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Strategic Planning Of Managing Technology In Indian Coal Mining Sector- A Critical Review

Anand Pd. Sinha¹, P.C Jha, Supriyo Roy

Birla Institute of Technology - Mesra, Ranchi, India

¹Email: anand.pd.sinha@bitmesra.ac.in

ABSTRACT

Indian prime industries are facing a lot of competitions now adays due to the problem of globalization. To keep in race, every industry has to be up to date especially in the area of technology involved in it. Mining industries warrant for state of the art technology in real time basis. The present study highlights the development of technology in Indian open cast coal mining industries primarily. Indian open cast coal mining is still far behind in global standards in spite of implementation and use of best technologies. Presently the Open cast Coal mining industries warrants for state of the art technology. Energy security is the prime concern of Indian economy which is distressing Indian industries a lot. The problem lies in the implementation and its effective management. The way in which internal planning and implementation processes are managed could greatly influence the outcome of new technology. For this purpose, one of the public sector organizations namely Central Coalfields Limited, located at Ranchi, Jharkhand is being selected.

Keywords: Effective management, Strategy planning, Technology, Open cast coal mining.

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1. INTRODUCTION

Technology is essentially a starting point for knowledge and it is required for taking initiative and decision making. It provides new tools to deal with knowledge and its result will have far reaching implication on the future decision-making process. On the other hand technology is becoming increasingly knowledge-intensive. Knowledge-intensity of production is increasing rapidly, and research-intensity in the development of new technologies is growing. With rising complexity and globalization, technology has gained overriding objectives in the fast changing competitive environment. In the contemporary, business environment needs latest technology is imperative for maintaining quality standards. Business house demands two aspect of technology: first one is the selection of appropriate/ suitable technology and the second one is the effective management of the same. Suitable technology is indicative to be a good match between technology utilized and resources required for its optimal use. Simply taking up of new technology is a difficult task due to innumerable alternatives available both indigenously as well as internationally. However, second aspect needs to be more focused to understand the effective management of technology for

capitalizing it to the maximum extent. Technology has become the backbone of corporate sustainability after pro-market reforms due to immense competition. Indian prime industries are facing a lot of competitions nowadays due to the problem of globalization. To keep in race, every industry has to be up to date especially in the area of technology involved in it. Mining industries warrant for state of the art technology in real time basis. The present study highlight the development of technology in Indian open cast coal mining industries primarily. Indian open cast coal mining is still far behind in global standards in spite of implementation and use of best technologies. The way in which internal planning and implementation processes are managed could greatly influence the outcome of new technology. Researchers feel that the coal mining industries under government control lacks effective management of the new technology and not able to justify the returns on investment. The technology cannot play itself but it can bring a change and has to be supported by appropriate interventions and an advanced human skill (Which can be attained through training). There is no denying of the fact that the wrong choice of technology leads to dismal consequences affecting the overall health of the organization nonetheless the fact also lies in the effective management of technology. Indian

coal industries have witnessed a series of technological changes but it is still struggling in extracting coal suitable for the domestic consumption rather depending on the imported coal. The technology cannot be effective unless it has been supported by appropriate organizational changes as well as changes in human skills and training. Therefore assessment and evaluation criteria with respect to its cost effectiveness, availability of raw material and skill availability are needed to be established. The present study explores the strategies and methods adopted in a Coal mining industry for effective management of technology and its implementation. For this, we follow survey based empirical analysis; consists of data collection primarily via structured questionnaires. Factors effecting management of technology are identified by further by using factor analysis in Statistical Package for Social Science (SPSS) platform. For association relating to all identified factors, statistical test has been performed. Domain for data collection, we take one of the largest public sector coal units; namely CCL along with its seven open cast mines and designing part (named CMPDIL). The study pertains to find out the reasons for low productivity of coal in seven sites of CCL, These are Piparwar OC, Ashoka OC, KDH OC, Rajrappa OC, Urimari OC, Amlo OC, Jharkhand OC.

2. OBJECTIVES

At the outset, this paper attempts to focus on coal mining industries which are included in vital sectors of Indian economy. This study explores the strategies and methods adopted in a coal mining industry for effective management of new technology and its implementation.

Considering the above, basic objective of present research is to

- (i) To understand the importance of effective management of technology and its implementation phase in Central Coalfields Ltd.
- (ii) Find out the problems related to acquisition and implementation of technology in CCL and its effect on the production of coal.
- (iii) Identification of various factors required for effective management of technology.
- (iv) Evaluate the existing framework of management of technology for productivity enhancement at CCL and to suggest means for its improvement.

3. RESEARCH PROBLEM

In the context of present research work and stated facts despite of having ample coal deposit, imported machinery/ technology as well as ample demand in market the actual production of coal is less than the targeted. In spite of such a huge natural coal reserve there is a gap in target and actual production. On the basis of the above statement, a basic line of study has been framed and some facts were discovered which are described below:

- (i) Problem in management of HEMM (Heavy Earth Moving Machine) in terms of their utilization, supply of materials and

of existing layout. Old HEMM has not been replaced in the desire scale. It has increased the fleet of old HEMM with poor reliability and efficiency.

