



TDOT
Department of
Transportation

Research Strategic Plan

2021-2025

Research Program
Long Range Planning Division
Tennessee Department of Transportation

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1 Introduction

The Tennessee Department of Transportation (TDOT) Research Program's Research Strategic Plan determines the research priorities for the Department and develops communication protocols for the agency's internal and external stakeholders. The plan aims to provide a research roadmap for TDOT and ultimately improve the effectiveness of the program.

1.1 Vision

It is the vision of the Research Program that the Research Strategic Plan will foster opportunities for collaboration of all stakeholders to address the agency's most critical research needs, improve the program's processes to appropriately address those needs, and set the foundation for research to drive innovation and transportation efficiencies within Tennessee.

1.2 Purpose

The primary purpose of the Research Strategic Plan is to develop goals and strategies for TDOT's Research Program that, when implemented, will effectively utilize research funds to address the most critical needs of Tennessee's transportation system. The plan identifies strategic research priorities to guide the agency's research direction and investments and serves as a framework for TDOT senior leadership, the Research Office, and other transportation research champions to recognize those research needs that are critical to achieving the Department's mission.

Additionally, through the development of the plan, the Research Program aims to better understand what services internal stakeholders want to access, how they want to access those services, improve internal/external processes to make the program more efficient, and drive innovation and technology transfer.

The Research Strategic Plan will serve as a blueprint for TDOT's Research Program for the next five fiscal years (2021-2025).

1.3 Need

In order for TDOT to have a successful and valuable Research Program, the agency's research activities need to align with the strategic direction of the Department. As the program serves the entire agency, it is vital to connect with stakeholders and consider their input when developing a collaborative research program. Communicating the priorities and goals of research conducted by TDOT is essential to establishing an effective research program.

1.4 Audience

This document and recommended actions are intended for use by TDOT leadership, the Research Office, division directors, TDOT Lead Staff and research champions throughout the Department, and external stakeholders, most notably University and Federal partners. Hopefully, all stakeholders will consider the goals outlined in this plan and support the efforts to implementing the Research Strategic Plan.

2 Agency Overview

2.1 TDOT Structure

The Tennessee Department of Transportation (TDOT) is a multimodal agency responsible for the planning and development, maintenance, and operation of Tennessee's transportation system, facilities, and services. In addition to the highway system, TDOT also has responsibilities in aviation, public transit, waterways, railroads and cycling and walking. The Department engages in a range of activities, from airport improvements to funding rural transit organizations.

TDOT is organized into three bureaus: the Administration Bureau, the Engineering Bureau, and the Environment and Planning Bureau. Additionally, some divisions (Legal, Legislative, Community Relations, and Aeronautics) that provide support on executive decisions, strategic projects, and communications initiatives are housed in the Commissioner's Office.

- **Administration Bureau** - The Administration Bureau, led by the Chief Financial Officer, is tasked with providing oversight for the administrative activities of the Department, including financial management, contracting and procurement, human resources, resource management, and information technology.
- **Engineering Bureau** - The Engineering Bureau is overseen by TDOT's Chief Engineer and works to develop, preserve, and maintain Tennessee's highway system. Responsibilities include highway data collection, program development and scheduling, roadway design, right-of-way acquisition, bid analysis, construction, asset management, traffic engineering, materials and geological testing.
- **Environment and Planning Bureau** - The Environment and Planning Bureau manages the planning, environmental, multimodal, and freight activities of the Department. The responsibilities of this bureau include environmental compliance and policy, highway beautification, long range transportation planning, travel data collection, GIS mapping, public transit grant programs, multimodal access policy, and freight planning. The Research Program is housed in the Long Range Planning Division of this bureau.

2.2 TDOT's Strategic Direction

TDOT has worked to establish a strategic direction to better provide a safe and effective transportation system for both residents and visitors to Tennessee. Through the adoption of a strategic management approach, the Department positions itself to effectively fulfill its mission both now and in the future.

TDOT's strategic direction is shaped by the mission, vision, values, and the 4-Year Strategic Plan.

