maintaining a flexible business network. IT is a multi-faceted technology which has got audio/video, image, capability of animation and this technology enables regaining the lost business through effective and efficient

management, control of wasteful expenditure, as well as, using technology for market penetration and produce quality services/goods with complete processes and functional integrity. Overall computer usage and awareness to share information through network has increased in our country and therefore the need to network is immense. Computer networks are now being used in many diverse fields like business, education, medical, research and entertainment etc. They provide a variety of advantages for computer users - reduced import duty on application software would make several international produces available to the Indian user community at a far more affordable price.

## IT & A FEW MINING SYSTEM REQUIREMENT AREAS

Computers and communications first impinged on each other, at any rate in the civil sphere, in the early 60's. It became useful to connect data-gathering equipment to computers at remote sites. In the mid 70's came developments in local area networks. These developments came mainly from the need to share exotic peripherals between cheap computers and eventually gave rise to the kind of distributed computing widely practiced today.

Information technology (IT) has had a spectacular growth where computers and communications have merged. Indeed, information and entertainment have also come together. It has had an important impact on strategic management at the macro level. Information is now recognized as the third important resources after people and finance. Alvin Toffler had called this Information Revolution as "The Third Wave" in 1980.

The convergence of computers and telecommunication has revolutionized the whole arena of communication. Use of Intranet (Local area networks within the mine and Wide Area Networks to link with other mines and offices) brings all information to desktop of every individual for quick and effective decision making. The internet can be an important part of such information collecting and used constructively it can both promote the Indian mining industry to a wider global audience and at the same time open new channels of communication, promote an exchange of ideas and source important information.

It has been experienced that the mining control systems have moved from a research idea in early 70's to an essential part of the mines production control and safety monitoring. The mining control system requirements are:

- intrinsically safe monitoring and control equipment;
- operating distance of at least 10 km;
- ability to change configuration;
- high integrity;
- ability to handle items of plant (conveyor, etc.).

The requirement for intrinsically safe equipment forces the development of special mining system. Intrinsically safe electronic equipment does not cause explosion in an inflammable atmosphere in case of short circuiting.

The location and movement of mining equipment is tracked with precision Global Positioning Satellite Technology. Field computer systems are installed on mining equipments with touch screen, user friendly, Graphical Interface console, for easy interaction with operators.

The ventilation network of a modern underground mine is highly complicated with a large number of fans, airways, doors and regulators forming part of the ventilation system. The initial attempts towards solutions of such problem were restricted to the natural applications of successive approximation method. To reduce time, labour and tedium of the process, the next step was to utilize the similarity of the current flow in an electrical network to that of air flow in a ventilation network by constructing an electrical analog computer.

Human Resource Management System facilitates a centralized database of all employees which helps in manpower planning, easier processing of employee benefits etc.

The electrical analog computer for solving ventilation network was first adopted in Holland in the early 1950's and later in UK, USA and USSR. Rapid development in the application of digital computers in mining took place in the 1960's. One of these applications was in the field of analysis of ventilation methods. Because of its high speed and versatility, this method has almost completely superseded the earlier method using electric analog computers.

## HARDWARE & SOFTWARE STATUS IN MINING SECTOR

An efficient and effective communication the mine and between the surface and the underground workstations is required. The major elements in any communication system are a transmitting device, a transmitting line or propagation medium and a receiving device. Recently, instead of conventional cable, optical fibre cable has been used and opto-electric components (LED and detectors) being employed in the communication systems. Optical fibre communication system provides high capacity of channel, noise-immune and noise-free sound. Being a dielectric and non-sparking, it is an intrinsically safe communication medium and ideally suited for the hazardous environment present in a mine. Besides wired communication system, we have radio (wireless) communication system and carrier current system.

The advent of mini computers which became widespread in mid 1970's demonstrated the potential application in various mining and other technical areas. The development of low cost micro computer in early 80's has pervaded the computer culture down to personal level. Presently PC-range of products is widely used though few companies are using the mainframe computer. Number of peripherals e.g. printers, plotters, digitizer, scanners and graphic terminals are also used.

