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Improve Productivity of Equipment in Construction by Proper Equipment Maintenance

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Abstract

The contractors equipment policy and equipment management system have a great impact on the profitability of a firm, especially for contractors with large investment in equipment. In construction project 20-25 % of total cost of project used for construction equipment. The data given is monthly equipment utilization on site & various reasons for losses in cost and production of construction Equipment. From the proper equipment maintenance plan contractor can minimize the downtime of equipment as well as time and cost. From a case study it is explained that the various problem occurred due to not proper maintenance of equipment. Also as per time and cost optimization which type of maintenance is required as per Equipment condition, and for that right maintenance plan to be prepared. By proper maintaining of equipment it will be increase the productivity of equipment. By proper planning, selection, procurement, installation, operation and maintenance of equipment is beneficial to contractor.

Keywords*: - Equipment maintenance plan, Productivity, utilization of equipment, Equipment management, etc.*

INTRODUCTION

This Construction industry is the second largest and basic input for socio-economic development of our country after agriculture. Though construction projects in India facing various problems, delay in

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construction is one of the major issues. It is defined as "the time overrun, either beyond the completion date specified in a contract or beyond the date that the parties agreed upon for delivery of a project". It is considered as a common problem in construction projects.

In most of the projects, there will be delays and their impact level varies on each project which depends on several factors such as nature and type of construction, importance of project etc.

The breakdown given was to 25% to depreciation, 15% to overhead, 23% to operating cost and 37% is related to maintenance and repair. 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 of 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.

Maintenance action can be categorized into four general strategies. Like On-Failure, Condition based, Fixed time, Design out of different equipment.

Need for equipment maintenance records and workshops

Construction is the ultimate objective of a design and machines make accomplishment of that objective possible. Mechanized construction is indispensable under certain conditions for quick, efficient and quality oriented execution of the projects.

The ability to win contracts and to perform them at a profit is determined for the construction contractor by two vital assets: people and equipment. Optimizing in the management of an equipment spread is critical for a contractor in achieving a competitive pricing position.

LITERATURE REVIEW

Anirban Deshmukh made a study on construction equipment used on site. The various method and equipments are outdated from these days because of that lot of construction projects are delayed and over budgeted. So his study about selection criteria of equipment & there availability, applicability in work. Also he

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gave a sample example for that study for better understanding.

Mali Pritam A had focus on benefits of preventive maintenance over reactive maintenance for construction equipments. He also studied on various losses and effects on production in construction industry because of breakdown or failure of equipment. At the end he proved that how regular equipment maintenance is beneficial to production.

Hamid Aadal, Ali Bagheri Fard, Kiyanoosh Golchin Rad made a separate study of construction plant use in the construction sites and also its effect on the quality and time of the project. In this study the collected and analyze through SPSS software and based on mean index of the scores five items have been identifies as the most important issues in the construction management regarding the use if plants. The effect of spare parts availability to decrease downtime, the effect of employing expert mechanics to increase the repair quality, impact of gasoline and petrol availability to decrease wasting the time, impact of periodic control and serviceability of plants and equipment to increase productivity, impact of training persons who are involved plants and equipment to increase productivity.

Nilesh D. Chinchore & Pranay R. Khare studied on planning and selection of heavy construction equipment in construction. For timely completion of construction project proper selection and planning of various equipments are very important. At the same time forecasting date wise requirement of number and type of equipment required for continuation of project.

M. Manikandan had study on how to manage the equipment for improve in productivity of construction project. Equipment purchasing, leasing or renting the equipment and guide in optimization the profitability. Effective use of equipment as per their requirement like light or heavy construction also focusing on calculating the overall equipment effectiveness.

Abdul Rajjak khan made study on maintenance process of equipment required at construction site. He focus his study on equipment maintenance and repair records of all equipment used on site & design a proper repair workshop for these equipments. At the same time he gave the importance of replacement policy

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of equipment at particular interval for maximizes the production.

Ricky A. Cook studied on Maintenance plan for different heavy equipments in construction. Also the time and cost associated for maintenance of construction equipment. For better efficiency of equipment and safety at construction site it is important to have a proper maintenance plan for different construction Equipment.

