Management and Implementation of Technology in Central Coalfields Limited (Open Cast Coal Mining)

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Abstract

To ensure effectiveness and efficiency of an organization in terms of operation and productivity support of optimal and innovative technology is required. To remain established and competitive in market installation/ maintenance of updated technology is required almost in all sphere of business. Technology planning and implementation always highlights the percentage and extent to which the strategic and tactical use of technology is warrant inside organization to achieve pre stated goals. Most of the organizations have invested or are investing huge amount on technology but still they are not witnessing comparative performances. Coal mining is one of the prominent sectors in India which requires much attention, although the sector`s productivity is less as expected of the inclusion of imported technologies. The prominent factors responsible are planning and implementation as these could influence the overall output of the sector and also the output of the installed technology. Indian open cast coal sector is in its transition phase from traditional to the start of the art technology for extracting coal. This study attempts to cover Central Coalfields Limited (Ranchi Region) and tries to highlight the factors responsible for effective management of technology and the problems related to technology adoption and implementation in the coal mining sector especially CCL, CMPDIL and the 7 affiliate mines of CCL. Attempts were also made to discover the problem responsible for the low production/ output of coal from the technology (installation, use and maintenance) point of view. The research design used was a combination of descriptive and empirical and the sampling units were the employees of CCL.

Key Words: Technology Management, Effective Management, Opencast Coal Mining.

1.0 Introduction

For sustenance, development and enhancing productivity adoption and use of effective technology is required and to remain established and competitive in market installation/ maintenance of updated technology is required almost in all sphere of business. Technology is a fine blended composition of techniques, comprising craft skills which require the dexterity of hand, eye and conceptual skills to achieve objectives. According to Soloman (1990), management of technology is necessary for social, economic and cultural development. Increment of value and wealth are some of the results of favorable technological change and the extent of change is directly proportional to the capacity of the organization to master the management of technology part. The optimal combination of Raw Material, Capital and

Technology determines success of business up to a larger extent and in pertaining to the same technology may minimize the wastage of resources to a considerable level. Almost every industrial sector today requires effective use and management of technology to remain competitive in market. Now a day where globalization is much talked about the technology and related innovations are important and have resulted into an increased competition among industries. Two aspects of technology are more important in this regard, the first part may be related to the choice of optimal technology and the other part may be related to its effective and efficient management. Technology is not an automatic invention rather it requires suitable innovations and interventions by the workforce to manage and support it. If the selection and placement of technology s not appropriate then it will cost the overall success of the organization and the goal completion in long run may be affected. The present research is an active attempt to underline the problem faced in context to management of the installed technology its adoption, implementation to productive utilization. The background of this research is based on managerial issues related to the effective management of technology in CCL. This study focuses on management of technology and not the technical innovation. This study is an active approach to un earthen the causes for low productivity of coal within seven affiliate mines of CCL i.e. Piparwar , Ashoka , KDH , Rajrappa , Urimari , Amlo , and Jharkhand Open Cast Mines in great extent. Taking information by collecting primary data via structured questionnaire, this study attempts to explore overall to various factors required for effective management of technology.

2.0 Technology and its Effective Management

One of the important factors determining the success of a firm is the proper and optimal utilization of the installed technology. As opportunities are always time specific therefore the management needs to respond proactively and quickly to the changes through the effective implementation and use of technology. The threat faced by an organization in a dynamic and open environment calls for effective management of technology. Technology carries no meaning without its effective and efficient use and for this management of technology and the skills are much required (Rastogi, 2004). The organizational performance to a larger scale depends on the human resource. A. successful organization always updates and upgrades the skills of their employee and intellectual capita as per the demand and need.

2.1 Reasons Affecting Production of Coal

Despite of installation and use of modern technology in open cast coal mining, the coal extraction and production falls far behind as compared to the global standards. Indian coal industries have experienced a wave of structural, operational and technological changes but still the production is not suitable in terms of quality and quantity therefore the industries operating/ Coal based industries have shifted and now are more or less dependent on the imported coal. Initial literature review, visits to the production floor and talking to experts, the following reasons were surfaced for low productivity

- Outdated mining methods and improper skills of employees/ Management

- Poor structural and tactical makeup and over runs
- Uneven excavation and the related transportation
- Breakage in the transportation from production to storage or transfer site
- Illegal mining operations and excavation
- Environment/ Forest land clearance issues

3.0 Objectives of the Study

- To highlight the factors responsible for effective management of technology.
- To highlight the problems related to technology adoption and implementation in CCL

