

Pavements

Improving Transportation Investment Decisions Through Life-Cycle Cost Analysis

Life-cycle cost analysis is a process for evaluating the total economic worth of a usable project segment by analyzing initial costs and discounted future costs, such as maintenance, user, reconstruction, rehabilitation, restoring, and resurfacing costs, over the life of the project segment.

Source: Transportation Equity Act for the 21st Century

In the face of increasing public scrutiny, transportation agency officials are under great obligation to demonstrate their stewardship of taxpayer investments in transportation infrastructure. Many transportation agencies are investigating economic tools that will help them choose the most cost-effective project alternatives and communicate the value of those choices to the public. The Federal Highway Administration (FHWA) believes that life-cycle cost analysis (LCCA) can help transportation agencies with this process.

LCCA is an engineering economic analysis tool that allows transportation officials to quantify the differential costs of alternative investment options for a given project. LCCA can be used to study new construction projects and to examine preservation strategies for existing transportation assets. LCCA considers all agency expenditures and user costs throughout the life of an alternative, not only initial investments. More than a simple cost comparison, LCCA offers sophisticated methods to determine and demonstrate the economic merits of the selected alternative in an analytical and fact-based manner. LCCA helps transportation agencies answer questions like these:

- Which design alternative results in the lowest total cost to the agency over the life of the project?
- To what level of detail have the alternatives been investigated?
- What are the user-cost impacts of alternative preservation strategies?

LCCA's structured methodology provides the information and documentation necessary for successful public dialogue. Because of this, LCCA is a valuable tool to demonstrate a transportation agency's commitment to infrastructure preservation.

How Life-Cycle Cost Analysis Works

Project teams using the LCCA process first define reasonable design or preservation strategy alternatives. For each proposed alternative, they identify initial construction or rehabilitation activities, the necessary future rehabilitation and maintenance activities, and the timing of those activities. From this information, a schedule of activities is constructed for each project alternative.

Next, activity costs are estimated. Best practice LCCA calls for including not only direct agency expenditures (for example, construction or maintenance activities) but also user costs. User costs are costs to the public resulting from work zone activities, including lost time and vehicle expenses. A predicted schedule of activities and their associated agency and user costs combine to form a projected expenditure stream for each project alternative.

Once the expenditure streams have been determined for the different competing alternatives, the objective is to calculate the total life-cycle costs for each alternative. Because dollars spent at different times have different values to

an investor, the projected activity costs for a project alternative cannot simply be added together to calculate total life-cycle cost. LCCA uses discounting to convert anticipated future costs to present dollar values so that the lifetime costs of different alternatives can be directly compared.

Discounting is an economic method of accounting for the time value of an investment. (The calculations of discounting are identical to those of compound interest.) Because the level of service provided by each project alternative in the analysis is assumed to be the same, LCCA allows transportation agencies to evaluate alternatives on the basis of their life-cycle costs. The results of the analysis can be used to revisit the design or preservation strategy behind the project.

LCCA Methodology Steps

1. Establish alternative design strategies.
2. Determine activity timing.
3. Estimate agency costs.
4. Estimate user costs.
5. Determine life-cycle cost.

FHWA Technical Outreach Programs

In 1998, FHWA produced Demonstration Project 115, "Life-Cycle Cost Analysis in Pavement Design," which developed a technical bulletin, an LCCA instructional workshop, and a proof of concept for an LCCA software tool. FHWA Resource Center personnel have presented the workshop to over 40 States. Resource Center staff are now available to provide consultant services in the application of LCCA to the selection of pavement design alternatives.

Within FHWA, the Office of Asset Management has been charged with developing LCCA software and training materials. Recognizing the need for LCCA software tools, the FHWA Office of Asset Management is developing an LCCA instructional software package for pavements and is creating a new workshop to deliver this product. This software will encourage transportation agency project managers to perform life-cycle analyses on pavement projects and will allow these managers and their agencies to investigate concepts such as discount rates, sensitivity analysis, data uncertainty, and probability. The workshop will promote exploration of the use of LCCA in the project design process.

The Office of Asset Management is currently focusing on the application of LCCA to pavement design decisions. Further work will include the application of LCCA to evaluating design, maintenance, and preservation strategies for other types of assets, such as bridges.