

DECISION STUDY ON USING CONSTRUCTION EQUIPMENTS FOR STAKEHOLDERS

Mr. M.Dhivakar Karthick¹, Prof. K. Thirumalai Raja²

*¹Student M.E-(CE&M) , ²Associate Professor, Civil Engineering Department,
Erode Builder Educational Trust's Group of Institution Kangayam, Tamil Nadu, (India).*

ABSTRACT

Consumer is using or choosing construction equipment based upon their maximum possible uses, initial cost, maintenance cost, depreciation cost and idle cost which are the factors responsible for the profit margin. By identifying the key factors and cost influence in equipment utilization in terms of rental basis rather than owning it, cost analysis is carried out with respect to productivity of the equipment. For which the questionnaire survey is conducted on engineers and contractors practicing the equipment management system in their construction projects. Accordingly the response from the respondents are analyzed by relative importance index method and the objectives are established with respect to real time requirements on equipment utilization. The evaluation strategies are carried out with various modes of acquisition. Such a way that profit margin chart is framed specifying right time to own the equipment for profit maximization of the construction firm.

Keywords : Equipment; Rent; Buy; Lease; Custom Hire; Net Present Value; Cost Analysis.

1.INTRODUCTION

The activities involved in construction projects where the magnitude of the work is on a big scale, timely completion and nature of work with quality control are very vital. The mechanization of work has to be done, where construction equipments play a pivotal role. Proper use of appropriate equipment contributes to budget, safety, quality, speed and on time completion of the project. Construction process performs with importance construction equipments. The contractor may not able to desire to own each and every type of construction equipment required for the project. On consideration of various features of the specific equipment, the contractor has to sparingly justify whether to purchase the equipment or to hire it. The amount capitalized in the owning of equipment should be recovered during the useful period of such equipment.

1.1 Scope of the Project

1. This research will optimize the investment on equipment's of a construction firm.
2. Thereby it increases the profit margin of the construction firm.
3. It creates value & support to the construction firm.

1.2 Objective of the Project

1. To carry out the study review on prevailing mixer, material handling equipment, screening equipment, vibrator, handling & compacting equipment.
2. To study the factors affecting like initial and maintenance cost, depreciation cost, idle cost and overheads involved in usage at various types of construction work.
3. To dispartate and equate the performance of the equipment's under the influence of study focusing cost aspects

II. LITERATURE REVIEW

The major cost consequences in construction operations are mostly due to the machineries and equipment expenses of the project. The typical method of obtaining the machineries for the construction operation may be achieved by personal financing or through loans at permissible interest rates or leasing the equipment [1]. Thus the contractors or engineers preferring the option of acquiring due to increased equipment cost, maintenance cost, obsolescence of owned equipment and limited sources of outside capital. These options includes leasing, renting, purchasing equipment, and obtaining machinery service from custom operators.

2.1 Equipment Acquisition

The major issues faced by the contractor and engineer in running their companies to a successful turnover depends on the mode of acquisition of equipment for their construction projects [2]. This consideration mostly lies on the contractors and engineers undertaking CLASS II, III, IV, V works in case of government projects and some significant private contracts. They doesn't know the right time to acquire the equipment as owned and to replace the equipment. Because the timely owning and replacement of equipment will definitely increases the profit margin of the construction firm. There are various factors to be considered before going for the acquisition of equipment. The factors are both financial and non-financial factors that influence the equipment acquisition methods [2].

2.2 Equipment Cost

Equipment cost may in the range of 10% to 40% of overall construction cost [9]. The equipment cost is considered as a major problem before and after acquiring it. The costs included in the equipment are tangible and intangible [3]. By which the tangible cost of the equipment can easily be recorded and estimated using cost accounting methods. Where the equipment cost management lies between the capital cost and operating inferiority.

The substantial portion of the equipment production includes its ownership and operating cost. Hence the equipment cost make up a significant part of fixed and variable cost of construction operation [4]. The fixed cost generally include depreciation, interest, shelter and taxes, insurance. And operating cost includes fuel, lubrication, labor, repairs.

2.3 Equipment Maintenance

Profitability of construction projects depends on the effective equipment maintenance, because the equipment is one of the key factor for improving contractor's capability in performing their work more effectively and

efficiently [5]. The economic production of construction machineries depends on keeping the equipment in good condition. Construction firm faces finance losses due to improper maintenance, equipment failure and breakdown.

2.4 Decision Options

Decision to acquire the equipment makes the value and profit to the construction firm. There are other options and conditions reviewed during decision making. The general thumb rule is that percentage contribution of equipment less than 60% should go for renting [6]. This consideration favors purchasing the equipment with cost significant cost consequences. The decision making also goes with consideration of taxes, incentives, capital investment, interest rates, depreciation and resale value also influence the decision making process.