4.0 Research Methodology

Research Design – Empirical and Descriptive
Data Collection Tool - Interview and Questionnaire
Sampling Area – Jharkhand, State

Sampling Frame

Table No.1 : Sampling Frame of the Present Study

Sl. No.	Selection of Units	Sampling Scheme
1	Sampling Area	Convenience
2	CCL as focal point for research	Judgmental
3	CMPDIL	Judgmental
4	Seven Open Cast Coal Mines	Random
5	Departments	Random
6	Respondents	Random

Table No.2: Response Details

Total Population	Total Questionnaires Distributed	Non-Response	Received filled in Questionnaire	Incomplete Responses	Responses considered for Analysis	Percentage
61,600	500	64	436	51	385	.625

The development of instrument considered for the study is a combination of Item generation, Pre-pilot study, Pilot study and Large-scale Data Analysis. A comprehensive literature review and data search has formulated the basis of item generation, and then it was further refined after

discussing the issue and data with experts and practitioners from the mining field. Structured interviews were also conducted to gain a practical insight ad to give a free flowing edge to the instrument. Pilot study was also conducted before finalizing the instrument.

4.0 Hypotheses

- **H_0**: Management of technology is not significant in enhancing the production.
- **H_1**: Management of technology is significant in enhancing the production.

5.0 Analysis and Interpretation

Sl. No.	Site	2008-2009 (Mt)		2009-20010 (Mt)		2010-2011 (Mt)		2011-2012 (Mt)		2012-1013 (Mt)		2013-2014 (Mt)		2014-2015 (Mt)	
		A	TV	A	TV	A	TV	A	TV	A	TV	A	TV	A	TV
1	Piparwar OC	7.5	7.68	8.00	8.152	8.50	8.616	9.51	9.08	9.00	9.544	9.90	10.00	10.15	10.47
2	Ashoka OC	6.10	6.282	6.30	6.598	7.10	6.914	7.60	7.23	8.03	7.546	7.72	7.862	7.80	8.178
3	KDH OC	4.00	2.48	4.01	2.76	3.14	3.04	3.51	3.32	3.451	3.60	3.60	3.88	1.55	4.16
4	Rajrappa OC	.84	.82	.85	.87	1.00	.92	1.10	.97	1.10	1.02	1.13	1.07	.76	1.12
5	Jharkhand OC	.79	.54	.81	.59	.92	.65	.60	.70	.606	.75	.71	.80	.47	.86
6	Urimari OC	2.30	1.96	2.33	2.01	2.44	2.06	1.51	2.11	2.03	2.16	1.95	2.21	2.22	2.26
7	Amlo OC	1.30	1.96	1.43	1.96	2.81	2.0	3.12	2.02	2.04	2.04	2.30	2.06	1.15	2.08

Table No.3 Forecast vs. Actual Coal Production in Open Cast (A- Actual Value, TV – Trend Value)

Observation - Pertaining to the above data, the red mark indicates that, out of 49 combinations only 26 combinations are there in which the actual production of the coal is less than the projected trend production value, whereas in rest of the cases the Trend Value production is more than the actual production. These figures clearly indicate that there is some problem in the industry with respect to the management and implementation issues. The Trend value production indicated the expected production of coal against the year demarked. These projected values are based on the standard equipment's, present and the standard factors considered. Despite that the actual production is on a lower side, this clearly indicates that the installed capacities are not

utilized to their optimal capacities. The present research work has highlighted this issue from management and capacity utilization point of view and has focused on different aspect responsible for it.

6.0 Factor Analysis

Principal component analysis was used to obtain output of factor analysis and specifying rotation using varimax. Eigen values were associated with each linear component (factor) before extraction, after extraction and after rotation. 24 linear components were identified within the data set before extraction. The Eigen values associated with each factor represents variance explained by that linear component and also displays the Eigen value in terms of percentage of variance explained. After factor analysis total 24 variables were reduced to 12 variables and from that 3 factors that were statistically significant were identified. The variables V6, V14, V15, V13, V21 have high loading of .975, .900, .955, .916, .933 respectively on factor 1. This suggests that factor 1 is a combination of above 5 variables. At this point, the researcher's task is to find a suitable phrase which captures the essence of the original variables which continue to from the underlying concept or 'factor'. In this case, factor 1 could be named as 'Mine Planning & Design' as shown in table no.4. Similarly for factor 2, variables V10, V11, V23 have a high loading of .883, .889, and .986 respectively, this indicates that factor 2 is a combination of the above 3 variables. In this case, factor 2 could be named as 'Evolution of Technology'**. F**or factor 3, variables V 1, V4, V12, V22 have a high loading of .957, .884,.996, .935, respectively, this indicates that factor 3 is a combination of the above 4 variables. In this case, factor 3 could be named ass 'Effective Management of Technology'. Out of 24 variables only 12 variables have extracted because of Rotation Sums of Squared Loadings percentage of cumulative value is .78 and rest of variables is low loading value, i.e it has dropped for further analysis and only 12 variables will be applicable which is statistically significant. The analysis data has given below:

