Next Generation Life-Cycle Cost Analysis Tool for Bridges in Iowa – Phase II

tech transfer summary

Iowa's bridge life-cycle cost analysis management (LCCAM) tool was upgraded to integrate road user cost calculations into the software and provide a more user-friendly interface.

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RESEARCH PROJECT TITLE
Next Generation Life-Cycle Cost Analysis Tool for Bridges in Iowa – Phase II

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The Bridge Engineering Center (BEC) is part of the Institute for Transportation (InTrans) at Iowa State University. The mission of the BEC is to conduct research on bridge technologies to help bridge designers/owners design, build, and maintain long-lasting bridges.

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Goal and Objectives

The overarching goal of this project was to upgrade the life-cycle cost analysis management (LCCAM) software tool for continued use by the Iowa Department of Transportation (DOT). Specific objectives were as follows:

- Integrate road user cost calculations into the software without disrupting the current maintenance management procedure for bridge decks in Iowa
- Upgrade the graphical user interface (GUI) to make the LCCAM tool more user-friendly and easier to navigate

Background

As a requirement of the Moving Ahead for Progress in the 21st Century Act (MAP-21), states are mandated to develop a transportation asset management tool for maintenance of their portion of the National Highway System.

To help meet this requirement, a team from Iowa State University's Bridge Engineering Center in cooperation with Iowa DOT Bridges and Structures personnel developed a MATLAB-based LCCAM software tool. In its initial version, the tool focused on bridge decks and successfully integrated risk into the decision-making process for bridge deck maintenance in Iowa.

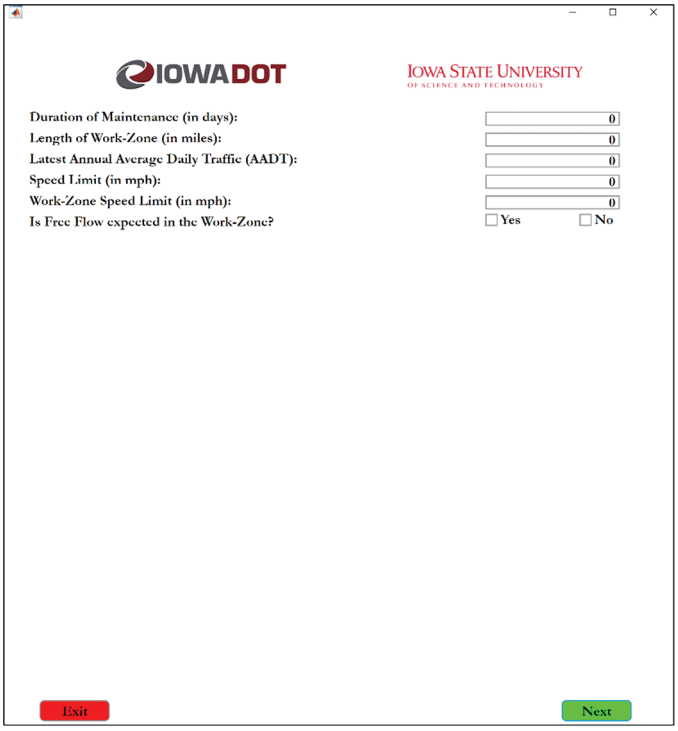
Problem Statement

To improve the utility of the LCCAM tool, the tool needed a new feature for calculating road user costs, a more user-friendly interface, and improved maintenance data that also provide a basis for future developments to include maintenance activities for bridge components other than bridge decks.

