

FY2024 Call for Research Problem Statements

The logo for the state of Tennessee, consisting of the letters "TN" in white on a red square background.

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Title: Customer Satisfaction Data

RRFPS Number: 1

Research Need:

TDOT has a variety of ways to gather customer sentiment and satisfaction/complaints with the services it provides. These include social media, information from maintenance requests, TDOT Comments, comment cards, and surveys. In addition to these mechanisms, TDOT conducts a Customer Survey with several questions devoted to satisfaction.

Information from these various customer listening methods is not aggregated or shared among the divisions so it is unclear how much information related to customer input is currently being gathered.

A research project devoted to inventorying and analyzing customer input from all TDOT feedback mechanisms and developing a real-time visualization for satisfaction/complaint data is needed so that the appropriate resources may be allocated to areas of need at the time they are needed. This visualization could be embedded as part of the Power BI Leadership Dashboard for the senior team to review. This would also allow the Strategic Planning Division to shift the Customer Survey to focus to more strategic areas (i.e., attitudes about EV adoption, CAV readiness, transportation system resilience, etc.) with less focus needed on overall satisfaction.

Title: Use of Confinement Reinforcement in Prestressed Concrete Beams to Improve Resistance to Impacts from Overheight Loads

RRFPS Number: 3

Research Need:

Prestressed beams have reinforcement around the prestressing strands for a distance of 1.5 times the beam depth at each end in accordance with AASHTO 5.9.4.4.2. At TDOT, these are known as HA300 bars. Every year, TDOT has beams that are struck by overheight loads and are either damaged or destroyed. We are interested in learning if using HA300 bars throughout the entire beam length would provide any significant benefit to the beams when struck by an overheight load.

Title: Determining Ways to Mediate Inaccurate Utility Estimates for Planning, Design and Bid Prices at Letting

RRFPS Number: 4

Research Need:

The State of Tennessee has experienced unprecedented growth over the last 10-15 years. This major growth in population has led to increased traffic and wear on state routes and development along state route corridors. With the recent passing of the Transportation Modernization Act, billions of dollars are being poured into Tennessee's roadways and infrastructure to improve infrastructure of multiple types and levels of service on Tennessee roadways. Another result of the unprecedented growth, perhaps that isn't as apparent, is the number of utilities that occupy the state highway rights of way. TDOT Regional Utilities offices are tasked with coordinating the relocation of these utilities to avoid conflicts with TDOT construction projects.

TDOT annual project budgeting is completed in part, from the preliminary estimates submitted from its various division, including the utility offices. Currently, the cost of relocations submitted by utility companies far exceeds the preliminary estimates done by TDOT's regional staff and may differ even more with contractor bid prices at letting.

TDOT has not had accurate ways of tracking the prices of utility relocations outside of the average unit price software maintained by the Construction Division. These cost discrepancies, sometimes in the order of millions of dollars, have led to extreme project delay, cost overrun, and avoidable disputes with utility companies.

New methods need to be developed for TDOT's Utilities Division that can more accurately determine the cost of relocating utilities of all types to ensure preliminary estimates are reliable for future project planning, more closely reflect estimates provided by utilities during coordination, and closer reflect bid prices at letting.

Title: Beautification Benefits Study

RRFPS Number: 5

Research Need:

TDOT's Highway Beautification Office seeks a formula showing tangible benefits of every \$1.00 investment in beautification efforts in Tennessee. TDOT's beautification efforts include litter pickup and prevention on rights-of-way, landscaping of gateways, and enhancement of scenic roadways. This formula will be included in the department's public messaging and used to articulate the need for increased funding of beautification programs. It should incorporate best practices using *Keep America Beautiful* and *National Main Street* models, and account for a variety of factors. These factors include: TDOT program performance data; departmental financial data and litter research data; volunteer hours; efforts of local partners; and Tennessee tourism and economic development data.

Title: Case Studies on the Economic Benefits of TDOT's Rail Connectivity Grant Program

RRFPS Number: 6

Research Need:

In 2018 TDOT initiated a competitive rail connectivity grant program to strategically expand rail access and opportunities within the state of Tennessee to benefit the state by:

- Impacting job creation and capital investment by industries that require rail access.
- enhancing the marketability of available industrial sites; and/or
- reducing highway and bridge maintenance costs by diverting heavy freight from the roadway network to rail.

To date four projects have been funded with three of the projects complete. This research will utilize these four grant projects to serve as case studies as to the economic benefits of these projects utilizing TDOT's Rail Connectivity Grant Program. The research will explore the appropriate best methods for calculating benefits and will also include a relative return on investment outcome for these projects. Case studies on economic benefits should be presented for each project. As part of this research, a literature review should be conducted on economic and return on investment approaches used by other states and recommendations on best methods for future reporting.

Title: Navigating Possibilities: Unlocking Tennessee’s Waterways for Interstate Freight Transportation

RRFPS Number: 7

Research Need:

Can Tennessee's waterways serve as a viable option for interstate freight transportation? The Port of Knoxville considered an international port with the potential to connect boaters to both the Gulf of Mexico and the Great Lakes. Located 372 miles west of the Atlantic Ocean, the Port of Knoxville stands as our nation's farthest inland freshwater port. Despite being a landlocked state, Tennessee possesses a unique and vital saltwater connection. To determine the feasibility of utilizing this route for barge traffic from the Great Lakes to the Gulf of Mexico and to understand associated costs, a comprehensive feasibility study is imperative. If a direct route proves unfeasible, the study should also explore the viability of barge traffic from the Port of Knoxville to the Mississippi River.

