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Construction of Life Cycle Cost Analysis Model for Economic Asset Management in Water Supply System

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Abstract. A life cycle cost analysis model has been constructed to economically perform asset management, a series of systems implemented to not only satisfy the life cycle cost of a water supply structure but also meet the level of service required. Life cycle cost is consisted of initial installation cost, maintenance cost, and disposal and replacement cost, while the calculation methods used are NPV (Net Present Value) and EUAC (Equivalent Uniform Annual Cost). In this paper, an LCC analysis is performed with a portion of data on the water supply system of YW filtration plant being used as a reference. Also, the ways to secure financial stability in the future are suggested and, thus, an economic asset management direction is also proposed.

Keywords: Life Cycle Cost (LCC), Maintenance, Inventory, Water Supply System, Asset Management

1 Introduction

A series of systems which are carried out to satisfy the minimum life cycle cost of a water supply system and to reach the desired level of service are defined as asset management [2]. Here, Life Cycle Cost (LCC) refers to a process to assess overall economic values by analyzing an initial cost and discounted future costs for tasks such as maintenance, reconstruction, reinforcement, repair and replacement. This research studies ways to economically manage water supply systems by utilizing the life cycle cost analysis method.

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2 Materials & Methods

2.1 Conception of LCC

The concept of LCC includes all costs generated during the life cycle of a facility or a facility usage system from a cost perspective and, for a manager, this is a technique that considers a cost, which is critical in facility maintenance, within the scope of economic lifespan and assesses economic feasibility by using values converted through a cost integration method such as NPV or EUAC.

LCC is a type of analysis that calculates all costs generated during the entire process from planning to disposal of a facility and finds an optimal combination. The goal of life cycle cost analysis is to find the minimum investment point that constitutes a suitable balance between costs and functional aspects (Fig. 1. Minimum Life Cycle Cost).

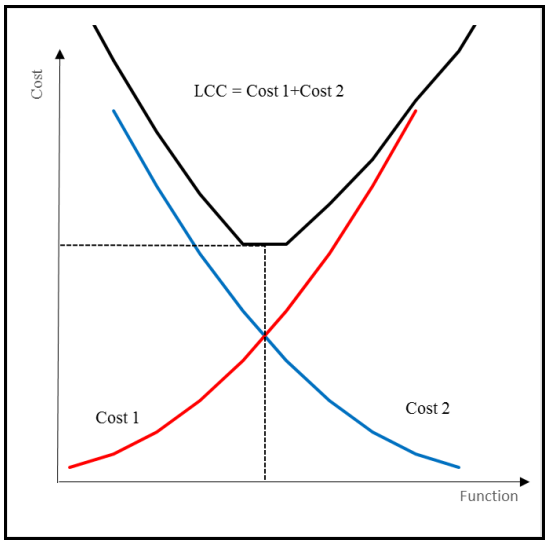

Fig. 1. Minimum Life Cycle Cost

Among costs in various stages of a facility's lifespan, the cost for planning, design and construction is defined as Cost 1 and that of maintenance and disposal is defined as Cost 2. Then, the minimum life cycle cost can be estimated by the correlation graph between functionality and cost. Through the LCC graph curve, which depicts the sum of Cost 1 and Cost 2, the point at which costs become minimized can be found. This enables decision-makers to be able to clearly define the point of investment for asset management and also reduce unnecessary spending.

3 Results and discussion

3.1 Procedure establishment of LCC analysis model

As previously mentioned, an LCC analysis may obtain greater effects in initial planning rather than maintenance but the current distribution rate of water supplies reaches 98.6%, meaning that water supply systems are established in almost all circumstances in Korea [3]. Thus, in consideration of these characteristics, it is appropriate to establish an LCC analysis model from the maintenance perspective (Fig. 2. Procedure of LCC analysis model).

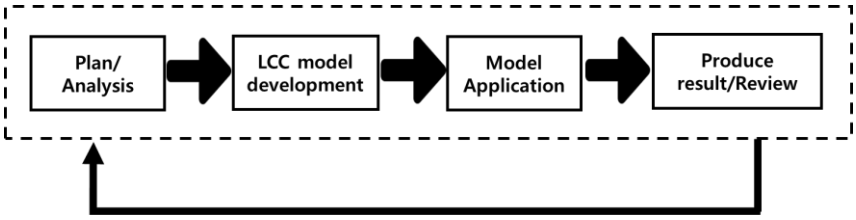

Fig. 2. Procedure of LCC analysis model

3.2 Construction of LCC analysis model

The LCC analysis model applied to a water supply system in this research referred to "LCC Analysis Research for Cost Reduction in Water Supply Construction Project" [1] and "Development of Asset Management Technique for Performance of Water Supply and Sewage Pipelines and Increase in Usage Efficiency" [2], and was established by considering characteristics of a supply system.
The total LCC for an LCC analysis of a water supply system is estimated as follows.

$$LCC_{TOTAL} = C_{INT} + C_{MAN} + C_{DRE}$$

where, LCC_{TOTAL} = Total Life Cycle Cost
C_{INT} = Initial Installation Cost
C_{MAN} = Maintenance Cost
C_{DRE} = Disposal & Replacement Cost

The initial installation cost, C_{INT}, is constituted of planning & design cost, supervision cost and construction cost, as follows.

$$C_{INT} = C_{DES} + C_{CSV} + C_{CON}$$

where, C_{DES} = Design Cost
C_{CSV} = Construction Supervision Cost

C_{CON} = Construction Cost

The maintenance cost, C_{MAN}, is constituted of direct & indirect management cost, inspection & diagnosis cost, repair & reinforcement cost and emergency recovery cost, as follows. In this paper, local economic losses by a third party were excluded from the scope of LCC analysis.

$$C_{MAN} = C_{DIM} + C_{DIA} + C_{RHE} + C_{EME}$$

where, C_{DIM} = Direct · Indirect management Cost
C_{DIA} = Diagnosis Cost
C_{RHE} = Rehabilitation Cost
C_{EME} = Emergency Recovery Cost

The disposal and replacement cost, C_{DRE}, is consisted of disposal cost and replacement cost.

$$C_{DRE} = C_{DIS} + C_{REP}$$

Where, C_{DIS} = Disposal Cost
C_{REP} = Replacement Cost

Elements may be freely removed from or added to the three stages of initial, maintenance and replacement cost stages that do not exist or are additionally generated in LCC analysis items.

4 Conclusion

The most important aspect in operation of a water supply system is to construct an inventory and clearly understand what one's assets are, and the second most critical element is to calculate the life cycle cost and manage the conditions and lifespan of a facility. The need for a life cycle cost analysis is specified in the laws and, as we enter into the era of maintenance, an efficient use of budget in environments mostly equipped with major infrastructure definitely requires life cycle cost analyses. Through an LCC analysis, water service providers can estimate the budget required in the future and, based on the analysis results, obtain budgetary approval from the government.

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