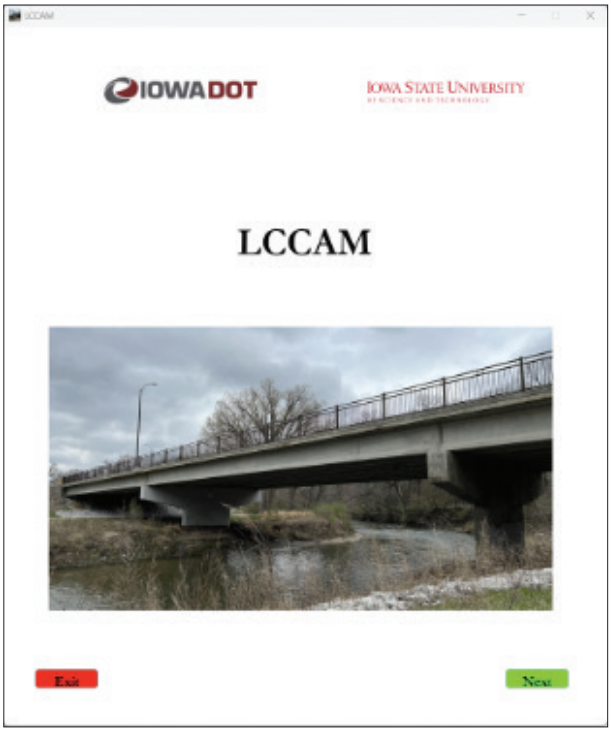
Project Description

The initial version of the LCCAM tool was upgraded and modified through the following:

Integrate road user cost calculations into the software. A roadmap for calculating road user costs published by Federal Highway Administration (FHWA) was followed to create this new feature. The software calculates the three main road user cost parameters—travel delay time cost, vehicle operating cost, and crash cost—based on user input and provides a breakdown of the final costs between the three parameters. This allows decision-makers to adjust the maintenance requirements to obtain the lowest road user costs.



Initial data input screen for calculating road user costs



LCCAM tool startup screen

Conduct a comprehensive survey of bridge maintenance activities. Following the nomenclature of the American Association of State Highway and Transportation Officials (AASHTO), a survey of the maintenance activities performed in the six Iowa DOT districts aimed to create a more consistent database of maintenance activities for the software. The survey also provides a basis for future development of the LCCAM tool to include maintenance activities for superstructure, substructure, and culvert bridge elements.

Update the software's user interface. The GUI was updated to provide a more user-friendly and aesthetically modern environment with the capability of saving software outputs and calculating road user costs. The interface also allows users to skip directly to the road user cost calculations. The updates are visible from the first page, where the input system has been changed from a command window to a scroller.

Key Results

- A road user cost calculation feature was successfully integrated into the LCCAM software. This feature not only calculates the final road user cost but also shows a breakdown of the cost among its three main components: delay time cost, vehicle operating cost, and crash cost.
- The survey of maintenance activities based on AASHTO nomenclature makes the software's maintenance actions more consistent with those of the rest of the nation and provides a basis for future development of the LCCAM tool to make it more inclusive of other bridge components.
- The upgrades to the LCCAM software's GUI make the tool more user-friendly and allow users to more easily navigate through the software's capabilities.

Recommendations for Future Development

- Degradation curves should be developed for superstructure, substructure, and culvert bridge elements to make the LCCAM tool more inclusive of components beyond bridge decks.
- Automation can help the LCCAM software become more user-friendly and require less user input. The user inputs for delay time can be linked to a historical traffic database to automate this part of the calculations. Similar automation is possible by linking the crash database of each road/county in Iowa to the software.
- A more comprehensive investigation of maintenance activities could make the software's maintenance estimations more accurate by measuring the cost and uncertainty of each maintenance activity.

Implementation Readiness and Benefits

Employing a reliable, Iowa-based bridge maintenance management tool that incorporates risk into the decision-making process allows Iowa to use its maintenance funds efficiently. The latest version of the LCCAM software tool continues to provide a user-friendly way to evaluate and compare maintenance costs for bridge decks over a bridge's lifetime.

The LCCAM tool has been enhanced with a new road user cost calculation feature and an updated GUI. The improved interface facilitates navigation through the software by providing the ability to go back during each step and the ability to skip to the road user cost analysis from the first page. The user can also save the analysis in a text file in the location of the software.

The incorporation of maintenance activities based on AASHTO nomenclature improves the software's existing maintenance data and provides a basis for future developments that can include maintenance actions for bridge elements beyond bridge decks.