To Study & Analysis Construction Equipment Used in Construction Projects for Improving Productivity: Review Paper

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Abstract:
Construction equipment is important resource to complete the project in successful manner. This topic elevated on benefits of implementing total productivity. While purchasing, leasing, renting the equipment and guide in optimizing profitability. Utilization of machine properly & match their capacities to specific project requirements. Current practices & observations made in Indian construction industry. The effectiveness of construction machineries is a major factor that differentiates construction companies in terms of construction & light construction. The time & cost is most important factor for successful completion of project. Data was acquired from equipment rental companies, construction companies & multiple construction projects. Hypothesis on some expected results were tested. Finally, the findings of this study were compared with findings of questionnaire conducted for finding significant commonalities & differences in equipment management. This research work revealed different factors of equipment management. Factors causing cost overrun in the construction projects were ranked. Top five significant factors identified time to time maintenance of equipment, frequent equipment break down, insufficient number of equipment, efficiency of equipment, performance of equipment & improper modern equipment system. Hypothesis on some expected results were tested. Finally, the findings of this study were compared with findings of questionnaire conducted for finding significant commonalities & differences in equipment management. This research work revealed different factors of equipment management. Factors causing cost overrun in the construction projects were ranked. Top five significant factors identified time to time maintenance of equipment, frequent equipment break down, insufficient number of equipment, efficiency of equipment, performance of equipment & improper modern equipment system.

Keywords: Construction equipment, Productivity, Maintenance of equipment, Efficiency of equipment.

1. INTRODUCTION:
In our country most of road projects activities are equipment oriented & they required very less amount of participation from laborers (Unskilled & semiskilled). Only high skilled manpower & operator are required to execute the activities & the productivity of equipment. All the machines that are usually used to carry out these construction activities are referred to as construction equipment. In most of the cases they are called heavy equipment especially in road construction. So now a days construction companies are facing problems related high rate equipment failure & effecting on productivity of project & timely completion of project, thereby increasing the productivity of the equipment. The way to avoid this huge amount of loss that usually lead to accompanies equipment failure is to adopt proper maintenance & strategy. This will keep construction equipment fit at all times & allow timely completion of project. This paper aims to study equipment productivity in major projects carried out by direct observation in two major projects over a period of time. The factors effecting productivity is also observed simultaneously. The observed productivity is then compared with standards & the variance is summarized. The various factors resulting in variance in productivity are established & the financial impact on the on the project due to variance productivity is estimated.

2. DEFINITON:
Many terms are used to describe productivity in construction industry like performance factor, production rate, unit person hour rate & others but productivity is defined as the ratio of the input of associated resources to real output. Generally in civil engineering projects issues related with productivity can be divided into macro level & micro level. At the macro level one deals with contracting method, labour legislation & labour organization at the micro level with the management & operation of a project mainly at the job site.

3. NEED FOR THE STUDY:
Research study explores vital factors which are affecting equipment productivity in highway construction. Interpretation of factors is helpful for the construction professionals who work inceptive phases of construction planning in order to successful deliver the project plan. This study mainly focuses on productivity loss assessment of heavy construction equipment namely grader, power shovel, scraper, back hoe on the selected projects also this study provide information about factors influencing equipment productivity to the project management team who qualify the project success.

4. RESEARCH OBJECTIVE:
1) Identify the latest equipment used in highway construction like grader, scraper, power shovel, paver finisher etc.
2) To study equipment management used in road projects
3) To identify main factors contributing to the loss of construction equipment productivity
4) To evaluate the extent of equipment productivity losses per day & its impact on the equipment financial performance.

5. LITERATURE REVIEW:
5) Nillesh Ayane, Managesh Gudadhe in this paper the author state that to improve productivity it is essential to improve the performance of the construction systems. The desired production output is achieved through high equipment

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availability, which influenced by equipment reliability and maintainability.

5.2 D. B. Phadatare, S. B. Charhate in this paper author concluded that the proper planning & proper maintenance is important for construction equipment for better production & for successful completion of project. The overall equipment efficiency was improved with less idling, low machine breakdown & minimized accident in plants which maximized the productivity.

5.3 Dushyat A. Deshmukh, Parag S. Mahatme In this paper, we have studied literature & identified some of those factors. It is found that, understanding fundamentals of such factors is important role of construction manager for better excavating equipment performance & the improper selection & use of excavator can cause of excessive costs, time & injuries to labours. Time required for excavation work depends on the performance of equipment.

5.4 Prajeesh V.P. Mr. N. Sakthivel This paper is to study the management of equipment practices in construction industry & to present the most popular practices of the contractor & to compare the equipment management policies with a case study of construction industry.

6. METHODOLOGY

The methodology adopted for this study is as follows. A detail survey is carried out to analyze the equipment & the literature can be seen in references of the current paper.