- (ii) Outdated mining technologies are adding to the problems on the existing technologies. The cost and time run over due to lack of structural, tactical, and strategic issues are of great concerns.

- (iii) The absence of optimal drilling capacity/facility and misbalanced excavation and transportation of coal has low availability and under-utilization of HEMM etc, due to this has resulted into the system.

- (iv) Shortages of skilled and statutory personnel also contribute to the problem. Equipments not properly handled and there is a decrease in production due to lack of technical skills, efficient supervisory manager and the workers.

- (v) Temperature, dust, and humidity are some of the important factors which affect safety and Productivity of the mine. Safety is an integral part of the efficient production and without which efficiency cannot be achieved.

- (vi) Another Problem is absenteeism which directly affects the production in mines resulting loss in revenue. Recent years have witnessed loss of production due to high rates of absenteeism among the miners and loaders. The loss of production imposes additional cost of production to this industry. Non-availability of adequate labor input has been a major problem in open cast mines.

- (vii) The general issue is shortage of skills required for the planning, supervision and management and its operations. The traditional coal mining countries (including Australia, South Africa and Indonesia) are all facing such skills shortages. They affect the development not only of the remaining larger deposits, but also of the development and appropriate exploitation of the smaller deposits.

3.1. RESEARCH METHODOLOGY

The extensive exploratory research was taken up in order to have a thorough understanding of the problem towards establishing priorities for further research actions. A preliminary survey was conducted by talking with experts and shop floor managers to find out various reasons of low productivity in opencast coal mines in CCL even after adoption of technology. Certain parameters were identified and incorporated in response form of question in the questionnaire to cover content validity. Factors effecting management of technology are identified by further by using factor analysis in Statistical Package for Social Science (SPSS) platform. For association relating to all identified factors, statistical test has been performed. Domain for data collection, we take one of the largest public sector coal units; namely CCL along with its seven open cast mines and designing part (named CMPDIL).

4. LITERATURE REVIEWED

Technology Concepts

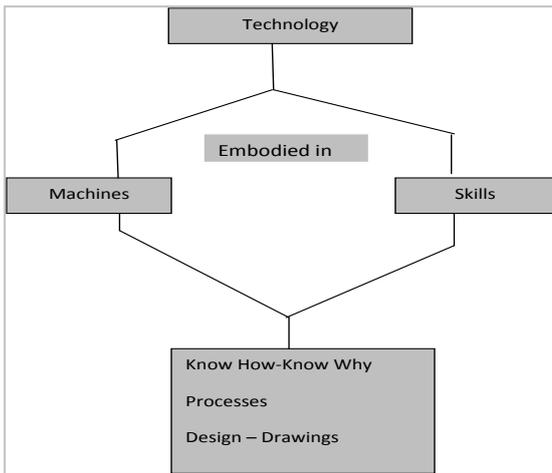


Figure -1.1 Technology Concepts (Source: Sharif ; Management of Technology Transfer and Development, 1983)

The organized efforts in the field of technology management began 1950s, onwards, when R&D as well as modern management ideas was developed (The period was characterized by plentiful resources to R&D). Management of innovation started functioning during 1970's; there was an interest in the entire corporate world to understand innovation and its proper application. However in the twentieth century, it slowed down as a result of the impact of global competition and the economic crisis of United States.

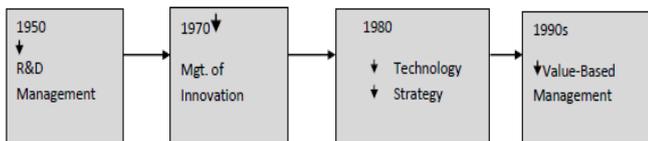


Figure 1.2 (Source: Managing Technology and Innovation, 2007)

Management of technology focuses on the principles of strategy and organization involved in technology choices, guided by the purpose of creating value for investors [1]. Management of technology is an interdisciplinary field that integrates science, engineering and management knowledge and practice. The focus is on technology as the primary factor in wealth creation, it may encompass factors such as enhancement of knowledge, intellect, capital, efficient utilization of resources, preservation of the natural environment and other factors that may contribute to raising the standard of living and quality of life. Managing technology implies managing the system that enables the creation, acquisition and exploitation of technology and it influences different functional entities of the cooperation, research and development, design, production, finance, personnel and information. Its domain involves both the operational and strategic interests of the organizations [2]. The operational aspect deals with the day- to-day activities of the organization, while the strategic dimension focuses on the long term issues. Technology generates wealth when it is commercialized or used to achieve a desired strategic or operational objective for an organization. While the underlying premise for the management of technology is the most

influential factors that contribute to the system [3]. Management of technology treats technology as the seed of the wealth- creation system and with proper nourishment and good environment seed grows to become a healthy tree [4]. For effective management of technology, three important factors have to be considered. First, there is always a time- lag between the development of technology and the commercialization of a product or service borne out of that technology. Second, it is very difficult to foresee the future while making evaluation and planning. Third is the readiness and abilities of engineers to draft ideas and concepts and manage development [5]. It is a potential weak spot in management systems by putting emphasis on the strategic objective of the organization. It guides management to improve productivity, increase effectiveness and strengthen the competitive position of the enterprise. The technology management is not simple it requires a coordinated effort to create a creative system design which further will produce novel products and services.

