Asset Management

Subjects: Business

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The international standard for asset management ISO55000 defines asset management as "coordinated activity of an organization to realize value from an asset". This standard requires establishing a Strategic Asset Management Plan (SAMP) for the organization's achievement of goals (value), which includes response strategies for identifying, assessing, and controlling any possible risks that may occur during the goal achievement process. Goals and risks are important from the view of asset management as they provide the directions for management of the asset's life-cycle and budget investment as the organization's enterprise management policies. The International Infrastructure Management Manual (IIMM), developed to reflect ISO55000, divides the types of risks into the continuity of business management, safety, politics, law, finance, and cash flow, suggesting the quantitative evaluation method in the consideration of the Probability of Failure (POF) and Consequence of Failure (COF).

Keywords: infrastructures ; asset management ; aging bridge ; deterioration model ; maintenance demands

1. Introduction

Infrastructure asset management starts from identifying possessed assets and defining what services and values shall be delivered to users. From this point of view, the service of the bridge can be defined as securing the continuity of the road network, and its value as the safe provision of the services. Meanwhile, ensuring a stable service and value of the bridge requires a correspondent management budget, and the road manager must prepare a data-backed, objective basis to secure an appropriate budget.

Bridges are one of the core assets for providing road services and have a very complex structure, with a variety of bridge types compared to other facilities [1]. The problem is that the structural and material durability of these bridges deteriorates over time. Many countries are experiencing difficulties due to the increasing number of aging bridges. In the United States, for instance, as of 2020, 7.5% of the 617,000 bridges in the country are structurally deficient, and 42% are reported to have exceeded an average design life of 50 years. The total cost of maintaining these bridges is estimated at USD 125 billion [2]. The US government is making efforts to establish the National Bridge Inventory to prioritize bridges for maintenance and to distribute/operate systematic bridge management programs such as Pontis (AASHTOware Bridge Management Software) [3]. In 1994, the Republic of Korea (Korea) witnessed 32 people killed due to the collapse of Seongsu Bridge. After negligence in maintenance was identified as the cause of the accident, a special law on inspection, diagnosis and maintenance of infrastructures was enacted [4]. Nevertheless, there are still cases of bridge collapses happening around the world. Since the 2000s, more than 130 bridges have collapsed [5]. The main causes are overload, natural disasters (such as heavy rains (flood), soil erosion, earthquakes, and tsunamis), poor construction or management, and aging due to long-term use.

Since the collapse of a bridge leads to a major disaster, extensive studies have been conducted on the life cycle cost, management system, safety, and deterioration characteristics of bridges [3][6][7][8][9][10][11][12][13][14][15][16][17][18]. Internationally, the condition of bridges is mostly expressed based on grades, which are generally divided into three to nine grades [3]. The bridge deterioration model can be divided into a comprehensive indicator model that recognizes the condition of the entire bridge as one, and a member model that builds an independent model for each part of the bridge. The former focuses on the service and asset value of the bridge, while the latter focuses on an understanding of member defects from an engineering perspective and the economic view for life cycle analysis. Most of the previous studies correspond to the latter type, aiming to estimate the life expectancy and range of major parts, and the probability of condition transition [6][7][8][9][10]. Meanwhile, a case study on the comprehensive life expectancy of bridges suggests that a typical life expectancy is 50 years, with a confidence range of 40 to 150 years [11].

2. Heterogeneous Deterioration Process and Risk of Deficiencies of Aging

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We confirm that the deterioration rate of aging bridges that have been used for more than 30 years is heterogeneously fast. The main results can be summarized as follows:

- The life expectancy of old bridges used for more than 30 years is 14.4 years, which is 1/3 of the network average of 41.9 years.
- The probability of deficiencies of the old bridges is seven times higher than that of new bridges of 10 years old or less.
- Preventive maintenance can help prolong the life expectancy of a bridge; however, it cannot completely prevent the deterioration of the condition grade.
- In order to keep the bridge management risk level of ROK above 95% of A + B Grade, 44.7% of Grade C bridges must be continuously maintained every year.

Future studies will focus on the increasing trends of annual budget demands, the timing of peak occurrence, and strategies for distributing this peak through life cycle cost analysis that reflects the trend of the increase in aging bridges. Above all, the development of deterioration models for each bridge member, effects of various explanatory variables (environmental condition, structural types, scale, material characteristics, etc.) on the deterioration process, and approaches to the consequence of failure, which were not covered in this study, are also essential topics for precise and reliable asset management.

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