TDOT's Mission

To provide a safe and reliable transportation system that supports economic growth and quality of life.

TDOT's Vision

Commitment to excellence in managing and improving the state's transportation system, promoting the success of our employees, and strengthening the trust of our customers.

TDOT Values

- Stewardship** We take the best possible care of our assets
- Integrity** We are professional, honest, and do the right thing
- Safety** We identify and mitigate hazardous conditions for our employees, contractors, and the traveling public
- Consistency** We are reliable and uniform in our actions and words
- Development** We continually grow and share our knowledge, expertise, and experience
- Innovation** We look for new and emerging ways to serve our customers
- Collaboration** We work together internally and with our partners to share ideas, skills, and insights to get the best results
- Family** We promote a culture of caring, concern for others, and pride in what we do

TDOT's 4-Year Strategic Plan

- **Goal 1:** Create an organization that is data-driven to improve decision-making and better align with customer expectations.
- **Goal 2:** Create a TDOT Employee Experience Program to support employee engagement, diversity, and inclusion throughout the employment lifecycle.
- **Goal 3:** Develop an approach for managing TDOT's information and knowledge assets which supports availability of quality information, best practice sharing, and organizational knowledge.
- **Goal 4:** Develop and improve work processes to provide better consistency and execution.
- **Goal 5:** Develop an organization-wide guide for implementation of strategies that includes measuring and verifying the effectiveness of those strategies.
- **Goal 6:** Update the 25-Year Long-Range Transportation Plan to focus on strategic solutions to address the changing needs of our state.

3 Research Program Overview

3.1 TDOT's Research Program

The Research Office coordinates the Department's Research Program. The Research Program strives to be responsive to the agency's research priorities and strategic direction, as well as to emerging transportation topics and critical research ideas as they arise.

The program's goal is to provide solutions, information, and tools to TDOT's decision-makers and subject matter experts to meet the needs of the Department, residents, and visitors of Tennessee. Additionally, the program focuses on funding applied research to produce practical findings that can be implemented into TDOT's business practices.

Mission

To enhance Tennessee's transportation system through high-quality research that leads to the adoption of efficient technologies, innovation, and best practices.

3.2 Research Activities

The Research Program plans, monitors, reviews, and coordinates the selection, completion, and implementation of transportation research projects supported by the Department. The majority of TDOT sponsored research is funded through the Call for Projects. The Call for Projects occurs in two stages: 1) the solicitation of research ideas through a Call for Research Needs Statements, and 2) the subsequent request for proposals based on chosen research needs through a Call for Proposals.

The program also acts as the lead for transportation research efforts for the State and supports national transportation research programs and organizations.

The program's current primary activities include:

- Identify transportation research needs for the Department.
- Solicit, evaluate, and recommend research projects for funding.
- Work with TDOT Lead Staff and researchers to monitor progress and the fulfillment of project scopes.
- Ensure all TDOT sponsored research is compliant with federal regulation, including working with the Federal Highway Administration (FHWA), to receive approval for research activities included in the State Planning and Research (SPR) Work Program.
- Assist and document implementation efforts of research findings when appropriate.
- Disseminate research findings and reports to the appropriate units.

- Manage TDOT's participation in Transportation Pooled Fund (TPF) Studies.
- Coordinate research-related activities with national programs, such as the National Cooperative Highway Research Program (NCHRP), Airport Cooperative Research Program (ACRP), Behavioral Traffic Safety Cooperative Research Program (BTSCRCP), and Transit Cooperative Research Program (TCRP).
- Act as the TDOT liaison to national transportation associations such as the Transportation Research Board (TRB), and the American Association of State Highway Transportation Officials' (AASHTO) Research Advisory Committee (RAC).

3.2 Research Staff

The Research Office staff administers and manages research activities funded through Title 23 of the Code of Federal Regulations (CFR) Section 420, Subpart B (SPR Part B) funds, ensuring the capture of research findings, deliverables, and technology transfer on behalf of TDOT. The staff provides the means to TDOT employees and universities to collaborate effectively and produce research, data, and products that enhance the innovative capabilities of the Department.