Consumer going for equipment acquisition need to know the elements involved in the life cycle of equipment and its estimated time period to be used with its frequency in that period [7]. Other sensible factors during decision making are reliable service for long time, down payment, tax benefits, and depreciation dispose of [8]. The condition in lease contract is that leases are structured to last at least a year. Canceling the lease contract prior to the contract period may end up with penalty.

There are some immeasurable factors like flexibility, ease of use, repetitions, which are responsible for the decision making on equipment acquisition. The measurable factors includes tax advantages, depreciation, maintenance cost and repair cost [9].

2.5 Evaluation of Decision Options

Cost benefit analysis is used to determine the appropriate contracting method. Cost benefit analysis includes two various methods such as Present Value Method & Net Present Value Method [7]. The method of estimating machinery cost over multiple time periods is in order to compare the options of leasing, renting, purchasing, custom hire [1]. The net present value analysis is used to evaluate the decision option in equipment acquisition. The DIRT formula which is used to calculate the annual depreciation, interest, repairs, taxes and insurance [1]. The discounted after tax rate can also be analyzed by NPV method. The analysis is made worthwhile under the consideration of equipment productive hours and its useful life [9].

This research focuses on construction contractor and engineer practicing equipment management in Erode district, especially in Mettur canal division, Bhavani, Gobi, Erode, to identify the factors considered in equipment acquisition and evaluate the various decision modes of equipment acquisition on cost benefit analysis method.

III. RESEARCH METHODOLOGY

A detailed literature review was carried out to collect the information about the objectives of this study by considering construction practitioners in various locations. Through the literature review helped to establish the research topic in detail and general. The construction equipments considered for this research includes seven categories or eleven no. of machineries includes concreting equipments, concrete handling equipment, screening equipment, compaction equipment, handling equipment, bar bending equipment, earth compactor.

The resources from various literature of this study are international and national conference papers. Documents, internet, journal articles, magazines, books, etc. These are collectively named as secondary data sources, used to identify the financial factors affecting on construction equipment acquiring method [2].

3.1 Establishing Objectives

The design of questionnaire meant for surveying with contractors and engineers are literally achieved through various literatures. The primary data that are obtained from the sources of contractors and engineers with open ended questions. This survey is used for identification of factors affecting on construction equipments acquisition methods.

3.2 Data Collection & Evaluation

With those identification through the survey from contractors and engineers, the objectives of this study is established. Such that secondary process of research is proceeded with data collection regarding equipment purchase data, rental data, lease data and customers hire option.

The purchase data includes its down payment, interest rate, tax deductions, loan length and annual payment, salvage value, etc. The rental data includes equipment rental rate, rental inflation rate and twelve monthly use. The lease data found parallel to rental data replacing the terms as lease purchase having additional data about its lease length. The custom hire option includes user defined options on hiring the equipment includes custom hire base charge, custom hire unit and its inflation rate. Some of the common data includes annual insurance, housing, repairs, labours, lubricant, etc.

The data collected are evaluated by means of cost benefit analysis method. Evaluated data is consolidated and put-up in the form of profit margin chart providing the right time to own the construction equipment rather than renting or leasing as shown in figure 1.

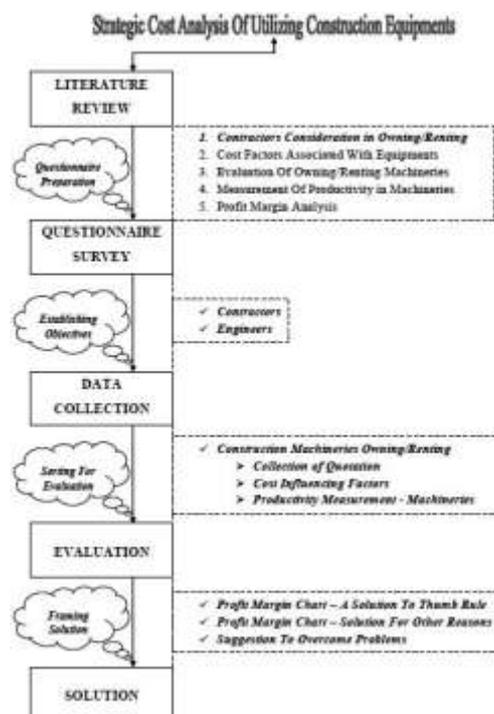


Figure 1 - Methodology

IV. QUESTIONNAIRE SURVEY

The data were obtained through the use of Investigatory Survey Research Approach Method (ISRAM), a well-structured questionnaire administrated on various constructors as in table 1.