Title: Active Transportation Quick-Build Program Guidelines

RRFPS Number: 8

Research Need:

We have identified the hot spots for vulnerable road user crashes and our Pedestrian Road Safety Initiative (PRSI) is implementing permanent safety countermeasures, but there is a need for temporary countermeasures to be implemented and for local agencies to build their own temporary safety projects on State Routes.

The Multimodal Planning Office is instructed by our Statewide Active Transportation Plan (2021) to "Create a quick-build pilot program to implement safety countermeasures at high-crash locations for pedestrians, bicyclists, and other low-speed users." In 2023, our office successfully facilitated three \$15,000 pilot projects in Tennessee cities funded by the CDC and Complete Streets Leadership Academy. The projects demonstrated the safety potential of more permanent safety countermeasures and generated lots of community engagement. To continue this momentum, our office needs a "TDOT Quick-Build Guide" that our office would incorporate into our PRSI and other programs and "Quick-Build Guidelines for Tennessee Cities" for local agencies to use and build their own quick-build projects on State Routes.

To accomplish this, research is needed to develop guides that will survey and review published guides and noteworthy practices, identify funding opportunities, incorporate modern design techniques and approaches, identify materials, and create a step-by-step process to implement. There is a possibility to develop and install a new demonstration project to act as a case study and to add further evaluation to the success of the 3 previous projects as well.

We know where our streets are the riskiest for the people most vulnerable to crashes, but our existing programs are only part of the solution. Quick-build projects would reduce fatalities and serious injuries with low-cost materials and demonstrate the need for more permanent facilities.

Title: Influencing Mode Shift through Behavioral Change Strategies – Phase II

RRFPS Number: 9

Research Need:

Phase I of the project titled “Influencing Mode Shift through Behavioral Change Strategies” identified specific strategies using the concept of behavioral science to nudge commuters toward sustainable mobility alternatives other than single occupant vehicles (SOVs). The project identified Transportation Demand Management (TDM) stakeholders in Tennessee and their current travel efforts, effectiveness and potential areas for improvement including actionable recommendations for TDM measures tailored to the unique characteristics of the state. Based on the stakeholder recommendations, the project utilized a survey-based commuter tool by incorporating nudging techniques as behavioral interventions to measure shifts in travel behavior, perceptions, and mode choice over time.

The survey resulted in a positive impact on the likelihood of individuals choosing non-SOV modes of transportation for commuting. These findings offer valuable insights for policymakers aiming to promote sustainable transportation options. Furthermore, the project generated a rich dataset, allowing for the development of open-access interactive maps showcasing clustered travel behavior at the county level. Beyond enhancing our understanding of commuter choices, this dataset provided a practical tool for policymakers to tailor interventions and infrastructure improvements effectively.

While survey based nudging techniques provided initial insights, the project recommended use of a practical nudging study to track and measure real world behavioral changes in choosing non-SOV modes of transportation for commuting.

Phase II of this research would apply these nudging techniques to real-world travelers and track how well these framed messages influence mode shift. The proposed study corridor is I-40 between Nashville and Lebanon.

Title: Retro-reflectivity Life of Pavement Markings

RRFPS Number: 10

Research Need:

Determine the best length of use and possible cost solutions to ensuring safe, reflective pavement markings are installed and maintained across the state. Currently, TDOT addresses pavement markings on a two to three-year basis to ensure reflectivity requirements are met. There is a need for research on the length of life for each type of pavement marking (paint, thermoplastic, etc.) and create a possible restriping schedule that ensures safety but provides a cost-effective solution.

This topic will partner with Materials and Tests, Maintenance, Traffic Design, and Engineering Divisions to ensure all concerns are addressed.

Title: Foundation Assessment for Reuse of Existing Foundations

RRFPS Number: 11

Research Need:

There is a trend in the industry to try to reuse old bridge foundations for new structures. This is often a very cost effective and time efficient way of replacing a bridge structure.

TDOT currently does not have any specific guidelines or tests to ensure that an existing foundation is in a state of good repair to support the new structure. There are even times where a bridge has been widened and the foundation types for the original structure and the widened structure are different. This research project would look at ways to evaluate existing foundations to determine if they are sufficient for reuse on a new structure.

Title: A Balanced Approach to Performance of OGFC

RRFPS Number: 12

Research Need:

Open Graded Friction Course (OGFC) is a porous asphalt mixture placed on the roadway surface and designed to enhance user safety and convenience by improving friction, visibility, noise reduction, and rideability. One of the main benefits is water penetration through its porous structure. Water penetration reduces vehicle splash and spray during rainfall so that it increases driver visibility and friction on surface. Despite the benefits, it is commonly accepted that OGFC has a shorter life span than conventional dense-graded mixture, because OGFC has less stability caused by interconnected air voids that allow water to penetrate through the mixture.

In other words, OGFC has a less stable structural skeleton due to reduced friction between aggregate particles in the mixture. Further, the current TDOT specification does not require measuring density after construction due to the infeasibility of current Quality Assurance (QA) procedures utilizing the nuclear densitometer. Since it is not practical to measure the actual density of OGFC, there is no way to verify how much stability is gained after compaction even though stability and penetration are directly related to the density of OGFC.

There is a need to develop a mathematical model or simple relationship from pound per linear inch of various roller compactor efforts to density, then we can indirectly monitor densification by the number of rollers passes.

There is a proportional relationship between vehicle speed and the amount of vehicle splash and spray. The larger the volume of interconnected air void in OGFC, the better for fast drainage.

There is an inversely proportional relationship between air void volume and structural stability. There is a need to validate the rate of penetration needed to adequately serve the rainfall intensity encountered in Tennessee and determine an acceptable balance with OGFC stability.