SL No.	Codes	Variables	Factor to which a variable is merged	Factor Loading	Communality
1.	VAR00001	Top Level Management	Factor – 3	.957	.926
2.	VAR00002	Middle Level Management	Factor – 3	.814	.667
3.	VAR00003	Adoption of Indigenous Technology	Factor – 3	.748	.587
4.	VAR00004	Adoption of Foreign Technology	Factor – 3	.884	.783
5.	VAR00005	Market Feasibility	Factor – 1	.712	.632
6.	VAR00006	Financial Feasibility	Factor – 1	.969	.955

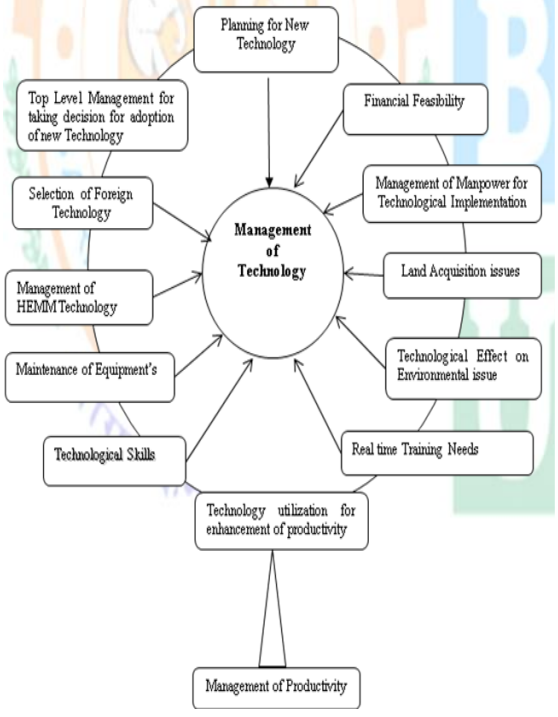
7.	VAR00007	Cost and Benefit Analysis (Economic feasibility)	Factor –1	.814	.712
8.	VAR00008	Real Time Technological Advancement	Factor – 3	.829	.717
9.	VAR00009	Continuous Monitoring of Quality	Factor – 2	.814	.731
10	VAR00015	Technology utilization for enhancement of productivity	Factor – 2	.883	.785
11	VAR00016	Real time Training Needs	Factor – 2	.889	.804
12	VAR00017	Management of HEMM Technology	Factor – 3	.966	.941
13	VAR00018	Management of Manpower for Technological Implementation	Factor – 1	.916	.857
14	VAR00019	Land Acquisition issues	Factor – 1	.900	.814
15	VAR00020	Technological Effect on Environmental issue	Factor – 1	.955	.939
16	VAR00021	Supply Chain Issue & Spare Parts management	Factor – 3	.792	.698
17	VAR00022	Minimizing Wastage by applying New Technology	Factor – 2	.857	.744
18	VAR00023	Socio-Economic Issue on New Technology	Factor – 1	.846	.726
19	VAR00024	Real Time Transfer of Technological Change	Factor – 2	.849	.723
20	VAR00025	Policy Implication	Factor – 1	.929	.864
21	VAR00026	Planning for New Technology	Factor – 1	.933	.875
22	VAR00027	Maintenance of Equipments	Factor – 3	.935	.889
23	VAR00028	Technological Skills	Factor – 2	.986	.975
24	VAR00029	Safety Need for Technology	Factor – 2	.736	.549

Table No.4: Summary Results of Factor Analysis

Significant variables are identified statistically, and the corresponding factors extracted by the researcher are important pillar of the work and are highlighted below:

- **Mine planning and design** is the most important factor identified and is vital and could be regarded as an indispensable having effect on productivity and the same part also triggers selection of technology.
- **Evolution of technology** is second most important factor identified after mining planning and design. Now a day more options in terms of technology are present at national and international level for productivity/ production improvement, but the problem lies in its effective selection and implementations.
- **Effective management of technology** is another important factor, in absence of management of installed technology its capacity cannot be utilized to the fullest and frequent breakdown due to ineffective utilization is witnessed causing adverse effect on productivity.

