

RESEARCH SPOTLIGHT

Project Information

REPORT NAME: Multi-Objective Decision Analysis and Optimization Model for Transportation Investment Decision-Making at MDOT

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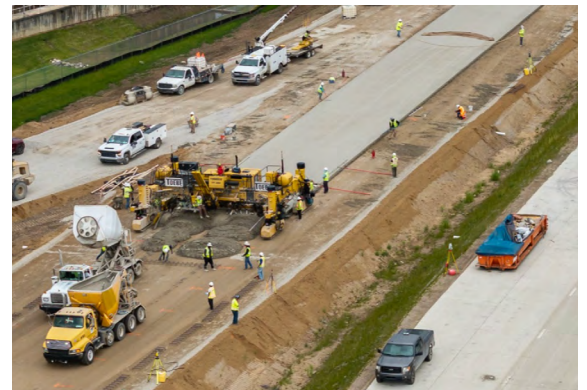
Decision tools for transportation project prioritization

Prioritizing transportation investments requires balancing aspirational goals, critical infrastructure needs and available resources. This research project explored a multi-objective decision analysis approach that could help the Michigan Department of Transportation (MDOT) align project decision-making with strategic priorities while adapting to changing budgets. Applying the model to a sample set of pavement projects demonstrated its potential to maximize the benefits of MDOT investments.

PROBLEM

Fair and objective resource allocation is key to effective transportation asset management. MDOT has the challenge of distributing its limited financial resources across a broad geographical area to a wide range of program areas and across thousands of assets with varying performance goals and objectives. To achieve the greatest possible benefit from these investments, MDOT sought a decision-making tool that could consider goals beyond asset condition, support the evaluation of multiple performance objectives and help evaluate trunkline infrastructure projects on a consistent, statewide basis.

Multi-objective decision analysis (MODA) offers a performance-based framework to help decision-makers achieve the greatest overall benefit from transportation investments. MDOT explored how a



A multi-objective decision analysis (MODA) approach helps MDOT prioritize transportation infrastructure projects by balancing strategic goals, asset conditions and available funding.

MODA-based approach could be applied to its Road Rehabilitation and Reconstruction program to support statewide project prioritization, with the broader goal of developing an objective, transparent and repeatable process that could be tailored to other asset types and regional project prioritization in the future.

“This research gives MDOT an adaptable, transparent way to prioritize transportation investments by balancing competing goals with available funding. Integrating this approach into planning can help ensure projects consistently align with MDOT’s statewide transportation goals.”

Michael Case
Project Manager

RESEARCH

Researchers conducted a literature review and interviewed transportation agencies that have used MODA-based project prioritization approaches. The review examined topics such as scoring criteria, funding categories and performance targets. Researchers then reviewed MDOT’s existing capital investment process, including the pavement condition-based criteria currently used to select rehabilitation and reconstruction projects.

Working with the project’s Research Advisory Panel, research administration staff and subject matter experts, the research team developed a prototype MODA model based on four goals from Michigan Mobility 2045, the state’s long-range transportation plan: improving asset condition, increasing safety, enhancing accessibility and mobility, and minimizing environmental impacts.

Researchers identified two to three performance measures for each goal to quantify the potential benefits of individual pavement projects. For example, asset condition measures included changes in remaining service life and federal pavement performance measures. The team then applied these measures to a sample set of 39 rehabilitation and reconstruction projects

representing a range of project sizes, costs, locations and treatment types.

The prototype initially assigned equal weight to all goals and measures. MDOT then convened focus groups, and a workshop was held with staff specializing in pavement, bridge, operations, safety and environmental analysis to review the weighting structure and adjust the goals and measures accordingly. Through this process, real-time results were shared and weights were refined until consensus among participants was achieved. Researchers then applied the new weights and divided the resulting scores by project cost to determine each project’s cost-effectiveness.

RESULTS

The MODA prototype generated a prioritized project list based on the projected benefits relative to project costs. Highly ranked infrastructure projects scored well across multiple performance measures and were distributed across MDOT regions and counties, although most were in urban areas.

Nine of the top 10 highest-ranked projects cost less than the average project in the sample. However, project rankings were not driven by cost alone. The highest-ranked projects also demonstrated strong potential benefits related to safety, bicycle and pedestrian access, operational improvements and environmental outcomes.

Like any decision-support tool, the MODA model depends on the quality and availability of data. Because performance measures are based on proposed infrastructure projects, estimating future benefits may require assumptions about where data gaps exist.

IMPLEMENTATION

To support future use of the tool, researchers developed an implementation plan outlining recommended process steps, data needs, project evaluation procedures and opportunities to refine and adapt the model for other MDOT program areas.

MDOT is able to adjust the weighting of included performance measures to reflect changing strategic objectives and desired outcomes. MDOT intends to continue refining the MODA framework while evaluating opportunities to integrate the tool into agency decision-making processes as strategic planning evolves.

Research Administration

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The final report is available online at

MDOTjboss.state.mi.us/TSSD/tssdResearchAdminDetails.htm?keyword=1764.

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