RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Enhanced Bridge Cost Estimating

START DATE: October 2022

REPORT DATE: March 2024

RESEARCH REPORT NUMBER: SPR-1732

PROJECT COST: $175,665

COST SHARING: 20% MDOT, 80% FHWA through the SPR, Part II, Program

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Improving cost estimates for bridge repairs and replacement

Preserving infrastructure, including bridges, is a priority among transportation agencies. The Michigan Department of Transportation (MDOT) needs accurate cost estimates for bridge repair and replacement to budget for these high-cost projects and to allocate resources effectively. Enhancing MDOT's existing methodology for estimating bridge repairs and replacement will improve budgeting outcomes, enable more efficient resource allocation and lead to better overall performance in the state's transportation infrastructure.

PROBLEM

Accurate estimates of bridge repair and replacement costs are necessary for transportation agencies to effectively budget resources. However, the current method for estimating bridge projects in Michigan is not reliable or consistent. Many of these projects take years to complete and are often a part of a multiyear budgetary planning cycle. When projects cost significantly more than forecasted, MDOT must adjust maintenance and repair schedules and take time-consuming actions to account for the overruns.

To improve the reliability of cost estimates, MDOT needed a method that included more historical cost data and provided a better analytical approach. This project sought to improve the underlying data, information and analytical methodol-

Improving the accuracy of cost estimations for bridge repairs and replacement will help allocate resources more effectively and lead to better system performance.

ogy used in calculating cost estimates while also maintaining the user-friendly cost estimation spreadsheet currently used by transportation staff across the state.

RESEARCH

The primary objectives of this project were to develop an efficient and accurate method for estimating costs for bridge repair and replacement, and to incorporate this

method into an existing cost estimation tool that can be easily updated with a program after the end of the calendar year. The project goal was to design an innovative approach that would account for more cost information from a longer time frame and would incorporate historic inflation trends. Additionally, this approach would allow staff to manually adjust prices and rates if more up-to-date information became available for calculations.

A review of the literature examined the analytical options available to produce the best estimates for individual items used in bridge repair and replacement, such as a bridge deck joint or epoxy overlay. The research identified several analytical methodologies of interest to MDOT, including linear regression, multiple linear regression, lasso regression, and case-based reasoning.

Researchers developed a work type cost model to incorporate the improved pay item estimations into an estimated cost for 46 different types of work activities, ranging from constructing a new multiple span bridge over water to cleaning out culverts. The modeling included several cost approaches depending on the complexity, including average unit costs and regressed costs. Further, the methodology included inflationary costs calculated based on the timing of the project.

RESULTS

Based on the results from the different methodologies employed, the lasso regression produced the most accurate results for predicting the cost of individual pay items. Therefore, in addition to using time-adjusted average unit costs, the underlying model employs the lasso regression methodology to enhance the MDOT cost estimation spreadsheet when possible, with the total cost estimation models incorporating the more accurate pay item estimates. The spreadsheet cost estimates also consider the expected year of letting; project complexity; and the specific characteristics of individual projects, such as regional location.

Further, the enhanced spreadsheet now allows for various adjustments in the estimation process, including limits on the predicted inflation rate, the type of cost index used, the degree of conservatism for the inflation model, unit cost conversion factors, and the use of average unit costs or regressed unit costs. The spreadsheet contains a default setting of these considerations to represent present cost trends most accurately. While results have shown large variability in individual project costs, the average cost for a typical project by work type can be well estimated.

The spreadsheet also includes new automation processes that allow the tool to be updated with new project cost data quickly at any time. Previously, staff needed to manually update the spreadsheet with new data.

IMPLEMENTATION

The enhanced cost estimation spreadsheet now incorporates new methodologies, improved data and options for manual adjustments. This updated tool should increase the accuracy and reliability of bridge repair and replacement estimates and reduce staff time due to the automation now included. The tool can be used by agencies throughout Michigan to better estimate costs for bridge repair and replacement across the state.

Further, the improvements in the accuracy and reliability of cost estimates will lead to a reduction in cost overruns and delays in needed work, which in turn will improve the overall performance of transportation infrastructure in Michigan.