Flower Model with Extracting Variables



Flower model present a networked approach to enhance productivity and efficiency in an integrative manner. Variables identified are not discrete rather they are complementary to each other. They are interdependent and guided towards the epicenter of management of technology. Out of 12 variables, which were found significant subsequently, were extracted in three factors namely; Mine Planning and Design, Evolution of Technology and Effective Management of Technology. These factors play a significant role in the Selection, implementation, and management of technology in an integrative manner and finally have a positive effect on enhancing productivity in prime sectors like coal mining. All variables identified here represents petals of the flower as the petals are joined together to the base of flower in a similar fashion these variables are interrelated and interdependent on each other to cast an incremental effect on the production of coal within the domain of CCL.

Factors	Factor- 1 Mine planning and design	Factor - 2 Evolution of Technology	Factor- 3 Effective Management of Technology
Variables	Financial Feasibility **(V6)**	Technology utilization for enhancement of productivity **(V10)**	Top Level Management for taking decision for adoption of new Technology **(V1)**
	Land Acquisition issues **(V14)**		Adoption of Foreign Technology **(V4)**
	Technological Effect on Environmental issue **(V15)**	Real time Training Needs **(V11)**	Management of HEMM Technology **(V12)**
	Management of Manpower for Technological Implementation **(V13)**	Technological Skills **(V23)**	Maintenance of Equipment's **(V22)**
	Planning for New Technology **(V21)**		

Table No. 5: Extracting Variables under Three Factors for Management of Technology

6.1 Test of Hypothesis

Selecting a modern technology as well as enhancing productivity with proper implementation is essential to manage the required important factors after factor analysis which is mention below for effective management of technology to enhance the production of coal. The center part of the research revolves around the fact-finding procedure "Whether Effective Management of Technology are Important for Enhancing the productivity of Coal". In this context the researcher feel that the production of coal is far behind and it is not getting the fixed target production because lacking proper management of technology. So, actual production was less than the targeted production which formed hypothesis of the study below:

- **H_0**: Management of technology is not significant in enhancing the production.
- **H_1**: Management of technology is significant in enhancing the production.

6.3.1 Hypothesis Test of Management of Technology

Observation

Chi-Square Tests			
	Value	DF	Sig. (2-sided)
Pearson Chi-Square	17.443	4	.002
Likelihood Ratio	18.627	4	.001
Linear-by-Linear Association	8.886	1	.003
No. Of valid Cases	385		
a. 0 cells (0%) have expected count less than 5. The minimum expected count is 11.29.			

The responses given by the selected respondents of CCL, CMPDIL and the open cast coal mines of CCL highlighted that to increase the productivity of coal , management f the installed technology is much required. The calculated value of Chi- Square Value is 17.443 at 4 degrees of freedom and P- value = 0.002, therefore it is statistically significant. In this case the alternating hypothesis is accepted and null hypothesis is rejected and it could be concluded that management of the installed technology s nuch required for an increased productivity. If management of technology is no done at proper evel then entire organization will suffer in terms of productivity.

7.1 Conclusion and Suggestions

- Most of the technologies adopted by Open cast mining industry in India are almost imported with latest technology involvement however the management of technology is lacking.
- Installation of technology is not only a panacea for productivity enhancement but its effective management of technology is significantly to improve productivity
- Support of Management, Selection of appropriate technology, Land Acquisition issues, Technical skills, Proper utilization of Machine and training are needed for advanced technology deployment and its effective management.
- Well trained and skilled people are more needed who can manage the installed technology and achieve the targeted production of coal.
- Te overall efficiency and productivity of the organization also depends on the technical expertise and know how to manage and use the technology.
- A sustainable innovation and improvement in management and maintenance of technology will increase the production of coal.

- Proactive decisions and effective managerial interventions are much required for selection, evaluation and installation of the required technology and improvement of product and processes.

Suggestions

On the basis of study following recommendations are forwarded to the company

- Selection and installation of technology should be carried by a joint team of experts, management representatives and employees
- To stimulate the adoption of installed technology programmes like open communication schemes, doubt clearing sessions, Job instruction training etc. should be organized frequently by management.
- Management should try to minimize both the layoff time of equipment and should also concentrate on reducing the cost of material handling.
- Organizations especially the mines in present context should organize the training and refresher programmes properly for workers and supervisory staff to ensure overall development
- Opportunity to every member of the organization should be given to discover and unlock their innovative ideas related to talent management, management of technology, decision making and developmental programmes.

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