- INTRODUCTION
- LITERATURE REVIEW
- METHODOLOGY
- CONCLUSIONS
- REFERENCES

Data required for research is collected from ongoing road sites in Solapur and Osmanabad such as values of purchasing cost, maintenance cost, operator wages etc. are collected from owners of equipment working on these sites and retailers of construction equipment. Collection of data related to calculation of productivity of equipment’s such as hauling speed, capacity of excavator etc. was made by observing equipment’s on construction site. Some important parameters required for productivity calculations

- **Capacity**: The capacity of each equipment is denoted by m3measure such as the bucket capacity in excavator or body capacity in case of tipper. This is found out by standard dimensions of each equipment given by the manufacturing company. The equipment’s are generally filled at its heaped capacity and not at its struck volume. The struck capacity is that volume actually enclosed by the bucket, while for the heaped capacity an angle of repose is considered. According to standard conditions angle of repose 2:1 slope is considered.

- **Efficiency**: Efficiency factor is the job efficiency of the operator. It is calculated as number of operating minutes per hour divided by 60min. Job efficiency for each type of machine operator is calculated by taking mean of the daily machine working time divided by actual working time. The daily machine working time is taken from the timesheets being maintained by the site accountant.

- **Cycle Time**: The sum of required to complete one production cycle is the cycle time for equipment. The cycle time consist of different elements for different equipment’s. Typical cycle time elements for different equipment’s are as follows

  - **Excavator**:
    1. Excavate/ load bucket
    2. Swing with load
    3. Return swing
    4. Dump load

  - **Hauler**:
    1. Load
    2. Haul
    3. Dump
    4. Return

  - **Dozer**:
    1. Push
    2. Return

- **Fill Factor**: Fill factor according to the type of material being handled, fill factor corrections are applied. Fill factor account for the void spaces between individual material particles of particular type of material when it is loaded into an excavator bucket. Material such as sand, gravel, or loose earth should easily fill the bucket to capacity with a minimum void space.

**Methodology for per hour ownership and operating cost (O & O cost)**

Following steps are used to calculate ownership cost:-

- Data collected related to purchasing cost & residual value of equipment’s from retailer, Data collected related to working life of equipment’s in hours from & performance report manufactures overall percentage of insurance & taxes to be levied on equipment’s throughout their life collected from equipment owner.

- Calculation of net value to be covered throughout life which is difference of purchasing cost residual value.

- Calculation of per hour cost which allows the coverage of net value by following formulae.

\[
\text{Cost per hour to cover net value} = \frac{\text{Purchasing cost (P) - Residual value(S)}}{\text{N Life of equipment (In hours)}}
\]

Submission of per hour cost to cover net value of ownership cost is (C1). Data related to per hour repairing cost including replacement tire from provisions provided by IS11590:1995&
Caterpillar performance Handbook. Submission of all these costs gives total per hour operating cost (C2). Hence, per ownership and operating cost= C1 + C2

**Following are some productivity improvement techniques**

1. Arrangement of skilled staff for operation and maintenance to get optimum output from any equipment, it is essential to handle the equipment by a skilled staff. The skilled staff includes the operator, the mechanic etc. The working hours of any equipment depends upon the maintenance period & the rest period of the engine. If the equipment is working in shift like first, second, third the operator shall be separate for each shift.

2. Establishment of service and repair facilities: Selection of equipment needs careful thought to ensure efficient and effective performance. Though the actual selection would depend on factors like type of work and its magnitude, location etc. The equipment requires regular maintenance during the work. Every equipment has its own unique features. This requires skilled mechanic, store spare parts, lubricants etc.

3. Maintenance of spare parts inventory: This is a job which needs the exact balance between availability of spares and low inventory cost. On one hand it should provide proper assurance for availability of desired spare parts in proper time and quantity. On other hand should not result in excessive stocking or blocking up of capital. Proper planning is very essential to get the best result.

4. Decision regarding number of shifts per operation: The shifts depends on the volume of the work to be done in the specified time limit, availability of skilled operators, working condition, location of site, environment etc. The decision of number of shifts shall be taken by the project engineer by considering the above factors.

**5. CONCLUSIONS**

Productivity is on the important aspects of project management and it makes or breaks a project. Equipment productivity can be standardised to a greater extent. Equipment productivity needs review at project level. Equipment productivity is in the decline all across the world particularly in construction work. Task level productivity in construction project has to be measured, analysed and improved in every project. Better productivity management will produce significant improvement in meeting predetermined targets. The implication in project profits due to lack of better equipment’s performance and their productivity in major construction projects is to extent of 3% to 5% of the project value and it needs to be constantly improved. So, the overall productivity of construction project 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.

**6. REFERENCES**

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