MONTANA Department of Transportation
Research

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Implementation Report
FHWA/MT-24-005/10336-933

SIGNIFICANT FACTORS OF BRIDGE DETERIORATION

https://www.mdt.mt.gov/research/projects/bridge-deterioration.aspx

More Info:

The research is documented in Report FHWA/MT-24-005/10336-933

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Introduction and Purpose

The Significant Factors of Bridge Deterioration research used two different statistical models to identify the most significant factors that influence bridge deterioration. Twenty factors were ranked using the General Linear (GL) and Random Forest (RF) regression models. The top three factors influencing bridge deterioration in Montana were the maintenance district where the bridge was located, bridge age, and deck surface material. The second task of the research included a General Condition Rating (GCR) analysis performed within BrM. To complete the GCR analysis, an estimate of the median years a bridge or bridge element remains in a particular NBI condition state was determined. Median years were calculated using a Time-in-State report within BrM and were compared with values previously estimated by MDT using engineering judgement and experience.

Good-fair-poor bridge condition forecasts were made using a zero-cost optimization within BrM to estimate the number of bridges in poor condition, assuming no maintenance, after 10, 20, 20, 40, and 50 years. The median year estimates from this research and estimates from MDT resulted in slightly different projections of bridges in good, fair, and poor condition.

Implementation Summary

The GCR analysis completed as part of this research demonstrated the potential of BrM to estimate the number of bridges in good, fair, or poor condition using different input parameters. To implement the results of this research, continued modeling in BrM is required to further evaluate the most significant factors of bridge deterioration using the most relevant bridge datasets and adding different funding scenarios. The implementation recommendations and MDT's responses below focused on longer-term strategies that could be initiated in the future when resources within the bridge bureau become available.

Implementation Recommendations

RECOMMENDATION 1:

Continue modeling in BrM using established or estimated maintenance scenarios and targets. The modeling would focus on the most significant factors and bridge groups and would incorporate deterioration curves and environmental factors from Phase 1 research.

MDT RESPONSE:

MDT's Bridge Bureau is currently searching for a new bridge engineer position to lead the BrM modeling effort. This person would work with Henry Henning and his team, Amanda Jackson, Stephanie Brandenberger, and others to run through some potential modeling scenarios identified in this research. MDT does not currently have the resources available to implement this recommendation.

Another suggestion from MDT design engineer Lenci Kappes would be to implement the research findings to new bridge design and construction. By improving or eliminating bridge factors identified in this research to be significant to deterioration, MDT could start improving the number of bridges transitioning from good to fair or poor in the future.

Another implementation suggestion made by MDT was to identify bridge outliers that performed well in the statistical analyses. Evaluating bridges with slower deterioration trends to identify potential factors such as concrete mixture design and joint maintenance that contribute to bridges in 'good' condition longer could be a useful approach.

RECOMMENDATION 2:

Identify and implement a method to document the date and type of maintenance activity in the inspection database. Accurate maintenance and rehabilitation data will allow enhanced dataset filtering to target pure deterioration and identify the efficacy of specific maintenance activities.

MDT RESPONSE:

FHWA is currently initiating the SNBI transition, which includes data collection for work completed on a bridge. When Bridge Bureau resources become available, all construction and maintenance activities could be reviewed and recorded in BrM. Implementation of the new SNBI by Departments of transportation is expected in 2027 or 2028.

RECOMMENDATION 3:

Continue recording and prioritize NBI component-level data using a scale of 0 to 9. BrM's GCR optimization capabilities are improved over optimizations using less-granular element-level ratings from 1-4.

MDT RESPONSE:

The research technical panel agreed there is value in the component-level rating scale from 0 to 9. However, the component level data doesn't capture the percentage of deterioration of specific bridge elements. When resources become available, MDT will likely continue evaluating NBI element ratings (0 to 4) in future BrM modeling efforts with a focus on element deterioration percentage as a threshold or target.

RECOMMENDATION 4:

Create recommendations and guidance for bridge inspection data entry. Consistent data entry will reduce potential variations in deterioration trends that may be caused by variations in inspector objectivity.

MDT RESPONSE:

MDT noted that inspection data after 2006 included a Quality Assurance program that took four or five years to implement. Some of the data challenges in the statistical and BrM analyses may be a result of less consistent data across maintenance districts prior to 2006. When MDT resources become available, future BrM modeling could focus on data later than 2006 to see if deterioration predictions change.

A second implementation suggestion from MDT was to consider new bridge inspection technologies as they become available to support more-consistent bridge inspection data across maintenance districts.

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