

# Management of Equipment in Construction

Anagha jaijith, Fazil P

Dept. Of Civil Engineering, Cochin College Of Engineering And Technology, Valanchery, Kerala, India

**Abstract:** Construction equipment is a major resource in the building process for a construction project. When equipment is owned by a contractor, it forms a sizable portion of his assets requiring proper management practices. Good project management in construction must vigorously pursue the efficient utilization of labour, material and equipment. The use of new equipment and innovative methods has made possible wholesale changes in construction technologies in recent decades. The selection of the appropriate type and size of construction equipment often affects the required amount of time and effort and thus the jobsite productivity of a project. It is therefore important for site managers and construction planners to be familiar with the characteristics of the major types of equipment most commonly used in construction. This thesis is to study the management of equipments practices in Construction Industry and to present the most popular practices of the contractors and to compare the equipment management policies with a Case study of a construction industry. The needed data were collected via a structured questionnaire. The collected data were analysed using the RII method. Finally, the findings of this study were compared with findings of questionnaire conducted for finding significant commonalities and differences in equipment management practices.

**Keywords:** Relative Importance Index (RII)

## 1. 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 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

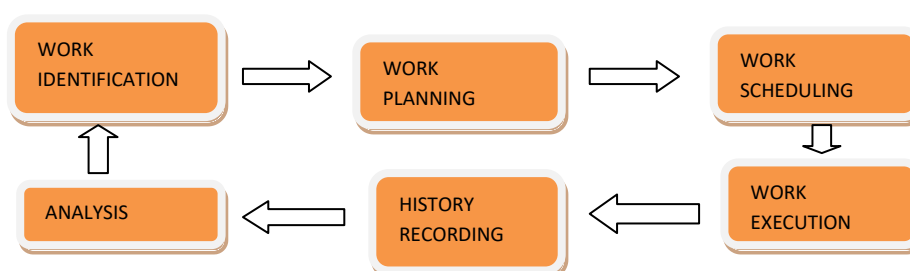
operations are referred to as construction equipment. In most cases, they are called heavy equipment especially in road construction.

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.

## 2. Construction Equipment Maintenance

In work identification, find the work of maintenance of that particular equipment; identify the type of maintenance required. Further in work planning, plane for how the maintenance work going to perform on that particular equipment, how much time required for maintenance work and schedule the work to be performed. After completing all planning and scheduling of work, actual execution of work start. Records the works performed on that equipment, and mention it in maintenance record book. Analysis the work, check whether it is performing better or not otherwise again starts from work identification.

Fig.1. Maintenance process



#### A. Type of maintenance

1. Reactive Maintenance – A maintenance system that repairs after breakdown occurs in equipment.
2. Preventive Maintenance – A maintenance system that uses maintenance procedures to prevent breakdown by following a procedural approach with schedules and guidelines.
3. Predictive Maintenance – In predictive maintenance, online condition monitoring helps identify when wearout risk starts to increase and anticipate when failure is likely to occur. It is an equipment condition rather than time intervals which determine the need for service.
4. Proactive Maintenance – Proactive maintenance based on data provided by predictive methods to identify problems and isolated the source of failure. To find out the root cause of the failure, proactive maintenance is use.

#### B. Maintenance strategies

Maintenance action can be categorized into four general strategies. These four strategies often used on the same machine.

1. On-Failure: Mostly the equipment fails at its running condition that's why it requires urgent maintenance for proper work perform.
2. Condition Based: Maintenance is done as per the condition of equipment. Earlier maintenance is requires if its condition is dangerous.
3. Fixed Time: Maintenance is done as per planned schedule. (Per month, every 3 months, once in 6 month, yearly)
4. Design Out: In maintenance work, first priority is to identify the main root cause of failure of that particular equipment.

### 3. Classification of construction equipments

#### A. Earthwork equipments

Earth cutting and moving equipments: Bulldozers, Scrapers, Front-end loaders, Motor graders.