Mali P.A. studied how maintenance of equipment is important in production in construction. From a case study he explained the various reason of breakdown of equipment and because of that the loss in time and cost of construction. He also explained that by proper maintenance plan for equipment and by using MSP software we can minimize the loss occurred by breakdown or repair.

Prasannasangeetha A, told about the importance of Equipment management in construction sector. In the project 10-25 % cost of project required for equipments. If we handle with care and adopting preventive measures then we can minimize time and cost of project & increase its productivity (Efficiency).

METHODOLOGY

Planning for construction Equipment

Proper planning of construction equipment play important role in production on construction site. It includes selection of equipment, number and size of equipment, capacity, required technical staff to operate, service and repair of the equipment.

- ***Selection of Equipment-*** It depends upon soil and ground condition and upon the different characteristics of material to be handled. Selection of most suitable equipment for particular work is very difficult to a contractor.

- ***Number and Size of Equipment-*** It depend upon the magnitude and nature of work/task, working time available. Also it depends on quantity of work to do and the time given for the same for completion of work. At same time distribution of work and time at site for better understanding.

- ***Capacity-*** As per given task or work and time to be complete will decide the capacity of equipment needed. It also depends on the working space restriction, Altitude and weather condition, availability of local resources of manpower, material etc.,

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availability of equipment hiring, repair and maintenance facilities, availability of fuel, oil & lubricants. It is also depends on usefulness of the suitable equipment available for other and future task.

- ***Operating Reliability-*** The different points should be considered before procured or hired any of equipment. Like, Manufactures reputation, equipment components, warranties and guarantees, operators acceptability, adaptability and training requirements. Various preventive maintenance programs, Safety features, ease of repair and maintenance.

- ***Economic Consideration-*** For procurement or hiring the equipments there are different points should be taken in consideration for arranging the finance for equipment. Means owning cost, operating cost, Resale or residual value after use, Replacement cost of existing, unit cost of production, etc.

Equipment Acquisition Option

A project has multifarious activities where plant can be employed effectively and efficiently, but this does not justify purchasing plant to perform all activities. For purchasing a plant requires very heavy capital & it is difficult to afford the luxury of owning all types of plant and machinery required in a project for contractor. So contractor have a number of options for acquiring plant. Like,

a) Purchasing –
b) Renting
c) Leasing and Hire Purchase
d) Outsourcing

At the same time it needs the exact balance between availability of spares and low inventory cost. On the one side it should provide proper assurance for availability of desired spare parts in proper time and quantity and on other side it should not result in excessive blocking up of capital. So at end Proper Planning is very much essential to get the best results.

EQUIPMENT MAINTENANCE PLAN (EMP)

The Equipment Maintenance plan (EMP) is used for developing tasks needed to properly maintain facility, process of equipment. It helps leads the persons developing the required maintenance tasks by ensuring that the development is done consistently for all equipment.

Each maintenance plan should include one or more maintenance task designed to ensure the continued operation and

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maintenance of an equipment item, system. The characteristics of each of those tasks as following,

1. A descriptive title for each maintenance task to be performed.
2. A frequency assigned for performing of each task.
3. Current Equipment condition required for performance of the task. (i.e., running or shut down)
4. Type of work- Reactive Maintenance, Preventive Maintenance, predictive Maintenance, Proactive Maintenance.
5. Estimated time to perform particular task.
6. Special tools, material and equipment required to perform the task.

The Maintenance plan determines the quality of maintenance work. To accomplish thus, each individual member of the maintenance crew must have sense of responsibility and consider methods for preparing, executing and validating his or her own work.

The benefits of creating maintenance plan are:

a) The number of operational steps can be reutilized.
b) Human resource required can be planned so that required personnel's are available.
c) Errors in the procurement of material, spare parts and subcontracting work can be prevented.
d) Quality can be checked and better material can be procured.
e) By devising related work detail plans, schedules can be set so that they are coordinated with production plans.
f) Repair cycle can be identified so that measures can be taken in a timely fashion.
g) Standardization patterns for repair work can be identified enabling the work to be done efficiently.
h) Simultaneously repair plans can be devised.
i) People's sense of responsibility can be encouraged.
j) Through planned work activities large volume of work can be more efficiently accomplished.