Currently, the Research Office is made up of the:

- 1) Research Supervisor,
- 2) Advanced Research Specialist,
- 3) Research Planning Specialist – currently a Research Planning Specialist-Trainee.

The Research Program is also supported by a Program Monitor specializing in contracting and invoicing, housed in Long Range Planning's Administration Office. Additionally, the program relies on subject matter experts throughout the agency to provide project oversight and support.

3.3 Research Funding

The majority of the Research Program's budget comes from SPR Part B funds, with the state providing a 20 percent match, for a total annual budget of approximately \$5.5 million. The annual budget is used to fund TDOT sponsored research projects, participation in Transportation Pooled Fund Studies, the Local and Tennessee Technical Assistance Program (LTAP & TTAP), and contributions to national research programs (e.g. NCHRP).

3.4 Program Oversight

In addition to the oversight provided by FHWA for regulatory compliance, the Research Program receives direction from an ad hoc committee and TDOT executive leadership.

- **Ad Hoc Research Oversight Task Force (ROTF)** – In past cycles, an ROTF was assembled and convened in the early stages of the Call for Proposals. The ROTF advises the program

on research objectives and priorities and makes recommendations to executive leadership for the Call for Proposals. The Task Force is comprised of key technical staff from various divisions across TDOT.

- **Executive Leadership** - TDOT's executive leadership, consisting of the Department's Commissioner and Bureau Chiefs, assist in setting the overall direction of the Research Program and provides final approval of the Call for Proposals.

Each research project sponsored by the Department is managed by a TDOT subject matter expert.

- **TDOT Lead Staff** – The lead staff person, also referred to as a Subject Matter Expert (SME), serves as the project manager. A lead staff person is assigned to each TDOT sponsored research project to provide technical expertise and direction for the project. Lead staff are also generally responsible with implementing the research findings when applicable.

3.5 Stakeholders

The Research Program has numerous stakeholders that have both an interest in and benefit from the research activities TDOT conducts and engages in.

Table 1 Research Program Stakeholders

Stakeholder Type	Stakeholder Group	Members
Partner	Internal Partners	TDOT Lead Staff, Research Oversight Task Force, executive leadership
	External Partners	FHWA-TN Division, Tennessee Universities, Consultants
Primary Stakeholder	TDOT	All TDOT divisions and staff
Secondary Stakeholder	Other State Agencies	All Tennessee state agencies
	Federal Agencies	USDOT and FHWA
	Planning Organizations	TN Metropolitan Planning Organizations, TN Rural Planning Organizations
	National Research Organizations	TRB, NCHRP, AASHTO, American Transportation Research Institute (ATRI), American Society of Civil Engineers (ASCE)
	Tennessee Stakeholders	Tennessee residents and visitors
Other Stakeholder	Businesses, Local Communities	Transportation industry, associations and trade groups, service providers (public and private), municipalities, authorities, and other traditional and non-traditional interests in transportation

4 Input Assessments and Findings

The Research Strategic Plan was developed to appropriately address the needs of the Department and future vision. As the Research Program serves the entire agency and numerous stakeholders, the planning process considered various sources for input to inform the strategic plan.

Five inputs were identified as critical sources to inform the plan development:

- internal and external stakeholder feedback,
- TDOT's 25-Year Long Range Transportation Plan,
- an initial internal program assessment,
- FHWA's program review, and
- the research peer exchange.

These takeaways at the end of each subsection as well as the section on Synthesis and Analysis informed the Action Plan steps in Section 7.

4.1 Stakeholder Feedback

Both TDOT's internal and external stakeholders were considered throughout the planning process. The Research Program considered feedback from TDOT staff and divisions, FHWA-TN Division staff, and University researchers. Feedback from numerous stakeholders assured research staff were taking a holistic approach to improving the effectiveness of the program and multiple points of view were examined.