1. Excavation and lifting equipment: Backhoes, Power shovels, Draglines, Clamshells.
2. Loading equipment: Loaders, shovels, Excavators.
3. Transportation Equipment: Tippers, Dump trucks, Scrapers, Conveyors.
4. Compacting Equipment: Tamping foot rollers, smooth wheel rollers, Pneumatic rollers, Vibratory rollers, plate compactors.

#### B. Concreting plant and equipments

1. Production Equipment : Batching plants, concrete mixers.
2. Transportation equipment : Truck mixers, Concrete dumpers.
3. Placing equipment : Concrete pumps, Conveyors, Hoists, Grouting equipment.
4. Concrete Vibrating equipment: Needle vibrators, Plate compactors.

#### C. Material hoisting equipments

1. Hoists: Fixed, Mobile, Fork lifts.
2. Mobile cranes: Crawler mounted, self propelled rubber tyred, truck mounted.
3. Tower cranes: Stationary, Travelling type.

#### D. Special purpose heavy construction plant and equipments

1. Aggregate production equipment: Crushing plants, Rock blasting equipment, Screening plants.
2. Concrete paving equipment: Concrete paver finishers.
3. Pile driving equipment: Pile driving hammers.
4. Asphalt mix production and Placement equipment: Asphalt plants, Asphalt pavers.
5. Tunneling equipment: Drill Jumbos, Muck hauling equipment, Rock bolters, Tunnel boring machines.

#### E. Support & utility services equipment

1. Pumping and Dewatering equipment.
2. Pipe laying equipment.
3. Generators.
4. Welding equipment.

### 4. Sourcing information

1. Name of manufacturer
2. Model number
3. Engine type, horse power and speed
4. Machine dimensions
5. Type of controls
6. Operating pressure
7. Fuel consumption
8. Type of transmission
9. Weight
10. Warranty periods
11. Maintenance details

## 5. Methodology

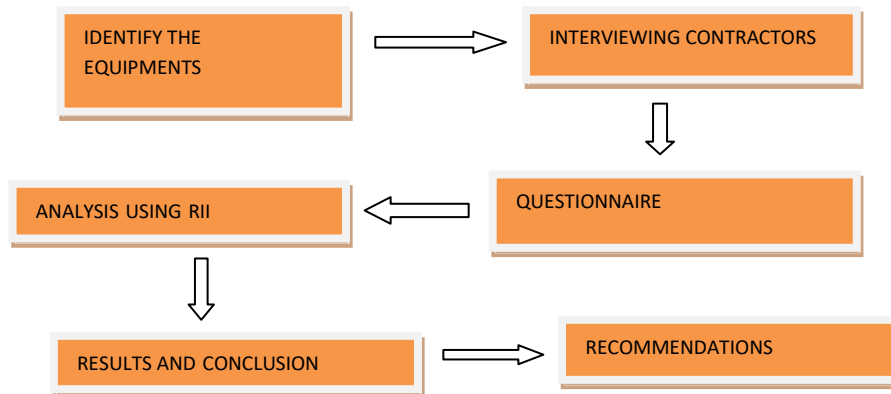


Fig.2. Methodology

## 6. Questionnaire

Table 1  
Questionnaire

S.NO.	FACTOR	1	2	3	4	5
1	Does the regular inspection avoid cost overrun?					
2	Will the equipment maintenance affect by improper cash flow?					
3	Have the past experience increase equipment workability?					
4	Have they facing accidents by improper equipment training?					
5	Do you reduce completion time of project by construction equipment?					
6	Have the quality improve by construction equipment?					
7	Have you choose earthwork equipment based on soil condition?					
8	If equipment management create any impact on construction?					
9	Does the equipment usage cost increase construction cost?					
10	If the usage of					

	modern equipment enhance projects?					
11	Do you test the equipments before buying?					
12	Are equipment proposal alternatives searched?					
13	Budget prepared for capital budgeting?					
14	Is standard forms used?					
15	Frequency of undertaking routine maintenance?					
16	Type of routine maintenance?					
17	Maintenance personnel?					
18	Is equipment utilization record maintained?					
19	Does operator fill operator's daily report?					
20	Frequency of making equipment reports?					
21	Checking replacement time					
22	Frequency of replacement?					
23	Influence of obtainable salvage value?					