Elements of Equipment maintenance plan

1. Organizational planning and support
2. Standards and Practice
3. Training
4. Accountability and performance feedback

Maintenance of equipment is the operation of keeping its various components in their original form as far as possible with the

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view to ensure that safety and production in operation do not deteriorate. It includes servicing, inspection and adjustment, small repairs in the field, major repairs and overhaul in main workshops.

Economics of Construction Equipment

Economics of construction equipment is mainly study on cost accounting process pertaining to the working of the Equipment and includes unit cost of production.

In another aspect of the cost accounting process is the keep of records pertaining to equipment. Without these records it would be impossible to control equipment costs and valuable information necessary in future equipment selection would be lost.

a) Cost of equipment delivered to owner
b) Conditions under which it is used.
c) Number of hours it is used per year
d) Number of years it is used
e) Maintenance and repair for the Equipments

In order to optimize the procurement and utilization of the construction equipment, it is necessary to understand the various factors of cost of using the equipment.

DATA COLLECTION

For data collection we have considering a JW Tower, building at Pune. Which is a commercial project site taken as case study. The data collected from site regarding the process of construction of JW project about equipment information is given below.

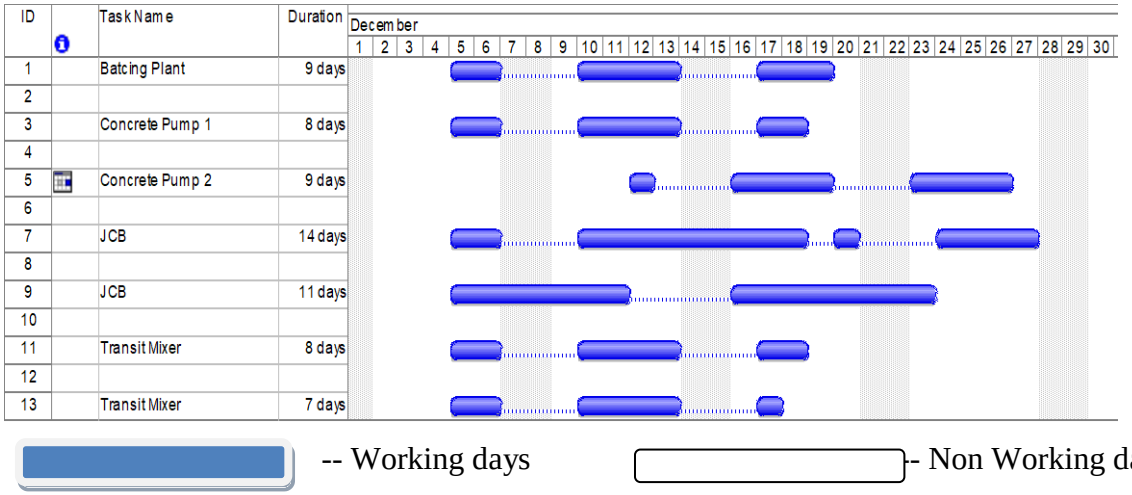
The details of Equipments to be considered for study are as follows,

Table no. 1: Equipment list to be considered for data collection

NO.	EQUIPMENT NAME	COMPANY
1	Batching Plant (30 cum/hr)	Schwing Stetter
2	Power Shovel (JCB)	L&T
3	Concrete Pump	Kirloskar
4	Transit Mixer	Ashok Leyland

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Monthly Equipment utilization on site (with MSP software)



Bar Charts showing outstanding cumulative production verses Actual Production data also Loss or Delay in Production

EXCAVATION

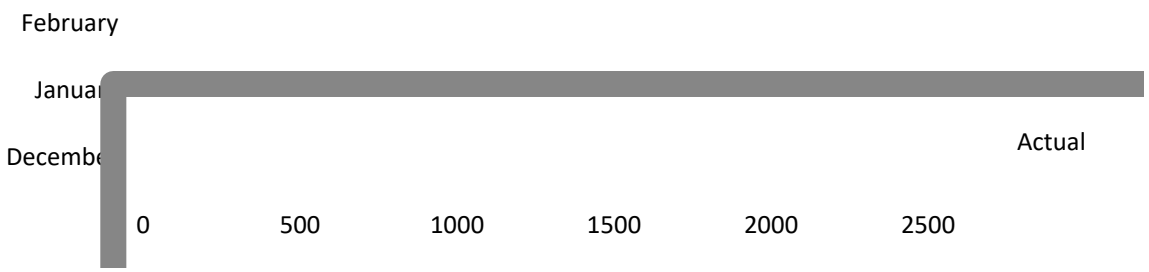


Figure 1: Bar charts of Excavation activity done on site Actual and planned production data

