

# A METHODOLOGY TO SELECT CONSTRUCTION EQUIPMENT ACQUISITION METHOD

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**Abstract:** Construction equipment is a high cost of capital investment necessary for the successful existence of a private construction company. The highest impact cost factor other than the initial purchase investment is the expenses related to maintenance and repair. As the equipment ages, the ownership costs decrease and the operating expenses increase as the maintenance and repairs requirements grow. Both private and public entities desire to manage this high investment for optimization of a perceived profit. This project recommends a decision support model that can be used by private and public entities alike to determine the best fit acquisition method and guidance for profitability optimization. Methods of life cycle cost estimating and decision methods were researched and compared. Data was acquired from equipment rental companies and private construction companies. This data was analyzed to select the appropriate decision factors and develop the Decision Model.

**Keywords:** Construction equipment, acquisition, equipment management.

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## I. INTRODUCTION

The construction industry is fragmented and consists of a high number of small firms scattered throughout the country with different specialties and capabilities. Many of these companies are individual or family operated corporations that have to struggle to establish a foothold and maybe for continuity of operations as well. For those companies that require construction equipment in execution, the investment tied up in long-term equipment carries a high risk that must be managed.

One of the big issues in construction companies is that the company needs construction equipment but doesn't know whether to buy it rent it or lease it; in the other word company doesn't know how to acquire it. There are varieties of factors that a good manager should consider in acquiring the equipment. These factors are both financial and non-financial. A good construction manager should identify these factors and by evaluating them decision making is possible. It is this concern that will be addressed in this Independent Research Study. This research will evaluate whether a small construction company is better off financially in renting, leasing or purchasing construction equipment.

## II. LITERATURE REVIEW

Equipment is a vital factor in construction, particularly in the heavy and highway segments of the construction industry, where it may be the largest long-term capital investment for many companies (Day & Benjamin, 1991). The acquisition and maintenance of construction equipment can absorb a significant portion of the resources of a company and can impact cash flow.

According to Vorester (2005), heavy civil construction equipment costs average approximately 30% of the company assets. Therefore, how companies acquire new equipment, whether equipment acquisition policies exist, and what the importance of an equipment policy is to large, medium, and small heavy construction firms should be questions of interest and are mentioned in the literature.

During the 1970s, several researchers presented the need for construction companies to have a greater knowledge with which to better calculate the cost of equipment acquisition. Elmer A. Cox, a construction services manager for H.B. Zachry Company, stated “to survive financially, highway and heavy contractors must be knowledgeable in acquiring, utilizing, maintaining, and trading equipment” (Cox, 1971). He further noted that a strategy for building a specific construction capability required good communication between those with financial responsibilities and those in construction management (Cox, 1971).

Douglas (1975) wrote Construction Equipment Policy to fill a void in construction management that he perceived existed for both owners and equipment managers. He theorized, “the rapid advancement of equipment technology during the past several decades has imposed the additional burden of establishing a sound policy governing the use of construction equipment.” He suggests several factors that a company should take into account when investing in new equipment:

1. Size and value of equipment fleets under control of a single manager.
  2. Size of heavy equipment contracts necessitating larger equipment investment on each job.
  3. Cost and complexity of individual machines resulting in technological progress.
  4. Availability of computers for cost keeping and investment analysis.
  5. Competition forcing contractors to adopt improved management methods in order to stay in business. (Douglas, 1975)
- Douglas argued that most large companies had the resources to dedicate to the creation of an equipment policy, and he recommended that smaller companies adopt a policy in order to survive in the changing business environment.

Researchers Tavakoli, Taye, and Erktin (1989) agreed with Douglas and noted that an equipment policy has a great impact on the profitability of a construction firm. The survey conducted by Tavakoli, Taye, and Erktin in 1989 gathered participants from the top 400 contractors as noted by Engineering News Record in 1982. The surveyed participants came from both heavy and non-heavy construction companies. The intention of the study was to report on the top 400 contractors’ equipment policies by using a questionnaire that paid “special attention to equipment financing, replacement analysis, equipment standardization, safety, and maintenance management” (Tavakoli et al., 1989).

Several surveys in the 1980s, investigated the theories of Douglas and Cox and statements involving equipment management policies. Additionally, these surveys gathered information on the status of construction companies and their attention to capital equipment. Researchers Schexnayder and Hancher (1981) conducted a survey focusing on industry practices and selected aspects of equipment ownership, including equipment record-keeping, replacement decision factors, and equipment retention periods.

### **III. METHODOLOGY**

This study is based on both primary and secondary data.

#### **A. Secondary data source:**

A detailed literature review was carried out to gather general information about the objectives of this study considered by construction practitioners in various countries. Conducting literature review helped to recognize the research topic in detail and general. Moreover, extra sources as well as essential knowledge required regarding this study were obtained through literature review. The resources employed during literature review of this study are international and local conference papers, documents, internet, magazines, journal articles, books, and etc. Secondary data sources were used to identify specially the financial factors affecting on construction equipment acquiring method.