4.1.MANAGEMENT OF TECHNOLOGY IN INDIAN COAL MINING

Technological progress has changed the life of everyone today scenario and it has also changes made in the coal mining industries. In other words coal mining industry requires the high-technological power that is equipped with all the necessary machinery for raise the productivity of the coal. Today in the dynamic business scenario it is the importance of the state of the art technology is observed to raise and enhance the productivity of coal mining to gain the desired production. Almost every industrial sector today warrants for the best use of technology in order to remain competitive for sustainability [6]. The production of coal involves open cast mining technique and surface mining technique, as compared to the underground technique the open cast mining is more popular and the method of open cast has gained importance in USA since 1970. The method is useful to extract the coal deposit near the surface. From this moment the coal exploration, extraction and delivery to the market has become secure, effective, clean and not harmful for the environment. Nowadays coal mining industries are greatly dependent on technology, organizations such as Globaltex Industries including applying all the advances of technology in their business. Secondly underground mining involves operations like reaching a coal seam either through an incline or a shaft cut through the overburden and lifting it to the surface. Development of tunnel roads may be an essential requirement to reach the seam to an appropriate location. It needs to consider the seam thickness, strata conditions and methods of underground mining. Coal cutting, blasting, picking, loading, transporting are carried out at different stages of mining. In the early days, coal was mined by hand, with individuals wielding a pick and shovel. By the Industrial Revolution, coal-cutting machines and steam shovels designed for coal mines were common, making the work more efficient and throughout the 20th century, improvements in equipment design led to a dramatic increase in productivity and safety [7]. Now a days, new advancements in technology are driving even higher levels of performance and material management-

especially in open-pit, or surface, coal mines, where miners are focused on removing the most of the material as quickly and safely as possible.

4.2. MANAGING NEW TECHNOLOGY

Managing new technology means to use new technology to create competitive advantages [7]. Management of technology links engineering, science and management disciplines to plan, develop and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organization. In both the cases the words managing and management have compatible meanings. In the first case managing means to create competitive advantages and second case, means to shape and accomplish the strategic and operational objectives of an organization [9]. Management of technology links engineering, science, operations, human resources and other management disciplines to formulate strategy, develop technological capabilities, and use them to achieve strategic objectives. The successful management of technology requires the capacity to orchestrate and integrate functional and specialist groups for the implementation of innovations, continuous questioning of the appropriateness of exploitation of existing technology and willingness to take a long view of technological accumulation within the firm. Technology and its management are today matters of global primacy [10]. Technology is being developed, improved, combined, refined, bought, sold and traded around the world at unprecedented levels. As technology is crucial to the development of a country, the management of such an important resource both at national and enterprise levels, is vital [11]. The technology and its management cannot be left to the forces of chance as an important resource, it has to be properly planned cultivated and developed. The management of new technology means providing freedom of choice to the technology manager and giving him different options to exercise his free will to manage the industrial situation through a flexibly evolved self-organizing management process, incorporating various change mechanisms. The technology manager understands the ambiguous situation through deep involvement, thinking of general qualitative patterns through reasoning by analogy [12]. In modern competitive world the National leadership largely depends on technology. The companies are looking globally for acquiring and developing technology. Their success in the international market depends on the assimilation and improvement of technology [13]. Technological forecasting is a prediction of future characteristics of useful machines, products, processes, procedures and techniques. It is also defined as the seeking of or anticipation of technological innovation and is an important management function. Technology forecast serves as an input to the process of making plans and decisions for future expansion or new business or even to remain competitive in the market [14]. Some of the forecasting techniques commonly used are: brainstorming, delphi technique, trend extrapolation, technology monitoring, growth curves etc.

4.3. IMPORTANCE OF TECHNOLOGY AND ITS EFFECTIVE MANAGEMENT

Organizational success largely depends upon the efficient use and application of effective technology. So its effective management is essential for the success of any organization. Successful conceptualization and implementation of projects require the coordination of a wide array of activities, information and expertise. Since business opportunities are time bounded so an organization needs to act quickly for availing the benefits of new and innovative technology in an efficient manner for the project which are to be implemented within a short duration of time. These challenges in the business environment have heightened the need for effective management and control of technology [15]. Thus achievement of any goal either at corporate or individual level requires a systematic and well planned process of decision-making. Effective management requires the setting of clear objective to perform effectively or efficiently [12,16]. Therefore it stands to reason that people associates themselves with an organization to provide a clear direction to contribute and perform for achievement and to have desirable to participatory approach to setup its objectives.