## 7. RII Method

The relative index of inequality (RII) is a regression-based index which summarizes the magnitude of socio-economic status (SES) as a source of inequalities in health. RII is useful because it takes into account the size of the population and the relative disadvantage experienced by

different groups. The disease outcome is regressed on the proportion of the population that has a higher position in the hierarchy.

The RII is particularly valuable when comparing risk factors (independent variables) that are on very different scales (e.g. low SES, low IQ, cigarette smoking). The RII is calculated in the following way:

1. Rank cases on each of the variables
2. For tied ranks and for categorical variables, assign the mean rank
3. Divide the ranks by the sample size, creating a value ranging from 0 to 1

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 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.

## 8. Result

Table 2

RII Ranking results

Sl.NO.	FACTOR	RANK	RII
1	Does the regular inspection avoid cost overrun?	1	0.93
2	Will the equipment maintenance affect by improper cash flow?	1	0.93
3	Does the equipment usage cost increase construction cost?	1	0.93
4	Budget prepared for capital budgeting?	1	0.93
5	Influence of obtainable salvage value?	1	0.93
6	Have the quality improve by construction equipment?	2	0.83
7	Do you test the equipments before buying?	2	0.83
8	Frequency of replacement?	2	0.83
9	Have they facing accidents by improper equipment training?	3	0.75
10	If equipment management create any impact on construction?	3	0.75
11	Maintenance personnel?	3	0.75
12	Does operator fill operator's daily report?	3	0.75
13	Do you reduce completion time of project by construction equipment?	4	0.74
14	Checking replacement time	4	0.74
15	Have the past experience increase equipment workability?	5	0.64
16	If the usage of modern equipment enhance projects?	5	0.64
17	Frequency of undertaking routine maintenance?	5	0.64
18	Type of routine maintenance?	5	0.64
19	Is equipment utilization record maintained?	5	0.64
20	Have you choose earthwork equipment based on soil condition?	6	0.57
21	Are equipment proposal alternatives searched?	6	0.57
22	Is standard forms used?	6	0.57
23	Frequency of making equipment reports?	6	0.57

1. **R1:** Every owner are concerned with the profit of the company. Earning a profit is important to a small business because profitability impacts whether a company can secure financing from a bank, attract investors to fund its operations and grow its business. Companies cannot remain in business without turning a profit.
2. **R2:** Quality control and safety are a number one concern in the construction industry, defects or failures can be very costly to both businesses financially but also to people as they can result in personal injuries or fatalities. Therefore whatever the job may be, big or small; you must always ensure that the equipment and materials used is to the highest quality standard, preventing the likelihood of accidents and costly delays. Better quality products not only provide a higher safety level for both you and others around you but they

can also enhance the quality of the finished project. One of the biggest mistakes in DIY or homebuilding is buying low quality equipment, to try and save money, however these products generally require frequent and annoying repairs, meaning that you end up spending far more that you would if you would have bought the higher quality equipment.

3. **R3:** Trained personnel will be able to make better and economical use of materials and equipments. Wastage will be low. In addition, the rate of accidents and damage to machinery and equipment will be kept to minimum by the well-trained employees. These will lead to less cost of production per unit.
4. **R4:** Construction equipment management requires real-time visibility and tracking of all of your equipment and tools–the very foundation for

profitable construction jobs. Regardless of how you bid the job, you need to accurately track costs, mobilize assets, measure utilization and be able to charge back costs to that specific job site or task. Equipment rental companies know a thing or two about managing assets that construction equipment managers might find useful. Specifically, the software they use to track their rental assets could be successfully used to help you better manage your equipment and accurately track costs.