#### **B. Primary data source:**

The primary data source of this study was interview. Initially interview was conducted through communicating with the key personnel of contractor companies. This interview was done through asking open ended questions. The results from this stage then used mainly to get some ideas and establish the objectives through finding the problems. The interview was used specially for identifying non-financial factors affecting on construction equipment acquisition methods. After preliminary data gathering, questionnaire survey has carried out to reach the objective of this study among selected construction practitioners involved in construction projects. Questionnaire survey specifically has been used for evaluation of factors affecting on CEA methods.

Also, it was observed that there is a trend of subletting a particular activity completely for which the equipment is to be acquired. Hence, the option of subletting the activity completely instead of acquiring the equipment has also been covered in the research.

**IV. RESULT AND DISCUSSION**

The result of this study is the development of a decision tool. This tool can be applied to both private and public entities. The entity will first identify the requirement and the equipment desired for fulfillment. The first step related to this study is that of quantifying the demand. As stated before, this is a high level decision of short-term/testing, long-term or uncertain. If the equipment need is only for a short period project, to use for a trial period while deciding what equipment to purchase, or to fill a short period spike requirement, then the demand would be classified as short term testing. If the equipment requirement is known to be a perpetuity, fulfill a several year project need, or expected to be necessary for the continued success of the entity, the demand would be classified as long-term. If the equipment need does not fit either of these two descriptions, then the demand would be classified as uncertain.

	rent		lease		buy		sublet	
	criteria	rank	criteria	rank	criteria	rank	criteria	rank
quantify demand	short term/test		uncertain		long term		short term/uncertain	
parameters	financing		financing		financing		financing	
	minimized assets and no control over equipment		option to purchase the equipment		full control over equipment		minimized assets and no control over equipment	
	fixed rate		semi-fixed		variable		fixed rate	
	maintenance by rental company		negotiated		maintenance by owner		maintenance by subletting company	
	freight charges		freight charges		freight charges		freight charges	
	initial unloading and assembly		initial unloading and assembly		initial unloading and assembly		initial unloading and assembly	
	storage		storage		storage		storage	
	labour		labour		labour		labour	
sum of ranking								
cost comparison	rental rates		lease estimate		own and maintenance rate		sublet rates	
normalized								
benefit cost ratio								
recommended acquisition method								

The next step is to identify the policies set in place or parameters identified by the decision-maker related to qualitative and financial preferences. It is recommended that four areas be ranked. The first is the capability of financing. This can cover both the risk of financing the entity as perceived by the financing institution and the desirable management of working capital. Secondly, the desired type of asset management. This relates to the preference of minimizing owned assets, wanting the option to purchase or desiring full control of availability and condition (pride of ownership). Thirdly, the desired confidence in estimating charged rates. This refers to the comfort of fixed costs through rental agreements, semi-fixed costs through lease agreements until negotiated to contract or the variable costs related to estimating and realty differences in ownership. Finally, the placement of maintenance responsibility related to the equipment. Whether it is preferred that the risk and responsibility of equipment maintenance and repair be retained by a dealer through a rental, held at the entity with a requirement as establishment of pride in ownership and control of mechanical condition or determined through negotiations of a lease agreement. It is recommended that all four of these areas within policy parameters be ranked across the row by filling in a 0, 1, or 2 independently. Low/No = 0, Maybe = 1, High/Yes = 2 . Divide Rank Sum by Cost factor for ratio. Highest marked column represents the recommended acquisition method. Next is a cost comparison. This may not be seen as necessary because of the expected higher cost of renting, decreased cost of a lease and lowest cost of ownership revealed through most evaluation methods. It is recommended that a cost comparison still be made, to ensure the proper factors are being compared. Most hourly rate comparisons use the Ownership & Operating hourly rate to compare with the rental cost over available hours.

rent		lease		buy		sublet	
periodic	₹	annual	₹	life costs	₹	periodic	₹
daily rent rate		estimated lease rate		purchase price		daily rent rate	
daily estimated use		maintenance cost		tire cost		daily estimated use	
hourly rate		estimated annual use		salvage		hourly rate	
		hourly rate		tax benefit			
monthly rent rate				interest		monthly rent rate	
monthly estimated use				tax/license		monthly estimated use	
hourly rate				$(P-T-S)*(1+i+td)$		hourly rate	
				maintenance cost			
				own+maintenance			
				estimated life use			
				hourly rate			

## V. CONCLUSION

The decision model is unique to include many different aspects of construction equipment management into a concise and simple decision tool. The most significant value added to the industry by the model is the identification of the different cost factors common and uncommon between the acquisition alternatives, resulting in a more accurate comparison of overall costs. The model also focuses on the inclusion of several factors typically left separated. First, it includes quantitative and qualitative factors within a single decision analysis. Secondly, it compares the entire LCC of purchasing to the rent and lease alternatives to provide a comparison not focused on short-term ownership with high recovery value costs (depreciation) skewing the compared rates. Thirdly, the model allows the user to calculate rates based on realistic hours of use instead of a textbook or manufactured estimation of available hours. This is vital as only the using entity knows how many hours of use that equipment will actually see in the given maximum number of available hours. Fourthly, the model covers optimization of the equipment use and not only the best method of acquisition. Because of these combined factors, the model can be implemented by beginners for equipment management and referred to by experienced managers in evaluating the existing processes.

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