

A STUDY AND ANALYSIS OF CONSTRUCTION EQUIPMENT MANAGEMENT USED IN CONSTRUCTION PROJECTS FOR IMPROVING PRODUCTIVITY

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ABSTRACT: Construction Equipment is the important factor to run the project in a successful manner. This paper elevated on benefits of implementing total Productivity. While purchasing, leasing or renting the equipment, and guide in optimizing the profitability. Methods of life cycle cost estimating and decision methods were researched and compared. Maintenance and it will also focusing on calculating the overall equipment effectiveness. Utilization of machine properly and match their capacities to specific project requirements. Current practices and observations made in Indian construction industry. The effectiveness of construction machineries is a major factor that differentiates construction companies in terms of heavy construction and light construction. The time and cost of project is most important constraint for the success of project. Data was acquired from equipment rental companies, construction companies and multiple construction projects. Hypotheses on some expected results were tested. Finally, the findings of this study were compared with findings of questionnaire conducted for finding significant commonalities and differences in equipment management practices. Maximizing the equipment effectiveness 81.5% of a production system. The objective of the work is to enhance the equipment effectiveness at a construction company. This research work revealed different factors of machinery management. Factors causing cost overrun in the construction projects were ranked on the basis of Relative Importance Index (RII). Top five significant factors identified were frequent equipment breakdowns, maintenance of equipment, insufficient number of equipment, performance and efficiency of equipment and inadequate modern equipment systems.

the mainstream of construction activities. The basic operations involved in the construction of any project are excavation, digging of small or large quantities of earth and moving them to fairly long distances, placement, compacting, leveling, dozing, grading, hauling, etc. All the machines that are usually used to carry out these construction operations are referred to as construction equipment. In most cases, they are called heavy equipment especially in road construction.

Construction firms are often faced with problems related to high rate of equipment failure or breakdown and accident resulting from unskilled operator's abuse. Poor training of equipment operators is often claimed as a major cause of equipment related accidents (John and Herman, 2009; Schenayder et al., 2002). In 1983, Agbo stated that the cost of equipment repair, fixed and variable operating cost wasted during the equipment downtime and a myriad of consequential costs that reverberate and surge through the construction business are enormous. The only way to avoid this huge amount of loss that usually lead to accompanies equipment breakdown or failure is to adopt proper equipment maintenance management strategy. This will keep construction equipment fit at all times and allow timely completion of construction project, thereby increasing construction project profitability. Thus, to understand effective construction equipment management, one must also understand effective construction equipment maintenance. There is need to let construction managers realize that maintenance of construction equipment if properly carryout is a profit Centre and not an unavoidable evil as some assumed.

I. INTRODUCTION

Good project management in construction must vigorously pursue the efficient utilization of labour, material and equipment. Improvement of labour productivity should be a major and continual concern of those who are responsible for cost control of constructed facilities. Material handling, which includes procurement, inventory, shop fabrication and field servicing, requires special attention for cost reduction. The use of new equipment and innovative methods has made possible wholesale changes in construction technologies in recent decades. Organizations which do not recognize the impact of various innovations and have not adapted to changing environments have justifiably been forced out of

CONSTRUCTION EQUIPMENT MAINTENANCE

The total productivity effort in morden industry is depend upon equipment and machinery .So those are a very important part of industry. Therefore, downtime or idleness of equipment's and machinery's becomes very expensive. Hence, the plant machinery should be properly maintained which is very much important. The highest percentage of cost commonly considered to maintenance costs which are related to operating a piece of equipment. It is also referred to by peurify and schexnayder (2002) as the highest percentage of cost related to the equipment's entire life cycle. The breakdown given was to 25% to depreciation,

15% to overhead, 23% to operating cost and 37% is related to maintenance and repair. The reason of the research title is maintenance due to its high percentage cost. The maintenance cost can shift hands in the process whether the piece is rented, leased or bought. The secondary impact condition is the level of service to the equipment directly impacts its life and therefore the hourly rate or cost calculation. In maintenance, it is important to keep various components in their original form as far as possible to ensure the safety and production speed. It includes inspection, adjustment and servicing, major repairs and overhauls in main workshop, small repairs in the field, and proper is of laid-up machine. The choice of construction equipment is determined on method of doing the work, the time to complete the work, and the cost of construction. Therefore, when there is shortage in selected plant and equipment force is occurred, it may influence on construction duration as well as the cost. Hence poor management of construction equipment may be considerable reason behind many of the factors. The Equipment Manager should coordinate with various wings of organization in discharging his job of equipment planning, balancing, selection of equipment, its deployment and its utilization, personnel selection and training, financial planning, preventive maintenance and general supervision. Hence, proper planning and management of equipment is crucial for the success of a firm, especially for the road project construction sector where profit margin is very low.

