

Construction Equipment Monitoring and its Effect on Project Cost

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Abstract: *Construction equipment is one of the major element of the construction process along with labour and material. The cost of equipment in project varies from 10 to 30% of the total cost of the project. For successful completion of the construction project; equipment management through Proper planning, selection, procurement, Installation, operation, maintenance and equipment replacement policy plays vital role in it. The first step is proper equipment selection; this means selecting the equipment that matches job conditions and gives the lowest total cost. Lowest total cost is a combination of highest production, lowest operating cost and lowest investment cost.*

Keywords: Equipment management, Construction process, Investment cost, operating cost.

1. Introduction

Good construction equipment management in construction possible by the efficient utilization of equipment. Improvement of equipment productivity should be a major and continual concern of those who are responsible for cost control of constructed facilities. Equipment management, which includes proper utilization of equipment without any downtime, optimum utilization of equipment 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. In contrast to this view of one large project; one may also point to the continual change and improvements occurring in traditional materials and techniques.

2. Objectives

Main objectives of this study include the following:

- 1) To identify how to improve a economy of Construction equipment.
- 2) To do survey of various construction companies for their equipment management strategies on the basis of economy.
- 3) To study the different costs affecting the economy in construction.
- 4) To study the equipment optimization and benefit analysis at the site through equipment production analysis

Equipment management is required and this will focus and enhance a companywide approach to improving equipment productivity. A phased equipment management approach is the process of focusing efforts to improve the elements of equipment utilization, equipment performance, and equipment availability.

These phases are key to moving a company through the installation of total productive management.

Phase I. Improvement of existing equipment

Phase II. Maintaining improved equipment or new equipment

Phase III. Procurement of new higher performance equipment

3. Literature Review

By studying various literatures we have some of the common factors that can affect the performance of equipments on construction site.

Dushyant A. Deshmukh and Parag S. Mahatme (2014) focused on factors which affects construction equipment performance. By monitoring excavators in terms of its planning, selection and performance; Some of the common factors that can affect the performance of excavating equipment has been identified and discussed in this work such as Proper equipment selection may affect to increase its productivity for that particular work, Site conditions can affect speed of excavation process, Greater angle of swing results in greater cycle time which may lead the work to delay, operator's skill is important to save cycle time, Proper repairs and maintenance of equipment may increase its life providing better performance.

Saurabh Kadam and Prof. Dhananjay Patil (2013) described equipment optimization and benefit analysis at the site through equipment production analysis with the help of studying the highway construction site for current practices of equipment management. To optimize the current composition of the earth material moving fleet they have focused on performance of equipment also they have studied comparison of the current composition at site by productivity analysis and benefit analysis.

Kunal Ghadge and Ashish Ugale (2013) focused on Dam sites which are very important structures as it deals with the major irrigation projects. Execution of work and handling of large equipments and machineries are plays vital role in it.

The economic dam site is one which is handled with economy of equipments. Thus in this study proper planning and management of equipments on dam site analysed. On time completion of project can be possible by only three factors as economy, time, quality and this contributes to many factors of resources but much affected by equipments.

Aviad Shapira, F.ASCE; and Marat Goldenberg (2007) described in his paper that the issue of "soft" considerations in the selection of equipment for building construction projects. The paper aims at increasing the awareness to the nature, variety, richness of soft factors. Authors also suggested that the outcome of decision making and difficulty evaluation is very important in comprehensive selection process of construction equipment. For this purpose existing state-of-the-art equipment selection models were analyzed and found to be inadequate in terms of both considering soft factors and providing mechanisms for their systematic evaluation.

Amir Tavakoli, Member, ASCE, Emmanuel D. Taye and Mehmet (1989) authors mentioned a result of a questionnaire survey that reports the construction equipment policy in the Engineering News Recorded top 400 construction companies. They are presented what kind of special attention is paid to equipment financing, replacement analysis, equipment standardization, safety and maintenance management.

4. Methodology

For carrying the proposed work, following methods are used for data collection,

- 1) Different reference journals and books.
- 2) Various websites and online journals.
- 3) Different research papers.

For carrying the proposed work, following methods are used for analyze the data,

- 1) Case Studies (Generate Questionnaire form)& Survey.
- 2) Visit to small, medium & large construction industries.
- 3) By taking information and opinion from the different expert persons of various industries who have lot of experience related to finance construction industry
- 4) By taking information and opinion from the different Engineers, Contractors & construction equipment suppliers.

5. Case Study

In the chapter for Case Study sample questionnaire is generated as follows

General Information

- 1) Please indicate the type of construction your firm is doing:
 - Residential
 - Building
 - Industrial
 - Heavy
 - Other (please specify)

- 2) What annual volume of work do you do, and what percentage of this work do you do in-house?
 - Total volume
 - In-house %

Equipment Financing

- 1) To what percentage do you own the equipment you are using?
 - Ownership %
 - Lease %
 - Rental %
- 2) If you rent some equipment, which of the following sources do you acquire rental rates from?
 - Local rental agencies
 - Yellow pages rental rates
 - Company's own data bank
 - Other (please specify)
- 3) In your decision to invest in equipment, do you consider the following?
 - Influence on business ratios
 - Influence on bond ability
 - Cash flows for each option
 - Discounted cost of each plan
 - Other (please specify)
- 4) What kind of financing do you use to acquire equipment?
 - Outright purchases
 - Short-term bank loans
 - Long-term bank loans
 - Service leases
 - Trade credits
 - Other (please specify).