CONCRETING

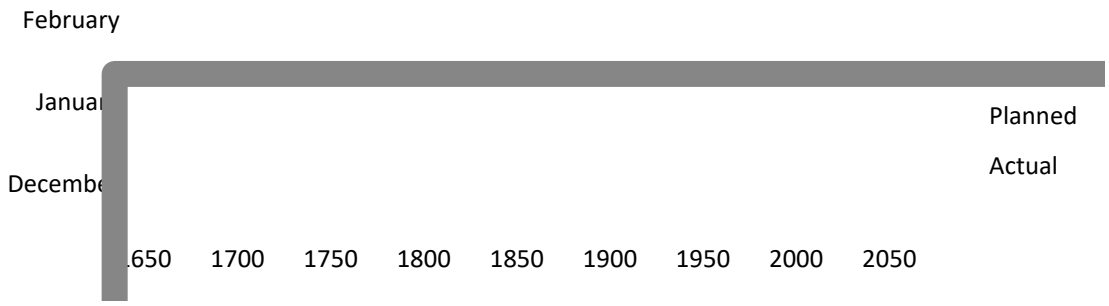


Figure 2: Bar charts of concreting activity done on site Actual and planned production data

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DATA ANALYSIS

In Data Analysis we focus on delay due to breakdown and cost required because of breakdown.

Delays due to breakdown

Total delay per equipment in entire period of 3 months (December – February 2020) with total Expenditure is given below-

Table no. 2: Total delays with expenditure for every equipment

NO.	EQUIPMENT	DELAY IN DAYS	DELAY IN HOURS	TOTAL EXPENDITURE IN Rs.
1	CONCRETE PUMP 01	3-4	22	2350
2	CONCRETE PUMP 02	3-4	21	2210
3	JCB 1	4-5	52	12100
4	JCB 2	5-6	68	15280
5	TRANSIT MIXER 1	4-5	55	5250
6	TRANSIT MIXER 2	3-4	46	5450
7	TRANSIT MIXER 3	2-3	31	2720
8	TRANSIT MIXER 4	2-3	31	4000
9	TRANSIT MIXER 5	4-5	46	4680
10	BATCHING PLANT	1-2	15	4550

In above site there was no proper maintenance schedule recorded. There was only Reactive Maintenance applied on their equipment's. There are mainly four types of Equipment Maintenance,

1) Reactive Maintenance
2) Preventive Maintenance
3) Predictive Maintenance
4) Proactive Maintenance.

In all these types of equipment maintenance if they are using PREVENTIVE MAINTENACE for their all equipment's then there was no wastage of money and time for contractor. The Project was completed earlier with less cost.

Total Expenditure in Cost of various Equipment

Graph Showing the Total Expenditure incurred on account of breakdown & failure for various Equipment in the duration taken for work-

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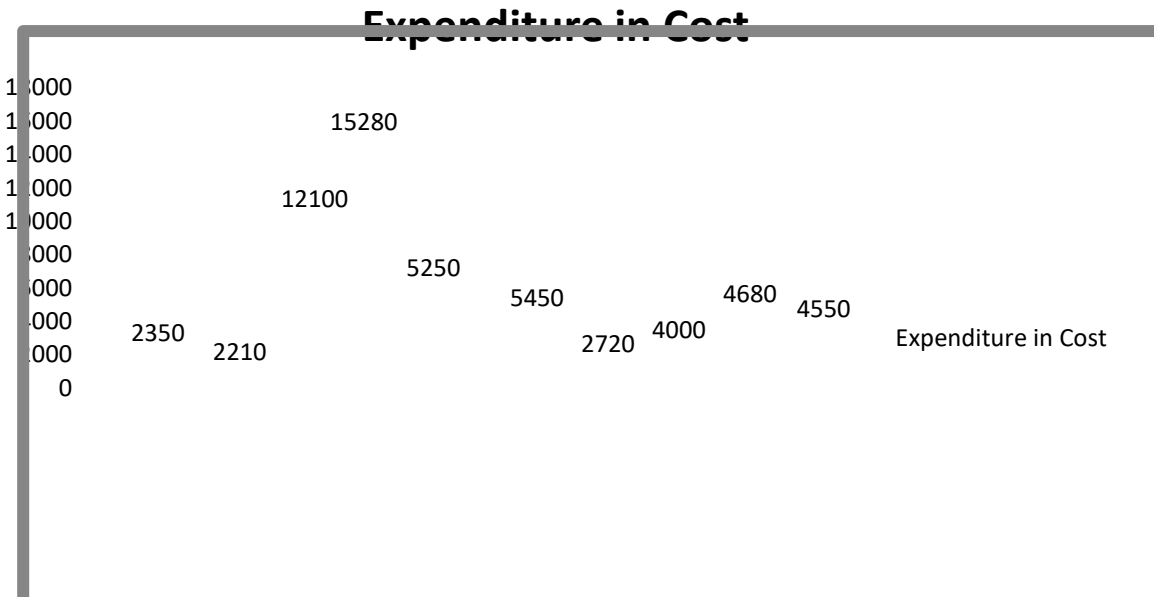