Technology is a fine blended composition of techniques, comprising craft skills which require the dexterity of hand and eye and conceptual skills such as operating data, design engineering, production and maintenance. According to Soloman [17], technology management is necessary for social, economical and cultural development and a proper technological change results into increment of wealth and it can be measured in terms of the capacity of the organization to master technological management. Technology management is important because with the help of this the process is initiated and it finally converts the inputs into value added outputs, which finally are used by the society. These facts are obvious for all countries. However technology management is more important for those countries which do not participate directly in the input aspects or their participation is less intense as compared to the industrialized countries as they are partially prepared to adjust, also they are less susceptible to master the output aspects. On the other hand it can be said that technology and technology management are only a part of the total business activity or business plan of an enterprise. If technology has to give a competitive edge to the organization, the management must manage it as a part of the business system [18]. The production of Indian coal industry is primarily based upon imported technologies, accompanied by import substitution efforts through indigenous sources. It has been recognized that in today's scenario a large number of industrial products are based on obsolete technologies which are not cost-effective and consume a lot of energy [19]. Technology is not a panacea for the lacking skills instead it is a tool that complements organizational abilities, allowing the organization to become more productive. Technology can also cause as many problems as it solves. Once it is determined, new technology is indeed the answer to organizational needs. The organization can move on to the next step with this strategic decision [20].

4.4 ROLE OF EFFECTIVE MANAGEMENT OF TECHNOLOGY

The effective management of technology is essential if all the potential benefits for individuals and organizations are to be realized. It has the capability to transform products and processes and can make a huge contribution to organizational performance and even to national well-being. Effective management needs to make complex decisions associated with identification and evaluation of technologies, developing new or improved products and processes and integrating technology with other business processes, and to manage change required by technology implementation [21]. Effective management includes the diffusion of innovation, strategic design, power, politics and influence the relationship between technology and the individual, organization, and the society. Adoption of technology seems attractive for the people / professionals who are open to development and innovation. For Ex - In order to get a fruitful answer to our ineffective system we need to concentrate on state of the art Technological Inputs [22]. However Technology is not a panacea for the skills that we lack or for every issue of improvement that we encounter. Instead, it is a tool that complements our abilities, allowing us to do more and to become more productive. Technology is the productive power; having both the abilities of development and destruction play a critical role in reshaping the world. On the other hand we can say that it is one of the prime factors of production, therefore, the effective management of technology is essential for the optimum utilization of natural resources [23]. Now talking about technology, it's neither merely a product nor a process. Technology is only a means for development and not an end in itself. Some views over technology is that it is a source of wealth, well-being and as an instrument of power to dominate nature and societies [24].

Effective management of technology covers a wide spectrum of scientific and engineering activities focused to produce a device, a process or a system to meet the desired output specification and the organization to truly benefit from the new technology, the capabilities of new technical systems must continue to evolve and improve long past the initial introduction [25,21]. On the other hand technology management is a tool that complements our abilities, allowing us to do more and to become more productive, because technology can cause many problems that are solved. Successful effective management of technology requires that the problem solution within the firm should take into account both technical and market considerations [26]. Technology management is an agent of change for creating value within a firm by the assembly of pieces of knowledge (both practical and theoretical), know-how, methods, procedures and physical devices which incorporate such knowledge. According to Mc.Aulay, L., [27]. Tacit knowledge is the knowledge that people acquire from the experience. Tacit knowledge may originate in the mind of individuals in the form of insights, intuitions and is not easily visible and expressible. According totacit knowledge is more valuable because it provides context for people, places, ideas, and experiences. Effective transfer of tacit knowledge generally requires extensive personal contact and trust. Galbraith, [28],

points out that one of the keys to corporate success lies in the efficient exploitation and transfer of knowledge-based assets. Indeed, a technology transfer project is essentially a knowledge accumulation task, which further disaggregated into knowledge creation, acquisition, and retention in other works, knowledge transfer. Polanyi, (1967), pointed out that a dichotomous division of explicit knowledge and tacit knowledge could possibly be made on rather tenuous grounds. Whereas explicit knowledge includes documents, drawings, calculations, designs, databases, procedures, manuals, audio and video, and so on and tacit knowledge includes experience, technique, culture and habit etc. In comparison, explicit knowledge is more precise and systematic and it can be recorded and communicated in the form of literature or codified procedures. Hence the explicit knowledge is relatively easy to transfer but tacit knowledge is not. Tacit knowledge is not available as a text and may conveniently be regarded as residing in the minds of workers of a particular organization. It involves intangible factors embedded in personal beliefs, experiences, and values. The operational aspect deals with the day to day activities of the organization while the planning factors focus on the long-term issues. The organization must take into account these factors as involved in technology, developed framework and there are several ways of condensing these into a manageable number of groupings.

