TECHNICAL SUMMARY

Development of an Approach to Facilitate Optimal Equipment Replacement

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INTRODUCTION

The Louisiana Department of Transportation and Development (DOTD) has a large quantity of equipment for which the department maintains a computerized database of information (EQMS). Management of the department is interested in two points with regard to the equipment as follows: When insufficient funds are allocated to replace all equipment that is in service past its economic life, what would be a good procedure for allocating funds? Secondly, what funding requirement would be necessary to bring the equipment pool current, i.e., to replace all equipment that is past its economic service life?

The basic thesis of economic service life is that when an asset is placed in service it has associated costs for depreciation, operation, maintenance, and lost service time. In general, on an annual cost basis the cost of depreciation will drop with each year of use, and the other three components will rise. This relationship leads to the phenomena of economic life, the life at which the average annual cost of operation of the equipment is at its minimum cost. At this point the depreciation charge equals the sums of the other three costs of having the equipment in service. At this economic life, the annual cost of ownership is at a minimum, and past this economic life, the cost of use begins to increase.

The result of applying this principle is then to replace equipment when it reaches its economic life in order to minimize costs. This principle is true only for an ideal world in which there is no inflation. In reality, when the cost curve for the equipment begins to ascend, it may still be cheaper to operate the existing equipment than to purchase new equipment (the assumption of the model is like-for-like-replacement, i.e. that the new equipment is identical to, and cost the same as, the old). Further, the replacement policies in the private sector are structured for economic feasibility considering the time value of money. They are not necessarily limited to a fixed budget for one year but consider the possibility of borrowing funds to spend more in the current period if this can be economically justified.

For the case at hand, funds budgeted must be expended in the budgeted year. There is no borrowing and no investing of funds budgeted to provide flexibility in some future period. Hence, the results of applying the principle must be tempered to some extent for the reality that we wish to consider.

The DOTD system must take into the account two priorities: general case and a higher priority necessitated by logic. The general case must include the equipment in the pool not chosen for the higher priority category of funds allocation. Equipment in the higher priority category may be replaced and the replaced equipment functionally downgraded into the lower category to be evaluated later for replacement and disposal. Included in the high priority category could be equipment representing a new technology that is essential for evaluation (technically, this case is not replacement, but rather, an initial purchase). The equipment from the higher priority category may be replaced and the replaced equipment sold as would be the procedure for the lower priority category. Equipment placed into the higher priority category will be replaced if sufficient funds are available. Normally, the fund requirements for this category will be small in relation to the overall replacement budget, and hence inclusion in this category would ascertain that the replacement occurs.

For the top priority category of replacement candidates, if funds allocated in this category are insufficient to cover the entire set of units, an administrative determination can be made as to priority. For the general priority category of replacement, it appears that the urgency rating for replacement could be a priority assigned to each unit. The value assigned would be the ratio of the current age of the asset to the economic life for that category of asset.

Information available for analysis does not provide a basis for the analysis of a specific piece of equipment that is currently in operation, but rather for an equipment category or class. Thus, statistical information can be used to calculate the economic life for a category of equipment, but no conclusions can be drawn for a specific piece of equipment other than the generalizations made for the category. A management policy could be adopted to "disallow the application of maintenance funds for major repairs to equipment that has reached 80 percent of its economic life or if the repair cost will exceed 50 percent of the book value of the equipment." Policies such as these would be justifiable economically due to the fact that the large investment in the later years of the equipment's life would significantly increase the total annual costs for the last years of operation. The reduced economic life would default to the current period, thereby increasing the urgency rating for the equipment in question to the value of "one". The fact that the equipment is not operating would necessarily need to be taken into account if the equipment were a required unit, thereby advancing this inoperable unit into the priority category.

OBJECTIVE

The objective of the study was to determine a way or ways to assign an urgency rating to equipment that is currently in service but in need of replacement. This urgency rating must in some manner take into account the various costs associated with retaining the equipment in service. Further, it is desired to determine the required capital budget to bring the equipment pool current in terms of economic life, i.e., the required funds to replace all equipment that is past its economic life.

SCOPE

The study is of the equipment pool of the Louisiana Department of Transportation and Development. This pool includes all assigned automobiles, trucks, tractors, and equipment of various categories. The current pool includes approximately 6,000 pieces belonging to 240 or more categories. The data used was that of the EQMS (Equipment Management System) of DOTD. In some cases, the data was deficient or deemed lacking for analysis. Most of these cases involved new equipment where insufficient data had been accumulated for analysis. In other cases where there was data, but inconclusive results, no elimination was made of the information, rather it was left for study by department personnel who might have interest in the anomalies.

RESEARCH APPROACH

Data from the EQMS was obtained. This data had been accumulated over a period in excess of twenty years. The initial analysis was done to index the data for inflation. All costs were converted to a "percent of initial cost" so that they could be used as a basis for statistical analysis. Using first costs and other maintenance and down time costs as a percentage of first cost, a one-way analysis of variance was run to analyze the cost data for each type of equipment. This analysis revealed that the confidence intervals on costs were the tightest in the earlier years of the equipment life and became more divergent as the equipment was held in service for longer and longer periods. Next, a model was formulated for analyzing the economic life of the equipment and the economic lives were calculated category by category. Curves were constructed to illustrate the minimum cost lives for each category of equipment. Using these economic lives, pool equipment was examined piece by piece to determine whether it was past the economic point for replacement. Cost of replacement information was obtained from DOA Purchasing, and together with the individual economic life analysis result was used to determine the funds required to bring the pool current.

CONCLUSIONS

The conclusions of the study are the following:

1. Approximately $36,000,000 would be required as a one-time funding increment to bring the equipment pool current.
2. The model developed to determine the priorities for the allocation of available funds for equipment will provide good results if applied objectively. This objective application would essentially require evaluation of the total equipment pool using the same criteria and methodology, then determining the amount of funds to go to each budgetary unit based upon their assigned equipment that falls within the prioritized units for replacement.