Table 1 Questionnaire Survey on Constructors

4.1 Contractors

The survey is triggered with contractors practicing equipment management system in public projects. Contractors so identified are from sources of tamilnadu public works department in mettur lower canal division followed up by the sub division’s ammapetta, bhavani, komarapalayam. The group so surveyed focused on CLASS I – V contractors, where priority is given to lower class contractors. This is because of logical reason that the premium class contractor’s holds maximum assets and so equipment management may not be major problem in acquisition. The survey is conducted through in-person interview with them respectively.

4.2 Engineers

The equipment management system other than public works covers private contracts such as residential building construction, commercial construction and other civil works. Here engineers are involved in large proportions. Hence the survey made effective with in-person interview with engineers performing private contracts. Survey with engineers are achieved through civil engineers association situated in gobi, and erode.

4.3 Consolidation

The overall survey with contractors and engineers are consolidated for evaluation of research objectives as below as in table 2,

Table 2 Consolidated Survey Results

Machineries	Acquisition			Reasons			Problems				
	D	O	R	T	D	F	O	D	O	R	F
Fully Loaded Mixer	0	23	17	28	0	12	0	0	27	0	13
Weigh Batcher	34	3	3	7	0	0	33	0	10	10	20
Wheel Barrow	4	20	16	26	1	9	4	0	23	0	17
Tower Hoist/Winch	7	13	20	25	2	7	6	0	18	7	13

<i>Mini Lift</i>	11	12	17	21	1	5	13	5	12	6	15
<i>Mechanical Screener</i>	15	10	15	21	1	4	14	0	14	0	26
<i>Vibratory Screener</i>	38	2	0	2	1	1	36	0	0	16	24
<i>Plate Vibrator</i>	40	0	0	0	0	1	39	12	8	11	9
<i>Needle Vibrator</i>	2	20	18	26	3	9	2	0	18	4	13
<i>Backhoe Loader</i>	8	9	23	21	3	10	6	16	13	3	4
<i>Mini DOR</i>	9	13	18	25	1	7	7	11	16	5	2
<i>Hydraulic Bar Bender</i>	40	0	0	0	0	0	40	21	7	9	3
<i>Earth Compactor</i>	22	8	10	14	2	3	21	0	18	7	13

V. DATA COLLECTION

The data collection is done for equipment acquisition options evaluation. Data are classified based on its mode of acquisition such as purchase data, rental data and lease data. There are some common forms of data's that are common to above modes of classification are annual insurance and housing, annual repairs, annual labours, annual fuel and oil, marginal tax rate and after tax discount rates. Out of which the custom hire option holds the combination of data obtained in purchase data and rental data.

5.1 Purchase Data

The purchase data of any equipment holds the following contents necessary for evaluation show in table 3,

Table 3 Purchase Data

Purchase Price	Down Payment	Interest Rate	Loan Length	Annual Payment	Salvage Value
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5.2 Rental Data

The rental data of any equipment holds the following contents necessary for evaluation as show in table 4,

Table 4 Rental Data

Rental Price	Annual Use	Rental Inflation Rate	Rental Length
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5.3 Lease Data

The lease data of any equipment holds the following contents necessary for evaluation as show in table 5,

Table 5 Lease Data

Lease Price	Lease Units	Lease Inflation Rate	Lease Length	Lease Terms
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VI. EVALUATION

6.1 Relative Importance Index

The survey evaluation was done using Relative Important Index (RII) method and found the bottom most factors leading to affect the labour productivity at construction site. The following formula is used to calculate the relative importance index.

Formula used for Relative Important Index

$$RII = \frac{\sum (X_i * Y_i)}{(Z_i * 5)}$$

Where,

RII = Relative Importance Index

X_i = number of responses to the factors

Y_i = the value of rating

Z_i = total number of responses to the factors

Table 6 Survey Evaluation

Machineries Factors Evaluation	Acquisition	Reasons	Problems
	RII		
Fully Loaded Mixer With Hooper	0.808333	0.85	0.935
Weigh Batcher	0.408333	0.79375	0.8
Wheel Barrow	0.766667	0.84375	0.915
Tower Hoist/Winch	0.775	0.8375	0.815
Mini Lift	0.716667	0.8375	0.715
Mechanical Screener	0.666667	0.84375	0.87
Vibratory Screener	0.45	0.74375	0.72
Plate Vibrator	0.433333	0.74375	0.605
Needle Vibrator	0.8	0.81875	0.82
Backhoe Loader	0.791667	0.78125	0.57
Mini DOR	0.741667	0.85	0.63
Hydraulic Bar Bender	0.433333	0.75	0.475
Earth Compactor	0.566667	0.79375	0.815

6.2 Depreciation Analysis

Depreciation can be calculated more than a few ways, the simplest is the straight-line method. The depreciation is constant for annual basis, reducing the equipment value yearly.