5. BRIEF HISTORY OF COAL

Coal is a fossil fuel extracted from the ground by mining. It is a readily combustible black or brownish-black sedimentary rock. It is composed primarily of carbon and hydrocarbons, along with assorted other elements, including sulfur and associated with the Industrial Revolution. Coal remains an enormously important fuel and is the most common source of electricity world-wide. Coal is extracted from the ground by mining, either underground by shaft mining through the seams or open pits. Coal was discovered by colonists in Eastern North America in the 18th century. Early coal extraction was on small-scale, lying either on the surface or very close to it.

5.1. COAL MINING INDUSTRY- A SNAPSHOT

Coal mining began in India in the early eighties. The private companies began mining activities in the year 1850. Commercial coal mining, which began in India in the late 1700's, was primarily in private hands till 1971. Government of India nationalized this industry in 1972-73 with the objective of ensuring an orderly development of a sector that serves strategically important industries like power and steel. It was also felt that this sector was a bare need to significantly improve on the technology arena for coal extraction and mining practices, and invest large sums of money in the development of new reserves-objectives that could be better served if the industry was under the direct control of the Government of India. As a consequence of the nationalization process, coal was subject to pricing and distribution controls. While prices were determined on the basis of the formulae fixed by the Bureau of

Industrial Costs and Prices, Linkage Committees consisting of representatives from the ministries of coal, power, steel, railways and others decided on the allocation among different consumers. India now ranks 3rd amongst the coal producing countries in the world.

70% of India's coal production is used for power generation, with the remainder being used by heavy industry and public use. Domestic supplies satisfy most of India's coal demand. Unfortunately most of India's coal is characterized by high ash contents, but the quality has other useful qualities such as low sulphur content (generally 0.5%), low iron content in ash, low refractory nature of ash, low chlorine content and low trace element concentration. Production costs in India are 35 per cent higher compared to Australia, Indonesia or South Africa, which is not due to higher wages, but lower out-put productivity. The Coal has come a long way to occupy pride and place in the industrial economy of the country as one of the prime source of energy. On 31st January 1973, non coking coal mines was taken over by the Government and Coal Mines Authority Limited was formed-with four operating divisions and NCDC because one of the divisions namely the Central Division of CMAL.

In 1975, further reorganization of coalmines resulted in the incorporation of CIL as the holding company. CIL and its subsidiaries produce and supply coal & coal products to core sectors like Steel, Power, Cement, Fertilizers, Defense, Railways, etc. CIL has eight subsidiary companies; details can be viewed in Table 1.0. Coal India Limited has acquired the status of the third largest coal producing company of the world, having its noble start in the year 1975 as a holding company, under ministry of coal, the company is now a maharatna company. The company is responsible for the production of 90% of the coal requirements of India. Captive Mines of TISCO, IISCO and DVC are also related to it. Coal India currently operates 510 mines and 15 washeries spread over nine states to produce and beneficiate coal for meeting the demand of the consumers all over the country. The ranges of products are: Raw coal (coking and non-coking), Washed coal, Middlings, soft coke & Hard coke, coal, coal gas, coal chemicals etc.

5.2. PRODUCTION OF COAL BY CIL

Production by CIL against its internal targets and the target fixed by the planning Commission for six years ending 31 March 2015 is given in Table 1.1.

5.3. LIST OF TECHNOLOGY USED IN OPENCAST MINING

Technology has become backbone of corporate sustainability after the pro-market reforms due to immense competition. Presently the open cast coal mining industries warrants for state of the art technology. Today in the dynamic business scenario the importance of the state of the art technology is observed and adopted for enhancing productivity. Almost every industrial

sector today warrants for the best use of technology in order to remain competitive for sustainability. The Indian coal sector presently is in the transition phase from traditional to the state of art technology. The coal sector is majorly under control of government under the aegis of CCL leading public sector mining industries. Most of the technology adopted so far by CCL is almost imported and rely on its effective management. Technology is not a panacea for the lacking skills instead it is a tool that complements organizational abilities allowing becoming more productive. Technology can cause as many problems as it solves. Technology can improve the efficiency of the organization manifolds but lack of effective management of technology can defeat the entire purpose. Indian prime industries are facing a lot of competitions nowadays due to the problem of globalization. To keep in race, every industry has to be up to date especially in the area of technology involved in it. Mining industries warrant for state of the art technology in real time basis. The present study highlight the development of technology in Indian open cast coal mining industries primarily. Indian open cast coal mining is still far behind in global standards in spite of implementation and use of best technologies. The way in which internal planning and implementation processes are managed could greatly influence the outcome of new technology. Technology implementation and planning refer to the extent how the organization has strategically designed the deployment of new technology(s) prior to its implementation. The processes incorporated within this design influence the overall effectiveness of technology deployment and utilization. Throughout the implementation process, effective management means supporting the project team, selecting the right technology, and designing and providing appropriate training. This will ensure that the new technology will be complement existing processes and systems will allow more productivity throughout.