4.1.1 Internal Feedback

As TDOT divisions and staff are the primary stakeholders, research staff held outreach meetings with all Division Directors and sent out an internal stakeholder survey to get feedback from TDOT staff at every level.

Outreach Meetings

The purpose of the outreach meetings was to speak with Division Directors about their interactions with the Research Office and their opinions on research relating to their Divisions. The outreach meetings also served as an opportunity for research staff to communicate an overview of the Research Program; the vision of the program as well as the Research Strategic Plan; and discuss the research needs and challenges of conducting research for each division.

While speaking with Division Directors, central to the discussion was research most critical to help achieve each division's vision and goals. Research ideas were categorized by the type of research need identified, including:

- General Topic/Issue: A broad statement of a research idea or areas where research needs are most anticipated.
- Specific Problem/Idea: A distinct research problem or idea has been identified.
- Best Practices: A request to identify best practices across the industry or from other state DOTs.
- Implementation: A request to deploy or demonstrate completed research or technology.

The research ideas identified through these meetings will be considered for future research cycles.

Table 2 Summary of Types of Research Needs by Bureau

Type	Administration	Engineering	Environment & Planning	Other*	Total
General Topic/Issue	5	28	12	4	49
Specific Problem/Idea	5	21	3	1	30
Best Practices	2	4	3	5	14
Implementation	1	-	3	-	4
Total	13	53	21	10	97

*Divisions housed with the Commissioner’s Office.

As seen in Table 2, general research ideas were most often discussed in these meetings, but additionally, 30 specific research ideas were identified. Best practices were also a recurring theme within all bureaus and the desire for support for implementation efforts was specifically expressed within the Administration and Environment & Planning bureaus.

While the needs of each division varied significantly, certain themes emerged across divisions, categorized in Table 3.

Table 3 Summary of Research Needs Identified by General Theme

Category	Number of Needs Identified
Evaluation of TDOT Practices	21
Process Improvement	15
Infrastructure Preservation	14
Technology Needs	12
Organizational Transformation	10
Mobility	7
Other	18

The most common research need identified in the outreach meetings was the evaluation of current TDOT practices, followed by ways to improve or modify processes to ensure optimal efficiency and research surrounding infrastructure preservation and maintaining Tennessee’s roads and structures. The need for a technological advancement was identified 12 times, such as the development of new software or preparing for connected and autonomous vehicles, and

ideas regarding organization change were mentioned 10 times, including leveraging funding and resources and shifting to a remote work environment. Seven needs surrounding overall transportation mobility were identified by divisions. Lastly, 18 research ideas could not be categorized and are included as “other;” some of the research identified included learning how to reduce impacts of structures on environmental features and understanding how to alter the behavior of drivers to better implement transportation demand management strategies.

Division directors were also asked about challenges they face managing a research project for their division and what barriers they have identified that may lead to a research project being deemed “unsuccessful.” These responses are summarized in Table 4.

Table 4 Summary of Research Challenge Identified by Division Directors

<i>Response Category</i>	<i>Number of Responses</i>
<i>Staff Time</i>	12
<i>Implementation</i>	9
<i>Insufficient Deliverables</i>	9
<i>Process Consistency/Improvements</i>	9
<i>Lack of Communication from Research Office</i>	6
<i>Collaboration Across Department</i>	5

Lack of staff time to dedicate to a research project or, alternatively, the excess of staff time needed to manage a project was the most common challenge identified. Challenges of actually implementing the research findings within the organization, issues with the objectives not being fulfilled/insufficient deliverables, and the want for process consistency and improvements were each cited on 9 occasions. Lack of communication from the Research Office was also identified as challenge by numerous divisions, specifically, directors mentioned wanting research staff to communicate more throughout the lifecycle of a project and more communication being necessary regarding TDOT’s research process. Lastly, directors called for more collaboration across the Department.