All the organizations in the mining sectors, academic institutions, R&D organizations, subsidiaries of Coal India etc. are making use of the computer these days. These organizations use a number of software packages which are acquired from different sources. The salient features of some of the mining specific software as follows: (i) In-house developed programs, (ii) Shareware, (iii) Indian packages, (iv) Foreign packages.

In opencast mining operations, quite a good number of equipments with varying degrees of sophistications are being used. The effectiveness of production is highly dependent on the quality of maintenance services. There is need for total maintenance that takes into account all aspect of Opencast Mining Equipment (OME), viz. design, manufacture, installation, maintenance, replacements and feedback of performance for the equipment; manufacturers. It is no wonder that the existing manual system, of MMS in mines is rather ineffective and deficient in many respects. However, with the introduction of IT, the management could resolve these problems and derive certain benefits including —

- reduction of paper works required of professionals;
- centralized data on one or many servers;
- improved accountability and accuracy of information;
- possible reduction in length of machine downtime;
- overall efficiency;
- reduction of data errors;
- easy access to valuable information;
- having a window to global information on all related topics.

A substantial portion of the maintenance activity is concerned with the processing of information, hence it is important to improve the efficiency of this information processing. It is necessary to have some evidence that the company is going to benefit from the investment of IT. Breakdowns of important machines pose a heavy loss due to reduced production. The investment made in IT for establishing an IMMS (Information Technology-based Maintenance Management System) may be justified, considering the loss incurred due to poor maintenance.

Standard mine planning software packages like Datamine, Surpac, GEMCOM, etc., are available for creation of a geological model from the exploration data and for mine optimization. Geostatistical packages like 'Magma' and 'ISATIS' are being used for geostatistical ore estimation. Mine planning packages developed by CMC and Indalco are being used for Bore hole data entry, survey, Ore Reserve estimation, ore body modeling, pit design, haul road design, pit optimization, mine scheduling. They have strong graphic user interfaces and are user friendly. Auto CAD software packages are being used in the Engineering department for designing purpose. GIS and remote sensing software packages like Arc Info, Map2000i, EASIPACE and ERDAS are being used for interpretation of satellite data for land use and land cover mapping.

## CONCLUSION

There is a need for an effective planning of overcoming all issues that can arise on implementation of computer-based mining processes. There is a need for an effective effort to improve the standard and activities of mining related areas by adopting the use of computers in all its dimensions. Hence, it is required to provide all means for organizing available resources that can be useful for streamlining of the whole system. Computers have provided a major tool for management and industries have wide scope for application of computers and computer-based equipments. In the world of competition, long term planning, projections and corrective actions are the necessary steps for the growth of an industry. The initial effort needed in computerization of the ventilation network of a large mine may appear to be high. Once initial exercise has been carried out, the advantages of computerization will be so great that no mine management should hesitate to implement the system in their mines. Information technology should be used as a competitive advantage for higher organization effectiveness. There is an urgent need for the top managers to learn the strategic use of information. At the same time, the entire organization needs to be made information-literate.

A centralized information system can be designed with different departments of the industry connected by a network. Sophisticated computers and most versatile software packages however, comprehensive and user-friendly they may serve the purpose only when they are applied with definite strategy. Generation of attractive outputs without underlying data integrity may lead to confusion. The ultimate aim of application of computer in all mining segments is to increase the production and productivity, efficiency, safety, and to develop an economically viable system. Unlike developed countries, in India the system is such that realization of benefit takes lot of time.

In order to implement IT effectively in coal mining areas, mining engineers should play a major role. The implementation of advanced technology and the timely use of information thus generated, has the potential to optimize overall mine productivity and further reduce unit costs under variable mining and economic conditions.