Installed some technology adopted by CCL for raise the productivity in their open cast mining as follows;

- (i) Installation and commissioning of mobile inpit coal crushing and conveying in Piparwar OCP (6.5 Mty).
- (ii) Installation and commissioning of 10 cu.mtrs. and 25 cu.mtrs. Shovels and 85 T Dumpers in different Open Cast mines.
- (iii) Introduction of surface minor in Ashoka Expansion.
- (iv) Installation of Rapid Loading System in Dhori Colliery.
- (v) 3.0 Mty Rajrappa OCP has been commissioned with a pithead coking coal beneficiation plant.

5.4. PRODUCTION EQUIPMENT AND METHODS

First, the mine boundaries and the various mine parameters need to be decided. The total quantity of coal to be extracted and total amount of overburden (OB) to be removed is calculated. A selection of the production equipments is the most important aspect of design in an opencast mining operation. Many factors, both physical and economical, have to be given careful attention. The decision will then affect the type, size and

number of the equipments allotted for operations, such as draglines, shovels, dumpers, drills, bulldozers etc.

The actual production was less than the target production in their open cast mines as shown in table no.1.2. The study focuses on the issues which purely pertain to the effective management of technology in the sites. These sites are:

- (i) Ramgargh (Rajrappa Mines)
- (ii) KDH Hesalong OCP
- (iii) Piparwar
- (iv) Jharkhand OC
- (v) Urimari
- (vi) Ashoka Expansions
- (vii) Amlo

The success of any business lies in the effective combination of three factors: technology, raw material, and capital. Technology may minimize the deficiency of natural resources to a considerable level. Today in the dynamic business scenario it is important to adopt suitable technology to enhance productivity. Almost every industrial sector today warrants for the effective use of technology in order to remain competitive and sustains in the market. Presently the Indian open cast coal sector is in transition phase from the traditional to appropriate technology. Majority of the coal blocks are under control of the government. However private companies have also entered into this field and are giving a tough competition to the central public sector. It is a prime concern for the government to control the mining industry to make it more competitive.

Table no 1.3, shows that there is no communication facility between the shovel and the control room. It is observed that a communication facility is essential between the shovels to the control room. Varieties of shovel, dumpers, drills and dozers are in operation in this mine. Hence a time bound programme is required for the scheduled maintenance of the above HEMM. The maintenance plan along with the requirement of spares for the HEMM should be formulated and should be submitted for approval.

Table 1.4 and Table 1.5 show that the target production was less than the actual production in CCL. Coal production by CCL in their open cast coal mines in Jharkhand is suffering from socio-economic problem of Naxalite activities. In Jharkhand, Naxalite problem is a major problem in coal blocks as well as law and order problem which affects the coal belt area for the production of coal. CCL has indicated that they are trying to make up the loss in production by increasing coal production on other working days.

5.5. EFFECTIVE MANAGEMENT OF TECHNOLOGY PRIME FACTORS

Production of coal and its further increment calls for effective management of technology, some of the important factors related to selection and implementation of technology are :

Sl.No.	Factors effecting mgmt. of Technology	Lit. support lead by Authors'/Practitioners'
1	Planning for Technology	Steele, 1989;
2	Selection of Technology	Khali,2009
3	Technological Skills	Christina Beach, 2009;
4	Financial Feasibility	Betz, Fredrick (1987).
5	Cost and Benefit Analysis	Boskin, M. J. 1992
6	Real time Technological Advancement	Mehta , 2002;
7	Managing HEMM Technology	Ghatak, 2009;
8	Supply chain issues	Monika Maria (2014).
9	Waste reduction by applying new technology	Allan C. Wexler,2013
10	Real time transfer of technological change	Moustafa, 1990;
11	Socio-Economic issue on new Technology	Stewart, 1987;
12	Maintenance of overall Equipments	Watson, 1968;
13	Continuous Monitoring of Quality	Sevim & Lei, 1998
14	Proper Utilization of Machines	Bancroft, 1992
15	Real time Training for Technical up-gradation	Edwin B.Flippo,1980
16	Safety needs for continuous technology	J. Ritson, 1983
17	Level of Mgmt. for adoption of new technology	Tarek Khalil, 2010
18	Technological barrier due to Land Acquisition	Saxena, 1996
19	Technological Effect on Environment	Singh, Gurdeep, 2005
20	Proper Management Of Manpower	Chhipa et al., 1999
21	Market Feasibility	Berman, E. M,1992

Obviously these factors are interlinked and a proper management of technology requires to be considered. The study was conducted over the five installed technologies identified for the research work which were being managed by CCL, Ranchi. The factors identified were based on the production report generated by CCL. The study identified the following possible factors which were relevant for study for effective management of new technology.

