Research Need Statement 637

I. Need Statement Champions and Information

I.A. Need Statement Champion Information

I.A.1. First and Last Name of Research Champion: David Hedeen
I.A.2. Research Champion's Office: Bridge
I.A.3. Research Champion's Phone Number: 651-366-4528
I.A.4. Research Champion's Email: david.hedeen@state.mn.us

I.B. Research Co-Champion

I.A.1. First and Last Name of Research Co-Champion: Sarah Sondag
I.A.2. Research Co-Champion's Office: Bridge
I.A.3. Research Co-Champion's Phone Number: 651-366-4529
I.A.4. Research Co-Champion's Email: sarah.sondag@state.mn.us

I.C. Research Needs Title (115 Characters): Develop Element Level Bridge Performance Measures and Targets

I.D. Project Sponsor: MnDOT Research Program

II. Research Need Background and Description

II.A. Research Need Background

II.A.1. Describe the problem or opportunity.

Currently, bridge performance measure condition targets are based on historical trends from NBI General Condition Rating data. Setting performance targets under this system is an oversimplification of the problem and causes many operational hurdles for MnDOT.

Fortunately, Minnesota also collects condition data under an element level system, which provides a comprehensive assessment of condition. Shifting MnDOT performance targets to this element level system would provide a more accurate reflection MnDOT's efforts to extend the life of bridge assets in the most cost-efficient manner.

II.A.2. If applicable, describe how this project will build on previous research.

Similar research conclusions and methodology from other states or assets may provide insight or a framework for this effort, but will likely need refinement for bridge design, deterioration, maintenance, and climate that is specific to Minnesota's inventory of bridges.

II.A.3. If applicable, include the title/s or previous research.

- [2016] "FHWA Synthesis of National and International Methodologies Used for Bridge Health Indices" https://www.fhwa.dot.gov/publications/research/infrastructure/structures/bridge/15081/15081.pdf
- [2001] "California Bridge Health Index: a diagnostic tool to maximize bridge longevity, investment" https://trid.trb.org/view/692561
- [2017] "Bridge Health Index: Study of Element Condition States and Importance Weights" https://journals.sagepub.com/doi/10.3141/2612-08
- [2021 (In Progress)] "Quantifying Benefits of Bridge Maintenance" https://researchprojects.dot.state.mn.us/projectpages/pages/projectDetails.jsf?id=25544&type=CONTRACT&jftfdi=&jffi=projectDetails%3Fid%3D25544%26type%3DCONTRACT
- [2021 (In Progress)] "Remaining Service Life Asset Measure, Phase 2" https://researchprojects.dot.state.mn.us/projectpages/pages/projectDetails.jsf?id=22005&type=CONTRACT&jftfdi=&jffi=projectDetails%3Fid%3D22005%26type%3DCONTRACT
- Synthesis of Information Related to Highway Practices. Topic 52-02. Using Bridge Element Data in Asset Management Decision Making. [Project]. National Cooperative Highway Research Program, American Association of State Highway and Transportation Officials (AASHTO), Federal Highway Administration. Start date: 16 Sep. 2020. https://trid.trb.org/view/1707232
- Inkoom, Sylvester; Sobanjo, John O. Reliability Importance as a Measure of Bridge Element Condition Index for Deteriorating Bridges. Transportation Research Record: Journal of the Transportation Research Board, Volume 2673, Issue 12, 2019, pp 327-33 https://trid.trb.org/view/1637869
- Fereshtehnejad, Ehsan; Hur, Jieun; Shafieezadeh, Abdollah; Brokaw, Mike; Backs, Jared; Noll, Brad; Waheed, Amjad. A Bridge Performance Index with Objective Incorporation of Safety Risks. Transportation Research Board 97th Annual Meeting, 2018, 8p https://trid.trb.org/view/1496660

II.A.4. What is the **objective** of the proposed research?

This research needs to determine an appropriate method to accurately and consistently score the overall health of a given structure based on accepted practices and an evaluation of quantitative data associated with Minnesota bridges.

It is anticipated that the resulting logic and performance targets will be a representative summary of a large collection of data modeled by complex calculations. For MnDOT to have confidence in the conclusions, all inputs and methodology must be well vetted, based on sound engineering judgement, and developed by leveraging findings from existing or accompanying research.

This research would determine the elements and other factors that have the greatest impact to structure longevity and then determine a method for reflecting and appropriately weighting these factors to assess overall bridge health. The proposed research would recommend a tool or methodology (such as a health index or other metric to assess bridge condition) to include appropriate important factors and weighting.