- Depreciation in Any Period = ((Cost - Salvage) / Life)

Partial year depreciation, when the first year has M months is taken as:

- First year depreciation = (M / 12) * ((Cost - Salvage) / Life)
- Last year depreciation = ((12 - M) / 12) * ((Cost - Salvage) / Life)

6.3 Residual Value Analysis

Residual value is another name for salvage value, the residual value of an asset after it has been fully depreciated. The estimated value that an asset will realize upon its sale at the end of its convenient life. The cost is used in accounting to determine depreciation amounts and in the tax system to determine deductions. The rate can be a best guess of the end rate or can be determined by a regulatory body such as the IRS.

The residual value derives its calculation from a base rate, calculated after reduction. Salvage values are calculated using a number of factors, generally a vehicles market worth for the term and mileage required is the start point of the calculation, followed by seasonality, once a month adjustment, and lifecycle and clearance performance. The leasing company setting the residual values (RVs) will use their own historical information to insert the adjustment factors within the calculation to set the end value being the residual value.

6.4 Net Present Value Analysis

When comparing leasing and purchasing alternatives, the future monetary value you would expend in a lease or lease-purchase contract must be converted to its value in present monetary value in order to compare the real costs of each option. Calculating Present Value can be used as an intermediate step to calculating Net Present Value (NPV) [7].

Net present value analysis involves four simple steps.

- The first phase is to forecast the benefits and costs in each year.
- The second phase is to determine a discount rate.
- The third phase is to use a formula to calculate the net present value.
- The final phase is to compare the net present values of the alternatives.

Analysts should follow five common rules when forecasting costs and benefits:

- Forecast paybacks and expenses in today's monetary value amount.
- Do not comprise sunk costs.
- Embrace opportunity costs.
- Use probable value to estimate uncertain benefits and costs.
- Overlook non-monetary costs and benefits.

$$NPV(i, N) = \sum_{t=0}^N \frac{R_t}{(1+i)^t}$$

Where,

t = time of cash flow

i = discount rate

R_t = net cash flow

i.e., net cash flow = cash inflow – cash outflow

NPV is an indicator of how much value an investment or project increases to the firm. With a particular project, if R_t is a positive rate, the project is in the status of progressive cash inflow in the time of t. If R_t is a negative rate, the project is in the status of reduced cash outflow in the time of t. Suitably, risked projects with a positive NPV

could be accepted. This does not certainly mean that they should be undertaken since NPV at the cost of capital may not description for opportunity cost, i.e., comparison with other available reserves. In financial concept, if there is a choice between two equally special substitutes, the one yielding the higher NPV should be selected as shown in table 7.

Table 7 Decision Conditions

What If?	Means	Then
NPV > 0	Investment worth adding	Equipment should be accepted on its mode of acquisition
NPV < 0	Investment doesn't worth adding	Equipment should be rejected on its mode of acquisition
NPV = 0	Investment may or may not considered	Equipment may be accepted on its mode of acquisition

VII. DISCUSSION

Effective equipment acquisition is sustained through evaluation of decision options. Relative importance index method and graphical method are used to evaluate importance scale of equipments. The importance scale of equipments addressed by constructors so evaluated from questionnaire survey is clearly understood by table 8,

Table 8 Importance scale by constructors

Machineries Factors Evaluation	Importance Scale by Constructors
<i>Fully Loaded Mixer With Hooper</i>	Most important & essential
<i>Needle Vibrator</i>	
<i>Backhoe Loader</i>	
<i>Tower Hoist/Winch</i>	
<i>Wheel Barrow</i>	
<i>Mini DOR</i>	
<i>Mini Lift</i>	Likely necessary but not important
<i>Mechanical Screener</i>	
<i>Earth Compactor</i>	
<i>Weigh Batcher</i>	
<i>Vibratory Screener</i>	Not necessary and not important
<i>Plate Vibrator</i>	
<i>Hydraulic Bar Bender</i>	

VIII.SUMMARY

Present study outlines the major equipment acquisition modes for profit maximization of construction firms. Based on literature study and from interview of experts, importance of equipments were identified under 3 major groups. Further methodology has suggested to work out with the data extracted from available modes of

acquisition by three methods; depreciation analysis, residual value analysis and net present value method as a function of framing profit margin chart. Data collection pattern is prepared based on these methods. It is proposed to carry out evaluation of equipment acquisition from net present value method.

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