II.LITERATURE REVIEW

NileshAyane, MangeshGudadhe [2015]

In construction operations on a large scale require the standard Equipments for Effective operations especially in the area of infrastructural development. This is the true picture of large construction companies whose physical successful activities depends on men, materials and sophisticated machineries that will produce output of operations during a particular period use. Thus, the effectiveness of construction machineries is a major factor that differentiates construction companies in terms of heavy construction and light construction. In the today's era of intense global competition, construction industries are determined to improve and optimize their productivity in order to remain competitive. Overall Equipment Effectiveness (OEE) of a machine plays an important role where performance and quality of the product are of key importance to the company. The OEE intended at minimizing the breakdowns, increasing performance and quality rate and thus improving the effectiveness of the machine. To improve productivity it is essential to improve the performance of the construction systems. The desired production output is achieved through high equipment availability, which is influenced by equipment reliability and maintainability. 3. TPM is a structured equipment-centric continuous improvement process that strives to optimize production effectiveness by identifying and eliminating losses associated with equipment and production efficiency

throughout the production system life cycle through active team-based involvement of employees across all levels of the operational hierarchy.

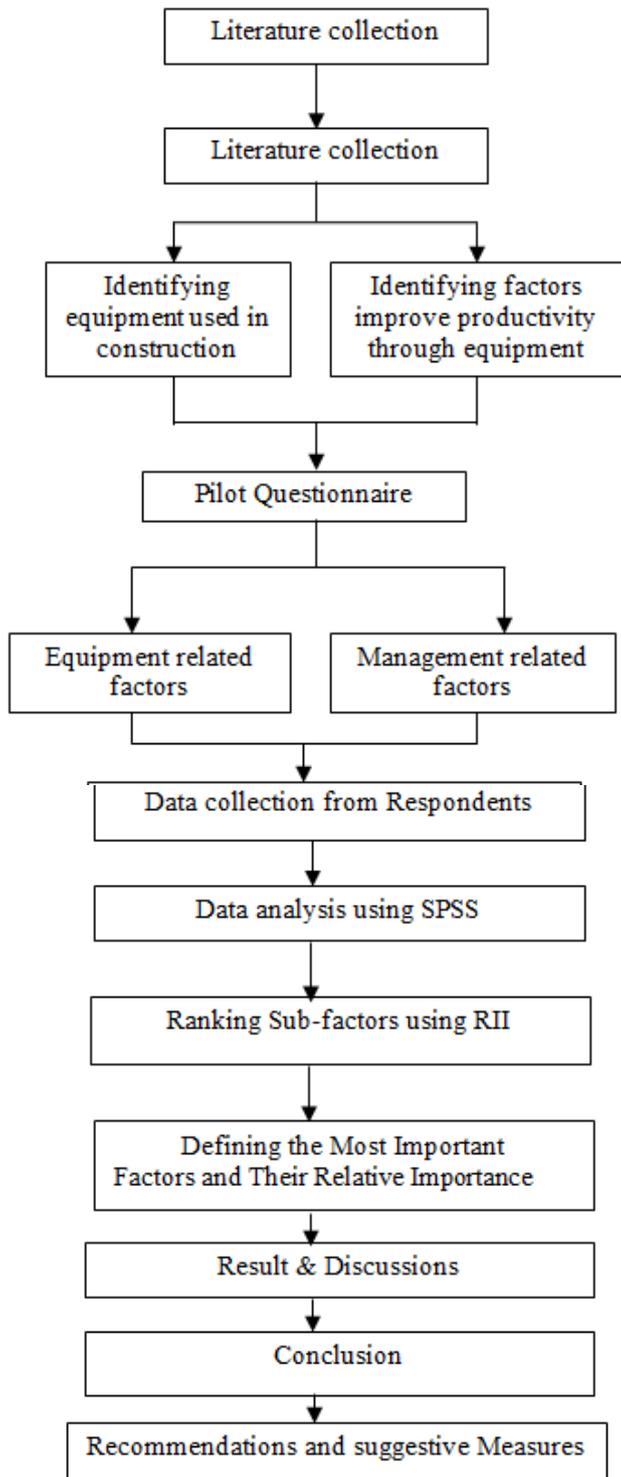
D. B. Phadatare, S. B. Charhate [2016]

The equipment management system and equipment policy always has a huge impact on the profitability of the contractors with more investment in equipment. In civil engineering construction projects, the cost of equipment can vary from 25-40% of the total project cost. The objective of this project was to study that how the planned and proper maintenance is important for construction equipment for better production. The overall equipment efficiency was improved with less idling, low machine breakdown and minimized accident in plants which maximized the productivity.