Figure No. 3: Expenditure in cost of each equipment in all month

Reasons for production loss and delay in construction due to Equipment breakdown & Failure

There are lots of reasons for delay in construction project. Some of major reasons for delay are below,

1. Equipment life was over.
2. Not providing daily/weekly maintenance to equipments.
3. Spare parts are not available on site.
4. No proper maintenance schedule was prepared for equipment maintenance.
5. Skilled labours are not available on site for operating Equipment.
6. Servicing workshop is far away from site.
7. Only Reactive maintenance was done they didn't go for any preventive maintenance for any Equipment.

ANALYTICAL CONCLUSION

From the above study we analyze that the breakdown & failure of any equipment leads to loss of production. For this loss of production is due to the various reasons are mentioned above.

If we analyze that then failure of equipment from the above reason then,

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Table no. 3: Reasons for % failure for considered Equipment

S. No.	Reason of Failure	% of Failure
1	Equipment life was over.	**13%**
2	Not providing daily/weekly maintenance to equipments.	**15%**
3	Spare parts are not available on site.	**21%**
4	No proper maintenance schedule was prepared for equipment maintenance.	**20%**
5	Skilled labours are not available on site for operating Equipment.	**4%**
6	Servicing workshop is far away from site.	**9%**
7	Only Reactive maintenance was done they didn't go for any preventive maintenance for any Equipment.	**18%**

In the 66 times events of failure occur for total 10 equipment's over a period of 3 months.(December 2019 – February 2019) Take example, first reason Equipment life was over this reason was applicable 20 times event in out of 84 events.

In case of life over of equipment reason , its occurrence in compared to total failure of equipment's over a period of 6 month will come to, (20/66)*100=30%

Total of % wise failure for all reason comes to 222.

Hence against the above total of % over the various reasons indicated in table above occurrence of reason,

1. Equipment life was over comes to, (30/222)*100= 13%

On the above line individual % of failure for a reason over total period, like wise calculate the all related reasons and their % failure.

Analysis of equipment failure can be done with different fashion however this methodology shows which reason has been observed for major duration for failure of equipment in the above table.

RECOMMENDATION

1. Replacement of old equipment by new equipments.
2. Carrying out routine Preventive Maintenance.
3. Major Maintenance once a month when all related activities work should be stopped.
4. Increasing number of units of equipment for certain activities & keeping them available as stand by, when their likelihood of loss in production.
5. Apply proper Maintenance schedule for each type of Equipment.
6. Some important spare parts should be available on site.
7. Use Software for proper planning & managing Equipments.

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CONCLUSION

Construction Equipment plays important role for completion of project within estimated time in construction industry. Proper planning, selection, procurement, installation, operation, maintenance and replacement policy plays important role in Equipment Management for successful completion of project.

From the case study and data collected it is seen that breakdown & repair of equipment ultimately affect the overall productivity in construction activity on the project. At the end it leads to loss in time and loss of money in construction project. From the above analysis we seen the Preventive maintenance is always better for all equipments. But in above case study they had gone for only reactive maintenance so its results to loss in production, loss in time & money. Proactive and Predictive maintenance are also very much helpful for minimizing failure of equipment. For some equipment Replacement is needed for better performance.

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