5. **R5:** To be efficient means being able to produce the desired results with a minimum of effort, resources, or waste. This is a concept that permeates our lives. A part of every occupation is the desire to improve the product or services by producing more for less or a better product for the same input. Engineers are constantly trying to improve the efficiency of operations by reducing the energy requirements and/or wastes from agricultural and manufacturing processes. When referring to machinery, efficiency is an evaluation of how well a machine does the tasks that it is designed to perform.
6. **R6:** Factors that are not affecting the company profit.

## 9. Conclusion and recommendations

Construction equipment are the most crucial and critical resource for a construction company. Construction equipment are a prerequisite for timely completion of all construction projects. As a matter of fact the equipment are one of the most capital intensive long terms investments that a construction company makes. Expenses related to construction equipment have a major impact on whether the company's balance sheet shows profits or losses and in what quantity. Keeping the economic viability of the company in mind managing the construction equipment and the related expenses becomes top priority at construction equipment companies. Construction equipment management refers to continuous evaluation of the construction equipment fleet and its cost while at the same time considering the projects at hand. The process of balancing the expense and use of the construction equipment against the timelines and income from the projects can be called construction equipment management. A construction equipment manager needs to be able to take practical decisions with regards to management of the construction equipment to ensure maximum benefits with minimal expenses for the company.

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.

The success of a small business depends on its ability to continually earn profits. Profit equals a company's revenues minus expenses. Earning a profit is important to a small business because profitability impacts whether a company can secure financing from a bank, attract investors to fund its operations and grow its business. Companies cannot remain in business without turning a profit. All factors related to money comes first.

## A. RECOMMENDATIONS

1. Know what you have.
2. Track how it is used.
3. Right asset, right place, right time.
4. Don't spend more – spend smarter.
5. Fix things before they break.
6. Find underlying issues.
7. Buy the best.
8. Use the right equipment inventory system.

## References

- [1] Xiaoning, Zhenhua Zhu2, Chantale Germain3, Roger Belair4 and Zhi Chen5 (2017), "Automated Monitoring of the Utilization Rate of Onsite Construction Equipment", Dept. of Building, Civil, and Environmental Engineering, Concordia Univ., Montreal, Canada.
- [2] Zhu, Z., Ren, X., and Chen, Z. (2016). "Visual Tracking of Construction Jobsite Workforce and Equipment with Particle Filtering." J. Comput. Civ. Eng., 10.1061/(ASCE)CP.19435487.0000573, 04016023.
- [3] Memarzadeh, M., Golparvar-Fard, M., Niebles, J.C., (2013). "Automated 2D



- detection of construction equipment and workers from site video streams using histograms of oriented gradients and colors.” Automation in Construction, 32 (2013), pp. 24–37 ISSN 09265805.*
- [4] Pradhananga, N. and Teizer J. (2013). “Automatic spatio-temporal analysis of construction site equipment operations using gps data.” *Autom. Construct.*, 29 (2013), pp. 107–122 .
- [5] Ahn, C. and Lee, S. (2013). "Importance of Operational Efficiency to Achieve Energy Efficiency and Exhaust Emission Reduction of Construction Operations." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)CO.1943-7862.0000609, 404-413.
- [6] Prajeesh. V. P, Mr. N. Sakthivel, (2016) ‘Management of Equipment & Machinery in Construction’-International Journal of Innovative Science, Engineering & Technology, 6(3), 2016, pp.113-118.
- [7] Mithilesh V.V.S, Nagavinothini R (2016) ‘A Critical Study on Latest Heavy Equipment and Latest Technologies Used In Road Works and Recommending the Types of Equipment and Its Effectiveness for Indian Roads Equipment Recommendation for Indian Roads - A Critical.
- [8] Prof. Desai D. B, Dr. Gupta A. K, Mr.JadhavAshish B. (2017) ‘A study on construction equipment management and it’s effect on project cost’- international multidisciplinary e-journal, Vol5(5), pp 8-11.