COST ANALYSIS OF CONSTRUCTION EQUIPMENT

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ABSTRACT- Managing a public agency's equipment fleet is rife with conflicting priorities. One of the most important aspects is the economic trade-off between the capital cost of replacing a piece of equipment and the ownership costs of operating and maintaining the machine in question if retained for another year. Therefore, determining life cycle costs and the economic life is vital for fleet managers to optimize equipment funds. Currently, most public agencies apply deterministic methods to make fleet management decisions.These methods do not account for uncertainty within the input parameters, such as volatility in fuel prices that potentially impact the replace-or-retain decision. Thus, the objective of this study is to develop a stochastic equipment life cycle cost analysis (LCCA) model to optimize equipment economic life based on life cycle costs for a public agency's fleet. A public agency does not have financial flexibility; consequently, the constraints on the us of available funding can affect the replacement and repair cycles for its equipment fleet. In this project, I have analysed the life cycle cost analysis of the multi-storied building. This Method impacts the profit is analysed and the alternate suggestions and remedies are discussed in this analysis.

INTRODUCTION

The objective of this research is to develop a stochastic equipment LCCA model to determine the economic life of equipment for a public agency's fleet. The PWFSD equipment fleet data was utilized in the LCCA. This thesis has three main areas of focus:

- Impact of Fuel Volatility on Equipment Economic Life
- Determination of the Most Sensitive Inputs to a LCCA Model for Equipment
- Stochastic Equipment LCCA Model to Calculate the Economic Life that Varies from Deterministic Method

Life Cycle Cost Analysis

Equipment LCCA is comprised of life cycle costs, equipment decision procedures, replacement analysis, and replacement models. The decision to repair, overhaul, or replace a piece of equipment in a public agency's fleet is a function of ownership and operating costs. This research explores the impact of commodity price volatility, as well as normal variation, in the costs of tires and repair parts. The accuracy of the life cycle costs can be improved by implementing stochastic functions. Thus, this research employed a stochastic model to better depict life cycle costs and compute optimal economic life to improve equipment fleet decisions.

Life cycle costs for equipment have two components: ownership costs and operating costs. Ownership costs include initial costs, depreciation, insurance, taxes, storage, and investment costs (Peurifoy and Schexnayder 2002). Operating costs include repair and maintenance, tire, tire repair, fuel, operator, and any other consumable equipment cost (Gransberg et al. 2006). The PWFSD provided equipment fleet data which was used in the research to evaluate equipment life and answer the research questions in a quantitative manner.

RESEARCH METHODOLOGY AND VALIDATION

Chapter 2 contains the research methodology that is functional in Chapters 3, 4, and 5. Figure 2 displays the research methodology that was employed for this study.

This is the overall approach in the development of the stochastic model and economic life determination used to implement equipment LCCA.

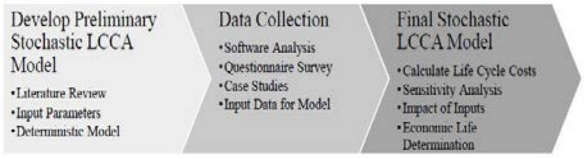

Figure 2. Research Methodology

IMPACT OF FUEL VOLATILITY ON EQUIPMENT ECONOMIC LIFE

Diesel fuel prices are currently more volatile than in any time in the past two decades. As a result, its impact on public agency equipment fleet management decisions is more prominent than ever before. Therefore, the purpose of this research is to quantify the impact of fuel volatility on the economic life of equipment and provide guidance on how to factor this major operating cost into public agency fleet repair, overhaul, and replacement decisions. The authors demonstrate the impact using both deterministic and stochastic equipment economic life cost models. An example utilizing a is Tower Crane S 5013 Model are provided to demonstrate the difference between the two models. When the stochastic model is used, the equipment management decision can be enhanced by associating a confidence level with the economic life determination. The researchers find that a 50% increase in fuel costs creates a 32% increase in the life cycle cost, which reduces the economic life of the tower crane. It was also concluded that the life cycle cost model is most sensitive to the interest rate used and the fuel costs.