6. CONCLUSION

During the course of the research, the researcher has been exposed to various trends and practices related to the management of technology in a large public sector organization

namely CCL and their open cast coal mines as well as CMPDI. The value added in thoughts and concepts acquired during the process of the overall analysis of the data collected, through interviews, survey of literature, and personal observations have enabled the researcher to make certain suggestions and recommendations having a significant contribution in effective management of new technology and its implementation in coal mining industry. During the course of interaction with the respondents, it was evident that the human element in organizations assumes a vital role during the formulation and implementation of effective management. The attitude and perceptions of the individuals involved throughout the process of value addition in thoughts and practices play a critical role in formulating effective management that are conducive to the attainment of organizational objectives. Therefore, the various factors that are responsible for building up the attitude and perception of individuals need to be thoroughly understood, nurtured, and enriched so that they get blended effectively. To keep up with technology and to extract coal as efficiently as possible modern mining personnel must be highly skilled and well-trained in the use of complex, state-of-the-art instruments and equipment and also important to impact improvement in technological competitiveness.

The major problems relating to the open cast mines in HEMM maintenance and utilization of machine are identified which leads to failure due to lack of effective management. The evaluation of the maintenance problems currently existing at the mine maintenance department indicates that there is a lack of effective training program. The department has to think of giving adequate trainings to the workforce so that they can execute procedures and practices in better manners which are firmly required for maintaining equipments. Continuous maintenance improvement program is not practiced in the mine instead of this improvement groups are created temporary to fix a specific problem in hand. To keep up with technology and to extract coal as efficiently as possible modern mining personnel must be highly skilled and well-trained in the use of complex, state-of-the-art instruments and equipment and also important to impact improvement in technological competitiveness include long term planning, Level of Management, Selection of appropriate technology, Advancement of Technology, Technical skills, Proper utilization of Machine and training needs that are needed for advanced technology deployment to extract coal and to achieve the productivity in mining sector. All the important factors which were relevant for the study for effective management of technology in Coal mining industry. If one factor is affected it affects all other related factor, so without ascertaining the value of one factor the next factors cannot be ascertained. If these interacting factors can be managed properly it is obvious that equipments reliability will be improved readily, reduction of operational cost and profit maximization will be the end results.

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List of Tables

Table No. 1.0 CIL with Eight Subsidiary Companies

Company	Headquarters	Year of Corporation
Eastern Coalfields Limited (ECL)	Sanctoria (WB)	1975
Bharat Coking Coal Limited (BCCL)	Dhanbad (Jharkhand)	1973
Central Coalfields Limited (CCL)	Ranchi (Jharkhand)	1975
Northern Coalfields Limited (NCL)	Singrauli (MP)	1986
Western Coalfields Limited (WCL)	Nagpur (Maharashtra)	1975
South Eastern Coalfields Limited (SECL)	Bilaspur (MP)	1986
Mahanadi Coalfields Limited (MCL)	Sambhalpur (Orissa)	1992
Central Mine Planning and Design Institute Limited (CMPDIL)	Ranchi (Jharkhand)	1975
NorthEastern Coalfields Limited (NECL)	Meghalaya	1975

Table No. 1.1 Production of Coal by CIL

Sl NO	Company	2009-2010(Mt)		2010-2011(Mt)		2011-12(Mt)		2012-13(Mt)		2013-14(Mt)		2014-2015(Mt)	
		Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
1	ECL	22.57	22.20	23.18	15.74	20.34	19.74	21.75	21.83	24.20	23.20	25.19	24.05
2	BCCL	19.59	19.30	20.62	20.75	21.50	21.38	23.45	23.61	24.75	25.31	25.19	25.30
3	CCL	42.00	42.32	44.90	41.68	52.6	45.61	62.60	47.52	75.60	48.00	75.50	48.05
4	NCL	52.00	52.16	58.00	59.62	61.25	63.65	66.50	67.67	72.00	66.25	75.55	68.25
5	WCL	32.10	33.30	32.39	33.53	32.75	34.59	34.85	36.12	36.35	34.95	36.95	35.65
6	SECL	71.00	72.30	74.04	77.05	78.00	83.58	88.50	90.18	93.50	95.90	94.50	95.37
7	MCL	77.59	78.03	85.60	85.89	96.11	94.19	107.20	101.88	114.46	98.11	115.35	101.95

(Source : Project and Planning Department- CMPDIL,Ranchi)

Table No. 1.2 Production of Coal Open Cast in CCL Site Wise

Sl NO	Site	2009-2010 (Mt)		2010-2011 (Mt)		2011-2012 (Mt)		2012-13 (Mt)		2013-14 (Mt)		2014-2015 (Mt)	
		Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
1	Piparwar OC	10.00	8.00	10.00	8.50	10.00	9.51	9.75	9.00	10.00	9.90	11.30	11.49
2	Ashoka OC	6.5	6.30	9.50	7.10	9.00	7.60	8.75	8.030	8.10	7.72	8.00	7.80
3	KDH OC	4.5	4.01	3.50	3.14	3.70	3.51	3.50	3.451	3.70	3.60	2.00	1.55
4	Rajrappa OC	3.00	.85	1.20	1.00	1.25	1.10	1.1	1.101	1.25	1.13	1.00	.76
5	Jharkhand OC	1.0	.81	0.85	.92	0.85	.60	0.95	.606	0.85	.71	.49	.47
6	Urimari OC	2.0	2.33	2.00	2.44	2.25	1.51	2.50	2.039	2.25	1.95	2.30	2.22
7	Amlo OC	2.50	1.43	1.20	2.81	2.00	3.12	3.00	2.041	2.70	2.30	1.50	1.15