Takeaways

Division Directors were very forthcoming in the interviews regarding the research process and perceptions of the Research Office. Through their responses, research staff found that many can identify general issues that need further assistance through research, as well as specific areas where they would like help. As far as their research challenges, they recognize staff must be able to balance their time with their other duties, while they also recognize that a push for better deliverables and implementation efforts is necessary. Procedurally, they identified communication, collaboration, and consistency as challenges where focus by the Research Office can help improve the overall research products.

Internal Stakeholder Survey

The internal stakeholder survey was created to receive feedback from TDOT staff at every level, including individuals previously involved with the Research Program and ones who have never interacted with the program.

The survey was sent to every Division Director within the Department, who were then asked to distribute the survey to the appropriate staff within their divisions. The survey received 145 responses (with 127 completing the entirety of the survey) from individuals representing all three TDOT bureaus and 23 of the 32 divisions. The survey can be found in Appendix A.

The survey focused on getting feedback from TDOT staff, no matter their experience, with the Research Program. The survey was broken into multiple parts to get the appropriate feedback depending on the individual's level of experience with research and the Research Program:

- 1) Those who are currently or had previously been a Lead Staff person,
- 2) Those who had previously interacted with the program but not been a Lead Staff person, and
- 3) Those who had never interacted with the program or research staff.

Lead Staff Responses

For Lead Staff, research staff was interested in gauging if expectations for their roles were clear and if they felt fully supported by the Research Office. Additionally, respondents were asked how the program and the Lead Staff roles could be improved.

Are you aware of what the Research Office desires from Lead Staff performance? (n=32)

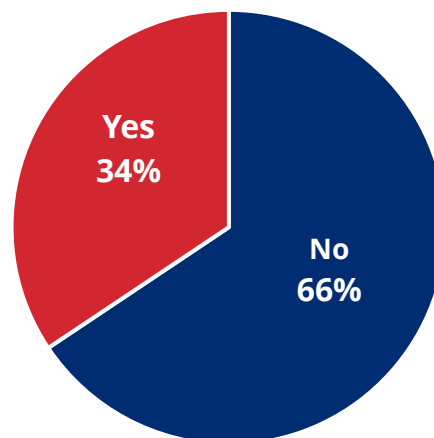


Figure 1. Survey Response from Lead Staff Regarding Performance Expectations

Two-thirds of respondents expressed not being aware of what the Research Office anticipates from Lead Staff when they manage a project. This finding is not ideal as Lead Staff should have a clear understanding at the onset of a research project as to which responsibilities they have been

tasked with, what managing a research project entails, and where TDOT research staff provides support.

Do you want more guidance from the Research Office or from your division director about the research you are helping conduct? (n=31)

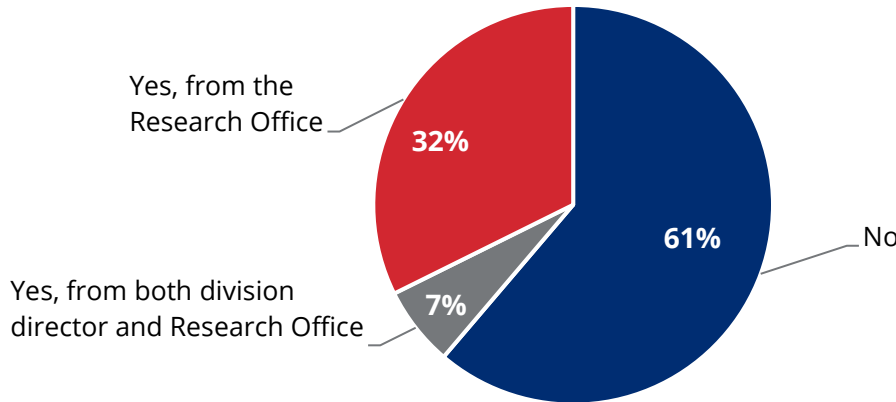


Figure 2. Survey Response from Lead Staff on Want for Additional Guidance

Figure 2 summarizes the survey responses from Lead Staff regarding the want for additional guidance from the Research Office and Division Directors for research. While most respondents indicated they do not desire additional guidance to manage research projects, 39% of respondents did indicate the desire of more guidance from either the Research Office or their Division Director. From the previous question, where roughly 2/3 expressed not knowing expectations from the Research Office, it can be inferred that a majority of these respondents indicated they desire more guidance. The other proportion of these respondents that would have said they do not know what the Research Office expects but also do not desire more guidance may have support from their Division Director or may feel confident in managing research projects alone. Alternatively, more guidance may also mean more rules or additional procedures, which may lead some Lead Staff to be hesitant of the consequences of greater involvement.