Parameters	**Tower Crane Model C 5013**
Initial Cost	Rs. 22,50,000
Annual Usage in Hours	5000
Annual Initial Cost (AIC)	Rs. 90,000
Tire Cost	Rs.8000
Salvage Value (10%)	Rs.2,25,000
Annual Salve Value (ASV)	Rs. 18,750
Useful Life	20
Sum of Years Digit	105
Change in Market Value	10.60%
Interest Rate	5.3%
Depreciation	Rs.4,50,000
Tire Repair Costs	Rs.8,000
R&MC	Rs.5,000
Fuel Price	Rs.70/Litre
Fuel Costs	Rs.20,160
Total Operating Costs	Rs.3,50,000
Ownership Costs	Rs. 500000
Annual Life Cycle Cost	Rs.8,50,000

Optimal Economic Life Cycle Analysis

The determination of the economic life for equipment fleet is a critical component of the LCCA. The economic life, or the optimal time to sell a piece of equipment, requires the usage of EUAC calculations. To properly use the EUAC, the ownership costs and operating costs must be calculated on an annual basis in the correct year. The life cycle costs must also be calculated, using Equation 9, on an annual basis in a given year to properly calculate the EUAC (Park 2011). Additionally, Equations 10 and 11 are utilized for the operating and ownership costs within the EUAC (Park 2011)

Results

The results contain the output from the deterministic and stochastic equipment example. A sensitivity analysis quantified the impact of fuel volatility associated with the LCCA. Additionally, the stochastic model is compared with the deterministic model to illustrate the discrepancies.

Deterministic Equipment Example

A Tower Crane Model C5013 was employed in an example to demonstrate the deterministic method. The data for the tower crane was derived from the records furnished by the PWFSD. The information that was used during the formation of the model for the tower crane. The tower crane was chosen for this demonstration because it is a typical piece of equipment used in public agencies.

CONSOLIDATED CONCLUSIONS AND LIMITATIONS

Conclusions

Deterministic and stochastic models were developed for construction equipment to calculate equipment fleet life cycle costs and the optimal economic life. This was achieved by modifying the PSM to fit the construction equipment fleet environment and applying basic engineering economics principles to find optimal life cycle cost solutions. When the stochastic model was applied to a piece of equipment using fluctuating interest rates and fuel prices, the sensitivity of the model's input variables was determined. The interest rate was found to have a greater impact on economic life output than fuel prices for a tower crane illustrated in Chapter 3. The fuel volatility did impact the life cycle costs when applying the stochastic confidence levels. Therefore, allowing fuel prices to range probabilistically in the analysis provided a means to quantify the certainty of the equipment replacement decision. With the increasing cost of diesel fuel, the issue of upgrading to a more fuel-efficient model of equipment using the latest technology has become an increasingly important element of the replace/repair decision. Therefore, employing the stochastic inputs allows the analyst to determine the impact of the most sensitive component of the model. This was illustrated in Chapter 4, where common input values were made stochastic to determine their impact on the public sector-adapted PSM equipment LCCA model. Based on Monte Carlo simulation sensitivity analysis results, the time factor and engine factor were the most sensitive input variables to the LCCA model.

This leads to the conclusion that when deciding to replace a piece of equipment, engine efficiency should be a high priority due to the costs associated with the time factor, engine factor, and its subsequent annual usage.

Applying that conclusion to the public sector, one must realize that once a given piece of equipment is added to public agency's equipment fleet, the equipment fleet manager can no longer influence many of the model's variables. These include the equipment's idle time, its working conditions, and its engine efficiency. While accounting for uncertainty was shown to add value to the overall decision, making all the input variables stochastic introduces a level of complication that is not necessary. Therefore, it is concluded that employing the inputs as deterministic is the most practical determination. Inputs such as the repair and maintenance uncertainty are more critical to equipment decisions because the fleet manager can control those inputs more closely. Consequently, the researchers determined which variables should be included in the equipment LCCA model as deterministic values and those better portrayed as stochastic variables to aid public agency equipment fleet managers, as shown in Chapter 4.Finally, Chapter 5 contained a stochastic equipment LCCA model that produced different output results than the deterministic methods for a public agency's fleet. The stochastic model accounted for uncertainty within input parameters, unlike deterministic methods that only use discrete input value assumptions. A range for the optimal replacement age was formulated within a 70% to 90% confidence level. Since public agencies must make equipment replacement decisions years in advance, the economic life range allows fleet managers to plan the replacement with certain levels of confidence. The usage of Monte Carlo simulations provided for a sensitivity analysis performed in conjunction with the stochastic economic life determination. The outcomes displayed a change in the sensitivity from year to year due to the change in market value and the repair and maintenance costs. The variation between the two input variables occurred within the economic life range developed by the confidence levels. Therefore, the confidence levels along with the sensitivity analysis provide a trigger point that equipment LCCA models. The results take into account uncertainty within each input, calculating a more realistic depiction of the actual costs.signals when the equipment manager should consider replacing a piece of equipment as it nears the end of its optimum economic life.

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