VERMONT
AGENCY OF TRANSPORTATION
RESEARCH PROGRAM

Pavement Deterioration Models for Pavement Management

STUDY TIMELINE
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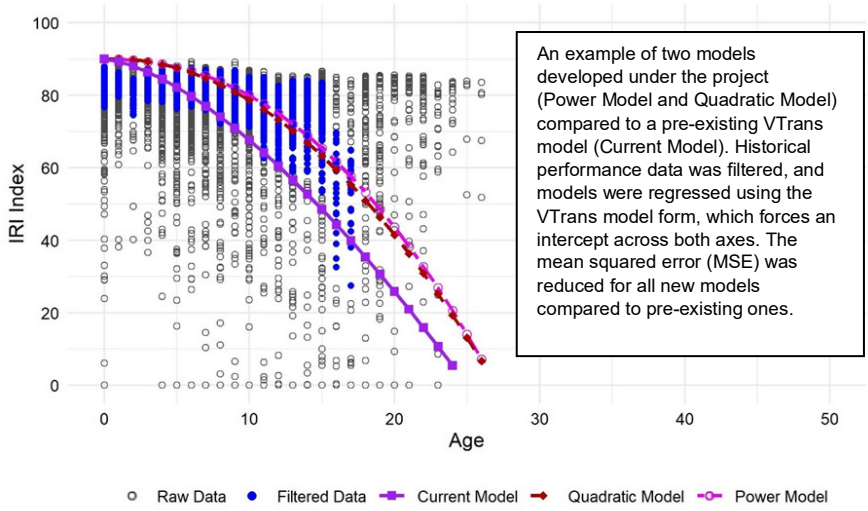
applied pavement TECHNOLOGY

More information about the Agency of Transportation Research Program, including additional Fact Sheets, can be found at: http://vtrans.vermont.gov/planning/research

Introduction

The Vermont Agency of Transportation (VTrans) owns and maintains 3,100 centerline miles of paved public roads. VTrans annually collects pavement condition data such as smoothness, rutting, and cracking. These data are stored in a pavement management system (PMS), called dTIMS, that uses pavement deterioration models to predict future pavement conditions. These predictions support Transportation Asset Management Plan development and related activities, including measuring and reporting performance, setting State and Federal condition targets, life-cycle planning, and financial planning. During this research effort, the pavement performance models in dTIMS were updated using historical pavement performance data to better reflect deterioration trends. Additionally, new pavement deterioration models for thin overlays and National Performance Measures were developed.

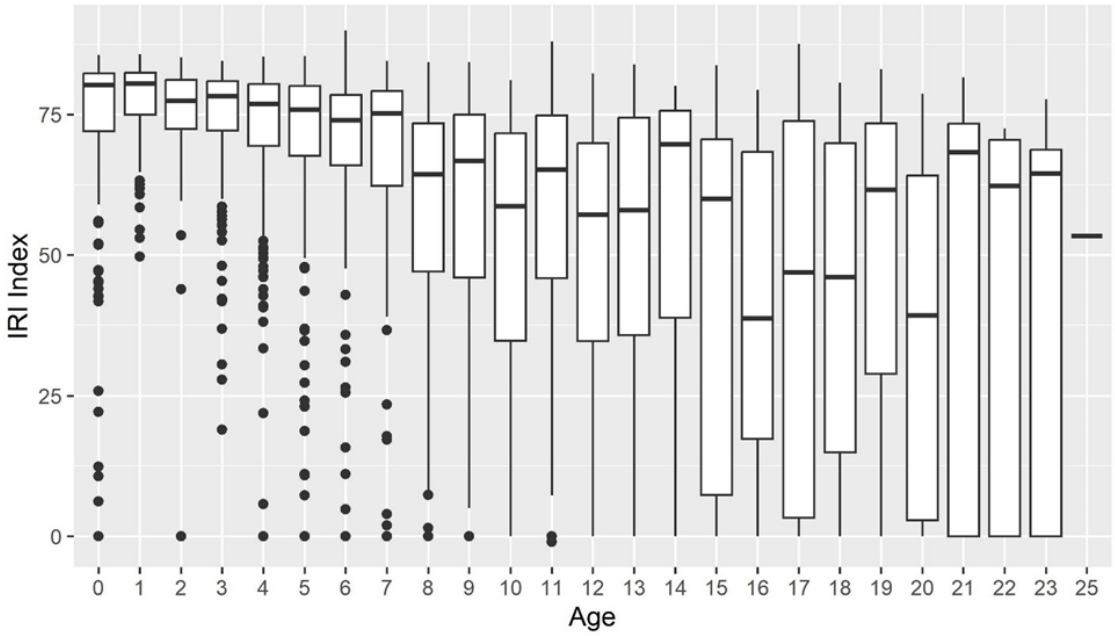


An example of two models developed under the project (Power Model and Quadratic Model) compared to a pre-existing VTrans model (Current Model). Historical performance data was filtered, and models were regressed using the VTrans model form, which forces an intercept across both axes. The mean squared error (MSE) was reduced for all new models compared to pre-existing ones.

Project Methodology

More than 20 years of VTrans historical pavement condition data was analyzed to identify pavement performance trends and establish updated prediction models. Models were based on existing VTrans model formats and family groupings, such as asphalt over concrete, thin pavement on strong bases, or thin pavement on weak bases. For each model, the research team reviewed historical performance, identified outliers, and reported statistical indicators to assess the reliability of models and

compare them to pre-existing models. Box and whisker plots of time-series data, such as the one shown below, were used to verify performance trends before beginning model regressions. Constraints in the existing model forms that force models to intercept both neutral axes limited options for assessing model fit, and special considerations were made to evaluate regressed models. The mean squared error (MSE) was used to compare new models to pre-existing ones.



Conclusions/Next Steps

New and updated prediction models were developed for VTrans' pavement condition indicators, including an International Roughness Index (IRI) index, rutting index, transverse cracking index, structural cracking index, and the National performance measure for cracking. Model recommendations were provided for 140 different combinations of base type and treatment families. Models were compared to previously existing models used by VTrans, and the model with the lowest MSE was selected for use in the PMS. The MSE was reduced for all combinations that had pre-existing models, reducing prediction error for all cases.

Impacts and Benefits

These updated pavement deterioration models will improve the accuracy of pavement performance in VTrans' PMS analysis provide more reliable outputs for funding needs analysis. Having reliable life-cycle planning tools will improve the cost-effectiveness of the pavement resurfacing and maintenance program by achieving long-term performance targets at a lower practicable cost, which make funds available for other programs such as bridges, capacity, or safety. The project results are expected to improve confidence in future pavement construction and maintenance activities that will lead to increased reliability in planning future investment programs.