Table 5. Summary of Suggestions from Lead Staff

Response Category	Number of Responses
<i>Process Consistency</i>	4
<i>Increased Collaboration Across the Department</i>	3
<i>Increased Communication</i>	4
<i>Clearer Expectations for Lead Staff/Lead Staff Training</i>	6

Respondents who had previously been or currently are a Lead Staff person for a research project were also asked for suggestions as to how the Research Program could be improved. Seventeen substantive responses from Lead Staff respondents were received, which are summarized in Table 5. Generally, comments could be characterized in 4 categories: process consistency, increased collaboration across the Department, increased communication, and clearer expectations for Lead Staff/Lead Staff training. Additional training and clearer expectations for

Lead Staff was mentioned most often by respondents, followed by the desire for more communication regarding research and program consistency.

Takeaways

Those that have been Lead Staff previously with the Research Office have varying experiences with their roles in research. While some feel comfortable with understanding what is expected of them, a significant portion do not express knowing what the Research Office asks of project managers. A sizable group of these individuals would like more guidance while some appear to feel a hands-off approach is better for their managing styles. As far as written suggestions, just over half (seventeen) of the respondents provided feedback that mirrored the Division Directors' in desiring more communication, collaboration, and consistency from the Research Office's administration of the program. Six very clearly expressed wanting more training and guidelines on their Lead Staff role.

Program Services

In addition to funding and conducting research on behalf of TDOT, the Research Program also offers various other services that TDOT staff can take advantage of, such as facilitating networking opportunities with national organizations and sponsoring conference and training attendance. Therefore, the Research Office was interested in getting feedback from those who had interacted with the program in a different capacity than Lead Staff, and those who had yet interacted with the program. Specifically, feedback was sought regarding which research services had been previously used by TDOT staff and which services were of most interest to them.

Firstly, respondents were asked about their awareness of ways to be involved in research the Department is conducting, such as managing a research project or submitting research ideas to the Research Office.

Are you aware of opportunities to be involved in research, such as leading a research project or submitting research needs to the Research Office?

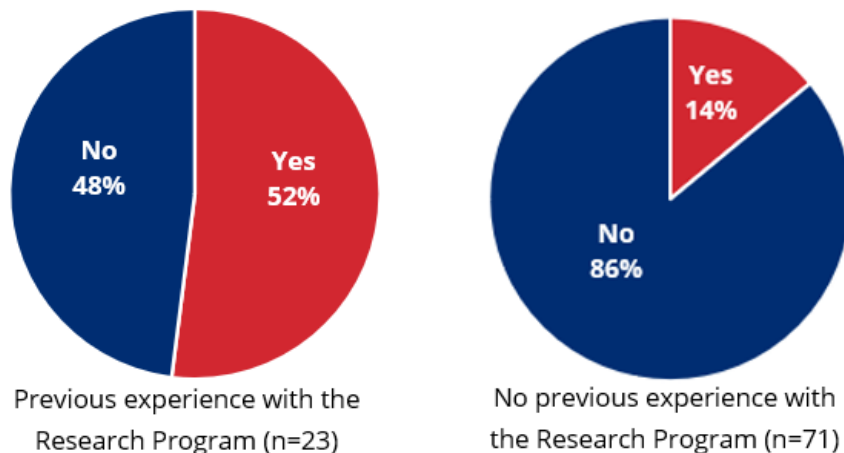


Figure 3 Survey Response on Research Involvement

As shown in Figure 3, just under half (48%) of respondents who had previously interacted with the program were not aware of opportunities to be involved with research activities, and respondents with no previous experience with the program were overwhelmingly unaware of such opportunities, with only 14% indicating awareness.

