Bridge Life-Cycle Optimization

**BRIDGE LIFE AND THE POSSIBLE LCC APPLICATIONS**

Bridges are vital links in many roadway networks and represent a big capital investment for both governments and taxpayers. They have to be managed in a way that ensures society’s needs are optimally met. Many countries are using the bridge management systems (BMSs) as the main tool for the effective management of their bridges. Although many BMSs contain some form of life-cycle costing (LCC), the use of LCC in bridge engineering is scarce. LCC in many BMSs has mainly been applied within the bridge operation phase to support decisions related to existing bridges. LCC has several useful applications within the bridge entire life, from cradle to grave. When more than one alternative is available, LCC can be used to specify the most cost-effective one. Figure 1 presents the typical Swedish bridge investment and management phases and schematically addresses the possible LCC applications and saving potential.

**INTEGRATED BRIDGE LIFE CYCLE COST APPROACH FOR EXTENDED BRIDGE SUSTAINABILITY**

Currently, LCC is more of a concept than reality in bridge engineering and mainly considers the conventional cost terms. Currently, the concept of the lowest bid is normally used when deciding a contractor. However, the lowest bid conventionally reflects the lowest first cost, not the lowest cost of ownership. In recent years, an expansion of the LCC concept has been made by also taking user costs into account. There are also third-party costs or split-user costs. These costs are indirect costs which incurred by entities who are neither the bridge owner nor direct bridge user. The bridge life cycle issues and cost categories that included in the new integrated bridge LCC approach are schematically presented in Figure 2.

**METHOD**

The research has been started by establishing a decision framework for the LCC and LC approach followed by studying and identifying the possible applications of these frameworks for bridges. The current and future phases of the project are to upgrade and develop the Swedish Bridge and Tunnel System (BaTM) for accommodating the developed tools. Doing so, the client will be informed on how and when the largest user can be achieved.

**CONCLUSION**

The purpose in this paper was to enhance the bridge investment and management decisions by specifying and supporting the use of LCC within the Swedish Bridge and Tunnel Management System (BaTM). An integrated, decision-oriented, and comprehensive scheme for LCC implementation within the bridge investment decision phases was illustrated. A stand-alone computer program (BaTM) has been developed. The program presents a unique integrated bridge life-cycle costing approach. The program supports all bridge life-cycle issues such as environmental, aesthetic, and user cost aspects and can measure and compare like the LCC approach. This approach helps the bridge designers and evaluators in making the best decision.

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**Bridge Work-Zone User Costs**

Bridges are public-use property and any roadway to repair or maintain a bridge might parallel the entire transport network. The work zone user cost (ZUCC) are costs incurred by the users of the bridge as a result of deteriorating conditions of the bridge, such as a narrow width or low load capacity, which results from maintenance, repair and rehabilitation activities, leading to an increase in the vehicle trip time. By analyzing the bridge work zone in detail, the importance of avoiding traffic disruptions will be considered. Consequently, the bridge type that needs fewer repair works during its service life will be indirectly promoted.

**Bridge Environmental Impact**

One issue, brought up in the construction of a new bridge nowadays, is the impact this structure will have on the immediate environment. Specific traditional requirements for the bridge, a trend toward extended attention to the bridge’s environmental impact, as well as its design, and different maintenance, repair, and rehabilitation strategies, are growing stronger. Life-cycle assessment (LCA), is a technique for assessing the potential environmental aspects associated with a product, a product system or an activity.

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**Agency Costs**


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**Figures**

FIGURE 1 Bridge investment phases in Sweden, the possible LCC applications and saving potential

FIGURE 2 Bridge investment life cycle issues and cost categories

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**The Swedish Bridge and Tunnel Management System (BaTM)**

Saithet, a long tradition in bridge management. Since Saithet information about the bridge management and management, the Swedish Transport Administration (TRAFFIKVERKE) and the Swedish Transport Administration (TRAFFIKVERKE) is the largest bridge manager in Sweden. The Management of BaTM, which was introduced in 1984, today, BaTM is handling the management of 25 000 bridges with a total bridge area of 7 700 km2 and a bridge length of 5 056 km. All information is given on a project, strengthening, and maintenance level of costs. BaTM is a computerized Internet-based system, which means that users can always have access to updated information about the actual bridges cost (http://www.trafikverket.se). Furthermore, the system consists of a separate management program (BaTM), which is a tool for any research or management purposes. BaTM is recognized as the best-known software system in Europe.