BantamlakAbebe, [2013]

The survey and interview was conducted through purposive sampling technique. For the sake of achieving the objectives of this study, questionnaires were analyzed in descriptive form and findings were displayed in a table with assistance of a statistical package for the social science (spss) program and data from interview and document reviews were interpreted qualitatively. The results show that construction equipment management practice from various perspectives of equipment management aspects in a total number of sixty-five (65) well-structured questionnaires were administered to eight different construction companies with identity of A, B, C, D, E, F, G and H to collect quantitative and qualitative data on how equipment maintenance has been handled in some randomly selected construction companies located in Abuja, Minna and their environs. The case study areas were selected because of their hub-heavy construction projects activities. Fifty-seven (57) which represents 87.7% of the total questionnaires were retrieved and analyzed. It is recommended that construction practitioners afford the opportunity of equipment maintenance strategy as part of construction project management. This will help reduce expenses, probability of unexpected failure, optimize utilization and minimize equipment downtime, which will in return increase the overall construction projects profitability.

III. METHODOLOGY



IV.ABOUT SOFTWARE

SPSS is a widely used program for statistical analysis in social science. It is also used by market researchers, health researchers, survey companies, government, education researchers, marketing organizations, data miners, and others. SPSS has scores of statistical and mathematical functions, scores statistical

procedures, and a very flexible data handling capability. It can read data in almost any format (e.g., numeric, alphanumeric, binary, dollar, date, time formats), and version 6 onwards can read files created using spread sheet/data base software. It also has excellent data manipulation utilities.

The many features of SPSS Statistics are accessible via pull-down menus or can be programmed with a proprietary 4GL command syntax language. Command syntax programming has the benefits of reproducible output, simplifying repetitive tasks, and handling complex data manipulations and analyses. Additionally, some complex applications can only be programmed in syntax and are not accessible through the menu structure. The pull-down menu interface also generates command syntax: this can be displayed in the output, although the default settings have to be changed to make the syntax visible to the user. They can also be pasted into a syntax file using the "paste" button present in each menu. Programs can be run interactively or unattended, using the supplied Production Job Facility.

V.QUESTIONNAIRE

1. Does the regular inspection avoid cost overrun?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

2. Will the equipment maintenance affect by improper cash flow?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

3. Have the past experience increase equipment workability?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

4. Have they facing accidents by improper equipment training?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

5. Do you reduce completion time of project by construction equipment?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

6. Have the quality improve by construction equipment?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

7. Have you choose earthwork equipment based on soil condition?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

8. If equipment management create any impact on construction?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

9. Does the equipment usage cost increase construction cost?

- Strongly agree
- Agree
- Neutral
- Strongly disagree
- Disagree

10. If the usage of modern equipment enhance projects?

- Strongly agree
- Agree
- Neutral
- Strongly disagree

VI. DATA COLLECTION

The study used both primary and secondary data. Here there are two basic sources of data sources namely, primarily and secondary source, in this study both primary and secondary sources of data was utilized through questionnaires, interview and literature review, observation check list & flows group discussion guide, etc. Primary sources of data

include interview and questionnaire, these questionnaires and interview were composed of both open ended and closed ended items, whereas secondary sources data were generated through a review of relevant documents. Questionnaires were distributed for 15 companies and collected their response for above questionnaire.

- This study was carried out within the major Construction Companies in India. These are companies that are majorly construction Engineering and are inclined in the execution of Infrastructural facilities development.
- The visit to some of these companies in some local government within the country shows that these companies make use of construction Equipment for the execution of most of their projects. This is one of the reasons why these construction companies have a wider scope of operation and good performance in their construction activities.
- The visit also awaits the opportunity of observing the practical operation of this construction Equipment with production and their effectiveness. The pictures taken for different construction Equipment were also reported for detail understanding and analysis.