Overall, the results should:

- Emphasize the elements and other factors that highlight the best cost/benefit opportunities for maximizing the life of a bridge.
- Provide a breakout of scoring factors so that specific corrective actions and transparency of benefit can be easily identified and prioritized by operations and maintenance staff.
- Guide the decision process for selecting the right maintenance and preservation action at the right time.
- Be designed in a manner that provides a wide range of values that distinctly identifies priority bridges.
- Predict the expected remaining service life

Once the methodology is identified, appropriate performance targets need to be developed using a data driven approach. One possibility is an optimization analysis resulting from a network application of Asset Management principles.

Performance targets derived from a strategically constructed process will guide MnDOT toward managing bridge assets by prioritizing activities that minimize life cycle costs.

The research will develop an implementation plan for MnDOT to effectively integrate these research results into MnDOT's bridge asset management processes.

III. Strategic Priorities, Benefits, and Expected Outcomes

Section III. is for MnDOT sponsored and co-sponsored projects only; all LRRB projects proceed to section IV.

III.A. MnDOT Strategic Priorities

Instructions: Briefly describe how the project aligns with the following MnDOT Research Strategic Priorities. Complete all that apply.

III.A.1. Innovation & Future Needs:

MnDOT tracks and funds bridge projects based on performance targets. The targets are inherently forward-looking but need to be derived from ideals. Minnesota is not the first state to approach bridge asset management in this manner but is on the leading edge for leveraging existing data systems to their fullest extent, this research would raise that bar even further.

IIIA.2. Advancing Equity: N/A

III.A.3. Asset Management:

Current condition performance targets are not derived by Asset Management principles, but rather historic trends. This research intends to change the culture of that thinking and shift the performance targets into a useful measure with how well Minnesota is managing their inventory of bridges with an Asset Management lens.

III.A.4. Safety: N/A

III.A.5 Climate Change & Environment:

This research intends to provide a framework for maximizing the life of bridges in Minnesota in the most cost-efficient manner possible. With the resulting a smaller turnover on the inventory of bridges, MnDOT will have less of an environmental impact.

III.B. Expected Outcomes

Instructions: Check all expected direct outcomes of this research.

- ☐ New or improved technical standard, plan, or specification
- ☐ New or improved manual, handbook, guidelines, or training
- ☒ New or improved policy, rules, or regulations
- ☒ New or improved business practices, procedure, or process
- ☐ New or improved tool or equipment
- ☒ New or improved decision support tool, simulation, or model/algorithm (software)
- ☐ Evaluation of a new commercial product

☐ New or improved technical standard, plan, or specification
☐ Other. Please specify below:

III.C. Expected Benefits

Instructions: Select all expected benefits that may be realized if the findings and recommendations from this research is adopted or implemented

III.C.1. Construction Savings Other Construction Savings. Please describe below

The results of this research will establish a framework for MnDOT to identify the most cost-effective strategy for managing its bridge assets based on a more comprehensive performance index.

III.C.2.Decrease Engineering/Administrative Costs Reduced planning/design costs

III.C.3. Environmental Aspects Hazardous Waste Reduction

III.C.4. MnDOT Policy Changed or inform a policy

The results of this research will provide improved bridge asset management performance targets that encourage activities with high cost benefit ratios that maximize the use of construction funding levels.

III.C.5. Lifecycle Products with longer lifespan

III.C.6. Operations and Maintenance Savings Choose an item.

III.C.7. Reduce Risk Choose an item.

III.C.8. Reduce Road User Cost Other reduced road user cost. Please describe below.

The results of this research will establish a framework for MnDOT to reduce the size and scale of construction projects, thus saving user costs from construction efforts with long durations.

III.C.9. Safety Choose an item.

III.C.10. Technology Choose an item.

III.C.11. Other, please describe below:

DEPARTMENT OF TRANSPORTATION

IV. Technical Advisory Panel

Instructions: Please list the name and affiliation of individuals to consider for the Technical Advisory Panel.

Kevin Western – State Bridge Engineer

Nicki Bartelt – Bridge Planning and Hydraulics Engineer

Edward Lutgen – Bridge Construction and Maintenance Engineer

Dustin Thomas – Metro Bridge Engineer

Paul Pilarski – Bridge Construction Engineer

David Hedeen – Bridge Asset Management Engineer

Sarah Sondag – Bridge Preservation Engineer

Beth Klemann – Bridge Operations Support Engineer

Andrew Lawver – D7 Bridge Engineer

Your assigned Project Advisor is available to answer questions and provide guidance (assigned by the Office of Research & Innovation).
Your Project Advisor is: Brent Rusco (651)366-3767 brent.rusco@state.mn.us