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# DEVELOPMENT OF AGENCY MAINTENANCE, REPAIR, AND REHABILITATION (MR&R) COST DATA FOR FLORIDA'S BRIDGE MANAGEMENT SYSTEM

## PROBLEM STATEMENT

The aging and decay of the nation's transportation facilities has led to the development of bridge management systems (BMS) for bridge maintenance and rehabilitation. A BMS allows transportation agencies to perform economic analyses on a large number of bridges in order to establish priorities and make preliminary selection of maintenance and rehabilitation options. A BMS includes a database and an active program for collecting and maintaining bridge element and condition data, along with tools to analyze network-level target funding levels, to identify and describe bridge maintenance needs, and to provide information needed for the development of cost-effective programs for bridge maintenance, repair, and rehabilitation (MR&R).

The Florida Department of Transportation (FDOT) is implementing the AASHTOWare Pontis® BMS as a decision support tool for planning and programming maintenance, repairs, rehabilitation, improvements, and replacement for more than 6,000 bridges on the state highway network.

## OBJECTIVES

The objectives of this study included the following:

- analyze the Pontis agency cost model in the context of FDOT requirements
- locate data that can be used to customize the model for Florida's purposes
- develop new agency unit costs to be made operational within FDOT's implementation of Pontis
- develop a strategy for keeping these costs up-to-date
- develop transition probabilities for a Pontis bridge deterioration model

## FINDINGS AND CONCLUSIONS

*Agency Cost Requirements of Pontis*

This study focused on preservation costs. Researchers conducted a sensitivity analysis of model input variables, such as overall agency costs (unit costs of element maintenance, rehabilitation, repair, replacement, and failure), and the discount rate, on the preservation model output.

The analysis was performed with the default data provided with Pontis release 3.4. Pontis is packaged with a set of deterioration models developed in California and a set of preservation cost models developed by Clemson University as an average of several states' data.

After completing network optimization, Pontis applies the optimal MR&R actions to each bridge. The network-level unit costs are then used to develop project-level cost estimates. The analysis focused on network-level long-term cost and recommended action as the outputs to be investigated for preservation. The Pontis software itself was used to perform the sensitivity analysis. Researchers found that, considering the total network level costs, selection of optimal MR&R actions were reasonably sensitive to estimates of the element repair unit costs, failure unit costs, and discount rate factors, while unit cost estimates of element replacement, rehabilitation, and maintenance showed relatively lower sensitivities. Considering individual bridge elements, selection of optimal MR&R actions was least sensitive to variation in element maintenance unit costs, but most sensitive to rehabilitation and repair unit costs. In the same sense, bridge elements were also sensitive to low estimates of element and failure unit costs.

*Determination of Existing Agency Cost Data*

Researchers conducted telephone interviews and held meetings with various FDOT employees, in addition to reviewing Internet web pages, to explore existing sources of agency cost data within the Department that are relevant to the Pontis-Bridge Management System for Florida bridges. Three pertinent sources identified within FDOT were the Maintenance Management System (MMS), the Construction Estimating System (CES also known as "Akbar"), and the District Contract Protocol (DCP). The types of data available were ascertained in terms of their appropriateness to BMS, their quality and timeliness, and the degree to which their availability is affected by new systems under development. In addition, the technical and procedural accessibility of the data was determined for use in this project and also for routine use by the BMS.

*Development of Agency Unit Costs*

Researchers conducted a detailed statistical analysis to explore the reliability of available unit cost data for Pontis and to determine the most appropriate data sources for each activity. Often the various information systems disagreed in systematic ways that were believed to reflect differing conventions for overhead costs and general cost allocation.

An expert review process proved essential to the successful development of final costs. The panel of experts identified weaknesses in the available data, reconciled conflicting results from the several data sources, and provided insights that filled in the many data gaps that were found. Researchers found that nearly all of the unit costs required a detailed review and substantial modification before they could be accepted for use in Pontis. Only fifty percent of the Pontis actions were covered with a statistically significant number of data points in any of the three FDOT information systems, and only fifteen percent of the Pontis actions ended up using the results from one of the information systems directly. About seventy percent of the Pontis actions had relevant data from FDOT systems, in terms of being helpful in the considerations of the panel experts, including data that were adjusted or used directly for the final results. They also included some relevant data that were recorded in units incompatible with those of the Pontis actions. This incompatibility does not reflect on the quality of the existing FDOT systems, since judging the quality of data collection and processing from this perspective was impossible. One of the biggest problems was the inability to match the scope of activities in MMS, Akbar, and DCP to Pontis elements, condition states, and actions.

This problem also influences the recommended strategy for keeping unit cost numbers up-to-date over time. Other than periodically using Pontis' built-in inflation feature, substantially automating major updates to the unit cost models will not soon be possible. Certain enhancements to the three FDOT project information systems may lead to the possibility of partial automation in the future, but an expert review will still likely be required. The combined process of statistical analysis and expert review proved effective, even if difficult, in producing unit cost values that the Pontis users would trust.

*Development of Pontis Bridge Deterioration Model*

Like most state DOTs, FDOT lacked the historical data needed to develop Pontis transition probabilities. Therefore, researchers employed an expert elicitation process to generate that data. A panel of district and head office engineers was asked a series of structured questions about deterioration, and their answers were converted to transition probabilities using a statistical process recommended in the Pontis Technical Manual.

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