The contribution of each of the factors to overall delays was examined and the ranking of the attributes in terms of their criticality as perceived by the respondents was done by use of Relative Importance Index (RII) which was computed using equation (2) and the results of the analysis are presented.

$$RII = \sum W / A * N \quad (0 \leq RII \leq 1)$$

Where:

W – is the weight given to each factor by the respondents and ranges from 1 to 5, (where “1” is “strongly disagree” and “5” is “strongly agree”);

A – is the highest weight (i.e. 5 in this case) and;

N – is the total number of respondents.

VII. ANALYSIS RESULTS

7.1 RII METHOD

S.NO	FACTOR	RANK CASE	RII
1.	Will the equipment maintenance affect by improper cash flow?	1	0.77
2	Have the improper training affect equipment?	2	0.72
3	Does the preventive maintenance reduce equipment loss?	2	0.72
4	Does the regular inspection avoid cost overrun?	3	0.68
5	Will you affect by unplanned budget?	3	0.68

6	If delay analysis are important?	3	0.68
7	If the higher resale value decrease economic loss?	3	0.68
8	Is there any problem with poor supervision?	3	0.68
9	How does equipment affect by un routine maintenance?	3	0.68
10	Will owning cost have the problem with construction equipment?	4	0.67

puts them into factors. This method does not include the unique variance of all variables. This method is used in SEM.

Image factoring: This method is based on correlation matrix. OLS Regression method is used to predict the factor in image factoring.

Maximum likelihood method: This method also works on correlation metric but it uses maximum likelihood method to factor.

7.2 FACTOR ANALYSIS

The key concept of factor analysis is that multiple observed variables have similar patterns of responses because they are all associated with a latent (i.e. not directly measured) variable. For example, people may respond similarly to questions about income, education, and occupation, which are all associated with the latent variable socioeconomic status. In every factor analysis, there is the same number of factors as there are variables. Each factor captures a certain amount of the overall variance in the observed variables, and the factors are always listed in order of how much variation they explain. The Eigen value is a measure of how much of the variance of the observed variables a factor explains. Any factor with an Eigen value ≥ 1 explains more variance than a single observed variable.

7.3 FREQUENCY ANALYSIS

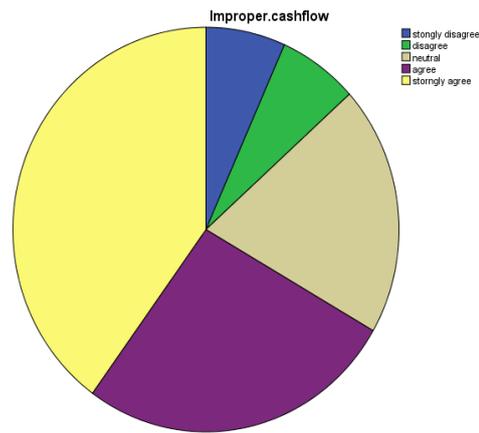


Fig 1 Improper cash flow

	Component			
	1	2	3	4
Improper cash flow	.612	.065	.684	-.022
Improper Training	-.594	.554	-.074	-.077
Preventive maintenance	.650	.064	.140	.001
Cost overrun	-.455	-.438	.668	.151
Unplanned budget	.855	.108	-.228	.089
Delay analysis	-.133	-.694	-.264	.403
Resale value	-.703	-.266	-.250	-.146
Poor supervision	.419	-.352	-.421	.452
Un routine maintenance	-.314	.292	.381	.755
Owning cost	-.112	.760	-.269	.368

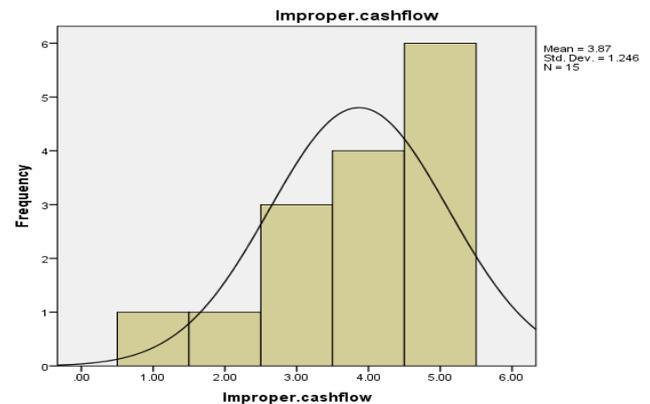


Fig 2 Histogram for Improper Cash flow

COMPONENT MATRIX

Principal component analysis: This is the most common method used by researchers. PCA starts extracting the maximum variance and puts them into the first factor. After that, it removes that variance explained by the first factors and then starts extracting maximum variance for the second factor. This process goes to the last factor.