(Source: Project and Planning Department- Central Coalfield Ltd, Ranchi)

Table No. 1.3 Utilization of HEMM in Open Cast Mines

Company : CCL									
CALANDER HOURS				CAP – 4					
Sl.No	EQUIPMENT	2009-2010	2010-2011	2011-2012	2012-13	2013-14	2014-2015	2016-17	2017-18
		ACTUAL	TARGET	TARGET	TARGET	TARGET	TARGET	TARGET	TARGET
1	SHOVEL	828958	853827	870903	879612	888408	897293	906265	951579
2	DUMPER	3677283	3787601	3863354	3901987	3941007	3980417	4020221	4221232
3	DRILL	528106	543949	554828	560376	565980	571640	577356	606224
4	DOZER	975213	1004469	1004469	1014514	1024659	1034906	1045255	1097518
AVAILABLE HOURS									
Sl.No	EQUIPMENT	2009-2010	2010-2011	2011-2012	2012-13	2013-14	2014-2015	2016-17	2017-18
1	SHOVEL	624289	643018	649448	655942	662502	669127	675818	709609
2	DUMPER	2290666	2359386	2382980	2406810	2430878	2455187	2479738	2603725
3	DRILL	376631	387930	391809	395727	399685	403681	407718	428104
4	DOZER	546847	563252	568885	574574	580320	586123	591984	621583
UTILISED HOURS									
Sl.No	EQUIPMENT	2009-2010	2010-2011	2011-2012	2012-13	2013-14	2014-2015	2016-17	2017-18
		ACTUAL	TARGET	TARGET	TARGET	TARGET	TARGET	TARGET	TARGET
1	SHOVEL	410256	424615	435230	443935	452814	460964	467879	495951
2	DUMPER	1292164	1337390	1370824	1398241	1426206	1451877	1473656	1562075
3	DRILL	164044	169786	174030	177511	181061	184320	187085	198310
4	DOZER	276413	286087	291809	297645	303598	309063	313699	332521
PERCENTAGE ACTUAL OF UTILISATION									
Sl.No	EQUIPMENT	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-2015
		ACTUAL	ACTUAL	ACTUAL	ACTUAL	ACTUAL	ACTUAL	ACTUAL	ACTUAL
1	SHOVEL	85.3	85.7	86.2	87.0	87.9	88.6	88.0	87.9
2	DUMPER	70.3	70.6	71.0	71.7	72.4	73.0	73.3	74.0
3	DRILL	77.7	78.0	78.4	79.2	80.0	80.6	81.0	81.8
4	DOZER	63.0	63.3	64.6	65.2	65.8	66.4	66.7	67.3

Table No.1.4 Technology Wise Target Coal Productions

Company : CCL									Prod- (Mt)
	Technology	Actual 2005-06	2006- 07 RE	BE 2007- 08	Projections				
					2008- 09	2009-10	2010-11	2011-12	2016-17
A.	<u>Opencast</u>								
	Manual	0.74	0.67	0.54	0.37	0.26	0.05	0.00	0.00
	Mechanised	37.46	38.33	41.46	44.53	52.34	62.55	75.60	112.60
	Total OC	38.20	39.00	42.00	44.90	52.60	62.60	75.60	112.60
B.	<u>Under ground</u>								
	Conventional B&P	1.68	1.39	1.37	1.36	1.36	1.36	1.29	1.25
	Conventional LW								
	Mechanised B&P (SDL / LHD)	0.63	0.61	0.63	0.64	0.64	0.64	0.66	0.70
	Mechanised B&P (CM)				0.10	0.40	0.40	0.45	0.45
	Total UG	2.31	2.00	2.00	2.10	2.40	2.40	2.40	2.40
	GRAND TOTAL CCL	40.51	41.00	44.00	47.00	55.00	65.00	78.00	115.00

(Source: Project and Planning Department- Central Coalfields Ltd, Ranchi)

Table No. 1.5 Technology Wise Actual Coal Production

Year	Opencast Mines		Underground Mines		Total
	Manual	Mechanized	Conventional B & P	Mechanized B & P	
2009-10	0.37	38.99	1.44	0.515	41.32
2010-11	0.25	41.75	1.47	0.53	44.00
2011-12	0.20	44.54	1.68	0.58	47.00
2012-13	0.21	44.61	1.63	0.61	47.06
2013-2014	0.41	45.84	0.85	.421	47.52
2014-2015	0.38	46.54	0.74	0.352	48.00

(Source: Project and Planning Department- Central Coalfields Ltd, Ranchi)