Replacement Analysis

- 1) Who in your organization generally makes the final decisions regarding major equipment acquisition and dispositions?
 - President (CEO)
 - Board of Directors
 - Project manager
 - Equipment manager
 - Other (please specify)
- 2) How does your company quantitatively evaluate requests for major equipment investments? Please rank the following techniques in order of their importance in the investment decision of your company:
 - Accounting return on investment
 - Payback period
 - Net present value
 - Internal rate of return
 - Other (please specify)
- 3) What minimum size of an equipment investment do you consider as major equipment investment being worthy of quantitative evaluation? Please indicate Rupees value of investment (purchase price of equipment).
- 4) Are alternatives to major investment proposals specifically searched and considered?
 - Yes
 - No
- 5) What do you compare in the quantitative evaluation of equipment investment proposals?

- Disbursements of alternatives
 - Net cash flows (receipts, disbursements) of alternatives
- 6) If you compare cash flows, how do you determine the receipts of the different proposals?
- Directly allocating revenues to the equipment investment
 - Using rental rates from local equipment dealers.
 - Using rental rates as suggested by the agency.
 - Calculating internal rates based on in-house data.
 - Other (please specify).
- 7) Do you use any of the following methods for determining the optimum replacement time for a piece of equipment?
- Generation of report-cost curve and replacement when a determined target value is achieved
 - Replacement when cost for necessary repairs seems to be too high
 - Determination of economic life of equipment and replacement at the end of this life
 - Other (please specify)
- 8) How do you determine the minimum rate of return for your accept-reject decision, applying the internal rate of return method? By:
- Cost of specific source of funds
 - Weighted cost of sources of funds
 - Firm's historical rate of return
 - Management determined target rate of return
 - Other (please specify)
- 9) In your replacement analysis, do you consider the effects of the following?
- Inflation
 - Downtime costs
 - Obsolescence
 - Depreciation
 - Taxes
 - Time value of money
 - Other (please specify)
- 10) What is your company policy regarding new, improved models of equipment that appear to be superior to yours? (Indicate first and second preferences.)
- Buy immediately
 - Test by renting before buying
 - Wait till bugs are known
 - Other (please specify)
- 11) How do you dispose of your equipment?
- Trade to dealer
 - Auction sale
 - Sell to others
 - Other (please specify)

Equipment Standardization

- 1) Which of the following methods of standardization do you use?
- Standardize by manufacturer (always buy the same brand)
 - Standardize by equipment family (buy same size of engines)
 - Other (please specify)
- 2) What is the percentage of commonality of engine spare parts in your inventory?

- 3) Please list the manufacturers whose equipment you standardize?
- 4) List the families of engines you standardize:
- 5) Why do you standardize your equipment?
- Savings in spare part inventory due to commonality of spare parts
 - Lower cost of maintenance due to learning curve effect on mechanics
 - Lower operator/labour cost
 - Better safety because operators always use similar equipment
 - Better relationship with dealer
 - Easier administration over similar units
- 6) If you don't standardize, why not?
- Company cannot purchase equipment at a competitive bid from other dealers
 - Company cannot reject dealer without breaking adopted standard
 - Bug found in one machine exists in the entire family of engines

Miscellaneous

- 1) Do you execute your own safety program?
- Yes
 - No
- If yes, How often?
How long do the meetings last?
- 2) What have you discovered to be the source of most work accidents in your line of work with equipment?
- Manufacturer defects
 - Poor operating techniques
 - Other (please specify)
- 3) Do you undertake your own maintenance?
- Yes
 - No
- If yes, which of these?
- Preventive maintenance
 - Scheduled maintenance
 - Unscheduled maintenance
- 4) Who generally performs routine maintenance on your equipment?
- Operator
 - Owner's mechanic
 - Independent mechanic
 - Dealer
 - Other (please specify)
- 5) Do you generally have the same operator continually working with the same piece of equipment?
- Yes
 - No
- 6) What classification codes do you use to register your equipment?
- 7) How often is a production-time-cost report made? At what level is the data gathered?
- Foreman
 - Operator
 - Mechanic
 - Other (please specify)
- 8) What types of computers do you use for your equipment record keeping and decision support system?
- Microcomputers

- Minicomputers
 - Mainframe computers
 - Other (please specify)
- 9) What computer software do you use for equipment data storage and analysis?

By obtaining such a data/filled questionnaire forms from various construction companies/contractors/vendors we will get the probable outcomes:

- The Life Cycle Cost (LCC) assessment factors can be possible to identify which will be helpful to calculating the construction equipment cost and improve a economy of equipment management.
- Operation performance and Profitability relation will be clarified.
- With the help of obtained data we can be analyse all types of costs associated with Ownership, Operational and Production.

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