## References

1. Abbas, M., Lolarak, R., Basak, D. and Prasad, G. M. (1994), *Computer hardware maintenance: options, problems and experiences in CMRS*, in "Workshop on Computer Hardware Maintenance", ISM, Dhanbad.
2. Abbas, M., Lolarak, R., Basak, D. and Prasad, G. M. (1996), *General software application areas and packages for environmental studies, in the course on "Computer application on Industrial Pollution Control" (training under industrial component of World Bank aided Industrial Pollution Control project) at CMRI, Dhanbad during 12-16 February*, pp 50-56.
3. Banerjee, S. P. (1978), *Experiences of computer application in solving ventilation network problems of a large coal mine*, *IE(I) Journal-MM*, Vol. 59, July, pp 27-32.
4. Basak, D. (1996), *Maintenance management application parameters: an overview*, *OPSEARCH*, Vol. 33, No. 1, March, pp 46 (abstract).
5. Basak, D. (1996), *Potentials of operations research in India: model concepts*, *OPSEARCH*, Vol. 33, No. 1, March, pp 52 (abstract).
6. Chatterjee, P. K. (1978-79), *Mine systems engineering - model concepts*, *IE(I) Journal - MM*, Vol. 59, Nov-March, pp 57-60.
7. Chandrasekaran, G. and Sakkriraj, A. (1994), *Office - 2000 for industries*, *CSI Communication*, Aug., pp 11-14.
8. Dhar, B. B., Bandopadhyay, L. K. and Basak, D. (1996), *Role of instrumentation in mining industry, in the International Conference on Instrumentation (ICI-1996)*, IISc Bangalore.
9. English, A. (1993), *Mine control systems - past, present and future*, *Mining Technology, UK*, Nov-Dec, pp 213-218.
10. <http://www.worldstonex.com/en/InfoItem.asp?ICat=2&ArticleID=251>, (2005), (accessed 2nd January, 2006). *Information Technology in Mining Industry*.
11. Kapoor, B. M. (1993), *Will we let the Information Revolution pass us by?*, *CSI Communications*, October, pp 33-34.
12. Nayak, A. K. (1995), *Information technology in education: opportunities and challenges*, *CSI Communication*, May, pp 7-8.
13. Nayak, A. K. (1995), *"Information technology for banking management"*, *CSI Communication*, Sept., pp 4-7.
14. Needham, R. M. (1993), *Computers and Communications*, *Computers Science and Informatics*, Vol. 23, No. 4, Dec., pp 1-6.
15. Nori, K. V. (1994), *Towards a discipline for software engineering*, *Computer Science and Informatics*, Vol. 24, No. 2, June, pp 1-10.
16. Singh, T. N., Abbas, M., Lolarak, R., Prasad, G. M. and Basak, D. (1994), *Jharia koilakshetra ke paripeksh me computer ka upyog: samasya evam samadhaan, in Jharia Centenary Celebration (in Hindi)*, CMRI, Dhanbad, pp 315-325.
17. Saxena, P.C. (1995), *Expert system and operations research*, *CSI Communication*, Aug., pp 7-11.
18. Sharma, A. R. and Arora, V. P. (1996), *Computerization of HEMM - IT significance in NCL mines, in the IXth National Convention of Mining Engineers and seminar on "Productivity in Opencast Mining (NCME - 96)"*, IICM, Ranchi during 18-19 Nov., pp 114-122.
19. Singh, T. N., Abbas, M. and Basak, D. (1996), *Information technology based maintenance management system for opencast coal mining equipment, in the IXth National Convention of Mining Engineers and seminar on "Productivity in Opencast Mining (NCME - 96)"*, IICM, Ranchi during 18-19 Nov., pp 123-130.
20. Subramanian, K. (1995), *IT-enabled Business Process Re-engineering from Automation to Business Scope Redefinition*, *CSI Communication*, June, pp 14-16.
21. Tewari, R. K. and Gupta, G. S. (1996), *Internet : An Introduction*, *CSI Communication*, Oct., pp 8-11.