Introduction

This project investigated the impact of varying two elements of pavement, bridge, and mobility asset management on the long-term network-level performance of those assets. The first element was the condition at which restorative treatments are triggered. The second element was the budget available to implement these treatments. The feasibility of examining the network-level performance impact of changing safety enhancement treatments' trigger values was limited, and therefore the project did not investigate those impacts.

For each of the pavement, bridge, and mobility assets, three different management strategies in the form of treatment trigger values were investigated: a standard treatment trigger strategy, an early treatment trigger strategy, and a late treatment trigger strategy. For pavement and bridge assets, the standard treatment trigger strategy simulates INDOT's current treatment trigger policy. The early treatment trigger strategy simulates performing treatment at a better condition level than the standard treatment trigger strategy, while the late treatment trigger strategy simulates deferring treatment to a worse condition level than the standard treatment trigger strategy.

For bridge assets, each treatment trigger strategy had six different treatments that can be applied to different bridge components.

For pavement assets, the treatment trigger strategies pertained to pavement rehabilitation treatments. For mobility assets, the treatment trigger strategies pertained to lane additions.

Findings

For bridge management, it was discovered that the standard treatment trigger strategy outperforms the other two strategies. Also, as the budget increases, the standard treatment trigger strategy shows more improvement in its performance. This means that as the budget increases, the standard treatment trigger strategy becomes a better and better option.

For pavement management, the pavement rehabilitation treatment triggers were tested for the State Urban road network, State Rural Arterials and the Federal-Aid Urban road network used to trigger pavement rehabilitation. The following analysis results are contained in Chapter 3.

• The roughness condition of all three pavement road networks is highly influenced by the policy being used to trigger pavement rehabilitation. The higher the trigger standard, the higher the percentage of miles in good condition, and the lower the percentage of miles in poor condition.

• For the State Urban road network, as the funding level increases, the standard being applied to trigger pavement rehabilitation remains a significant factor in increasing the percent of road miles with smooth pavement but progressively becomes a less relevant factor in decreasing the percent of road miles with rough pavement.

• For State-Owned Rural Arterials and Federal-Aid Urban road networks, it was found that for any given funding level, switching from the late treatment trigger strategy to the standard treatment trigger strategy (labeled as Low and Medium Deficiency Standards, respectively, in Volume II of the report) results in a greater magnitude decrease in the percent of roads miles with rough pavement than switching from the standard treatment trigger strategy to the early treatment trigger strategy (labeled as Medium and High Deficiency Standards, respectively, in Volume II of the report).

• At all funding levels for State-Owned Rural Arterials and Federal-Aid Urban road networks, switching from the standard treatment trigger strategy to the early treatment trigger strategy has an effect of greater magnitude in increasing the percent of smooth pavement miles than switching from the late treatment trigger strategy to the standard treatment trigger strategy.

For mobility management, the lane addition treatment triggers were tested for the State Urban and Federal-Aid Urban road networks.

• For the State Urban road network, the standard treatment trigger strategy has more cost-efficient performance than the late treatment trigger strategy at all funding levels in reducing the percent of road miles or VMT traveling on roads with peak hour congestion. Although the early treatment trigger strategy shows more cost-efficient performance than the late treatment trigger strategy at all funding amounts, the early treatment trigger strategy does not seem to be more cost-efficient than the standard treatment trigger strategy at the highest funding levels.

• For the Federal-Aid Urban road network, the effect of the treatment trigger strategy on the network-level mobility condition is more obscure. The standard treatment trigger strategy demonstrates more cost-efficient performance than the late treatment trigger strategy in reducing the percent of VMT traveling on roads with peak hour congestion only at the highest funding lev-
For the pavement asset class: 
1. Increase the amount of the bridge management budget to get more detail in the report in Volume I, Chapter 5.
2. Check the bridge management strategies with more treatments, at INDOT are working well. The suggestions below are described in more detail in the report in Volume I, Chapter 5.
   1. Continue with current bridge management strategies.
   2. Check the bridge management strategies with more treatments, using dTIMS if possible. Test combinations of bridge management strategies. This research tested one constant strategy for the entire 50 year analysis period. Testing variable strategies is recommended.
   3. Increase the amount of the bridge management budget to get improved performance, if at all possible.

For the pavement asset class: 
1. Use the results shown in Volume II, Chapter 3 (specifically sections 3.3.4, 3.4.4, and 3.5.4) as guidance for decision makers to currently justify retaining or modifying the pavement rehabilitation treatment trigger policy for any anticipated consistent annual budget over a multi-year period.
2. Periodically (every 8–10 years or so) conduct analysis to find the impact of modifying project-level treatment triggers and varying budget availability on the long-term network-level performance of the pavement asset classes. This strategic analysis will enable INDOT to do its best in providing good levels of service on the physical transportation infrastructure while responding to anticipated changes in the consistent annual budget level over a multi-year period.

For the mobility asset class, the analysis of the peak hour congestion condition at the network-level has shown that the lane addition treatment is effective to deploy on the most highly congested roads, typically Interstates and Expressways.

Therefore, INDOT should explore other congestion mitigation strategies to strategically ensure mobility on roads in the future.

This would necessitate the following list of actions:
1. Quantify, with different short-term and long-term mobility measures, the increase in capacity and the user benefits realized by implementing various congestion mitigation treatments (both those that modify or don’t modify physical capacity).
2. Quantify the mobility condition “deterioration” that takes place annually or over a period of time for roads of different functional classes and characteristics.
3. Define condition-based policies for triggering congestion mitigation strategies, including for travel demand management strategies such as congestion pricing.

Taking the above actions will enable the analysis conducted in this study to be possible to execute on congestion mitigation treatments other than lane addition.

For the safety asset class:
1. Use the safety screening tool created for Indiana through SPR-3315 to identify high crash locations and screen the safety performance by geographical scope, roadway element, crash type criteria, and roadway feature. The backbone data contained in the tool consists of Indiana road links, intersections, ramps, bridges, and geometric inventory information.
2. Link this tool with a safety asset management software module for the purpose of evaluating network-level safety performance of the highway system in response to funding countermeasures designed to address safety issues.
3. Use the tool in conjunction with the findings of the SPR-3640 research study that is developing a geometry sufficiency index to evaluate the geometric adequacy of road cross-sections based on documented safety and speed effects. This index is being developed to evaluate current deficiencies throughout the network and to aid in prioritizing safety improvement projects.

Implementation

This research shows that the bridge management strategies used at INDOT are working well. The suggestions below are described in more detail in the report in Volume I, Chapter 5.
1. Continue with current bridge management strategies.
2. Check the bridge management strategies with more treatments, using dTIMS if possible. Test combinations of bridge management strategies. This research tested one constant strategy for the entire 50 year analysis period. Testing variable strategies is recommended.
3. Increase the amount of the bridge management budget to get improved performance, if at all possible.

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