In order to get better understandings of what the major construction equipment planning and management problems affect the productivity of equipment in many construction sectors 15 case study projects were conducted. The analysis was carried out on the evaluation of construction equipment’s overall performance. The analysis focused on performance analysis of construction equipment productivity on projects to depict the extent of current productivity loss and impact of productivity loss on the financial performance of equipment. The research undertaken established that many constructions were used multifunctional equipment’s for improving productivity, relative importance index of 0.77 and was ranked as the top

Common factor analysis: The second most preferred method by researchers; it extracts the common variance and

most criteria. it can be observed that the key factors that contributed most to Equipment used construction projects are, Based on our Respondents response in pilot survey major factors to affect productivity will be categorized are, Improper cash flow (RII = 0.77, Rank case = 1), Improper training, Preventive maintenance (RII = 0.72, Rank case = 2) are the same priority.

IX.CONCLUSION AND RECOMMENDATION

Factors affecting productivity in construction can be divided into two categories: human-related factors and management-related factors. These factors affect the morale and motivation of individuals. Quality of supervision, material management, site planning, constructability, and change management are the most significant management-related factors that influence productivity directly. The cost of the project must include the cost of equipment needed to build the project. The constructor must be able to determine, as accurately as possible, the duration of each piece of equipment required for each activity of the project. In our project focused on leading construction equipment planning and management problems in construction projects. The result indicated that idle time, down time, poor equipment maintenance practices, improper determination of economic life and timing of replacement, poor training of equipment operators, equipment breakdown, over maintenance of equipment, huge capital investment during acquisition, balance of interdependent equipment, misunderstanding the scope of work carried out, unit cost of production and equipment suitability for job condition were found to be the major problems that affect construction equipment planning and management. The overall productivity of construction is affected by various reasons. To improve productivity it is essential to improve the performance of the construction systems. The desired production output is achieved through high equipment availability, which is influenced by equipment reliability and maintainability.

9.1 RECOMMENDATIONS

Rank I:

Predictable expenses

Planned maintenance can help you budget for ongoing maintenance including parts, labor, travel, supplies and lubricants and provide totals per month and total length of contract. Knowing the fixed costs of planned maintenance can also help minimize the impact of any unexpected business expenses and protect against ongoing nickel-and-dime repairs that can deplete your maintenance budget. These small repairs can add up over time. You may not think they are hurting your budget, but imagine the damage five or six small repairs can do. Planned maintenance also eliminates the expense associated with stocking filters, oil, tires, tracks and other common replacement parts.

RANK II

A planned maintenance program helps control the cost of ownership by guarding against unexpected downtime and sudden, costly repairs. The ability to minimize downtime depends entirely on how proactive you are about taking care of your machine. Proactive planned maintenance by trained service technicians addresses minor fixes before they become major repairs. Identifying these repair issues during regular, planned maintenance helps avoid future breakdowns and unscheduled downtime. Reliable maintenance intervals also make it possible to efficiently schedule your machine service at a time and location that doesn't disrupt your productivity. Some manufacturers provide road service technicians and trucks that travel to your jobsite to complete routine maintenance and diagnostics should a machine experience problems. Longer machine life.

Rank III

The proactive measures are those which should be adopted in the planning stage of project. The following list talks about the classification of some common planning strategies. The proactive strategies include: efficient planning of strategies, and management of site and supervision of the project; appropriate planning and arrangement of project; organized regulatory mechanism; and using proper methods for construction. Regular meetings on development, employing proficient subcontractors and suppliers, attributing less weight to prices, and more weight to abilities and earlier performance of contractors to improve the contracts and their procedures are some reactive and organizational strategies. Using channels for perfect information and communication is a proactive and organizational strategy. Utilization of latest technology is a proactive and reactive strategy. Maintaining your heavy construction equipment requires more than simply following a manufacturer's maintenance schedule. Taking proper care of your equipment while it is in use is also critically important to avoiding machine failure. One way that you can reduce the risk of breakdowns is by following a manufacturer's guidance when it comes to how equipment should be utilized. Exceeding the performance specifications and limitations of a particular piece of equipment can compromise its efficiency and effectiveness, and can ultimately lead to a failure that may endanger workers.

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BIOGRAPHY:



M. Manikandan. M.E.,(Construction Engineering & Management) student of Sona college of Technology, Salem - 636005. In my Journal I would like to conclude Improve productivity based on construction equipment factors influencing the optimization of cost management.