Respondents who had previously interacted with the Research Program were asked about which services they had used, and which was of most interest to them; the responses are summarized in the following figure.

Use of or Interest in Research Program Services (n=23)

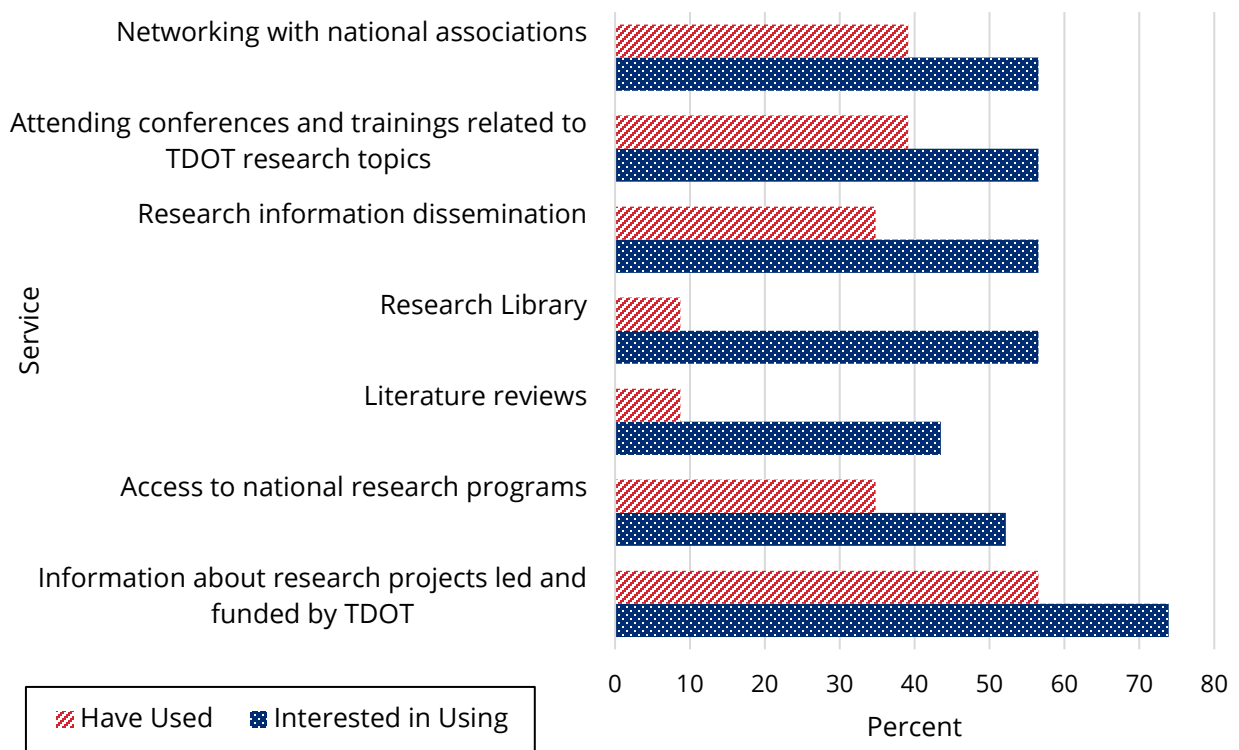


Figure 4. Survey Response from Non-Lead Staff with Previous Experience with the Research Program on Research Program Services

As shown in Figure 4, ‘information about TDOT sponsored research projects’ was the most accessed service and the service respondents are most interested in. While less than half of respondents had used any of the other services listed, over half of respondents showed majority interest in all other services other than ‘literature reviews.’

Respondents who had yet to interact with the Research Program were also asked about their interest in services offered by the program, these results are captured in Figure 5.

Interest in Research Program Services (n=62)

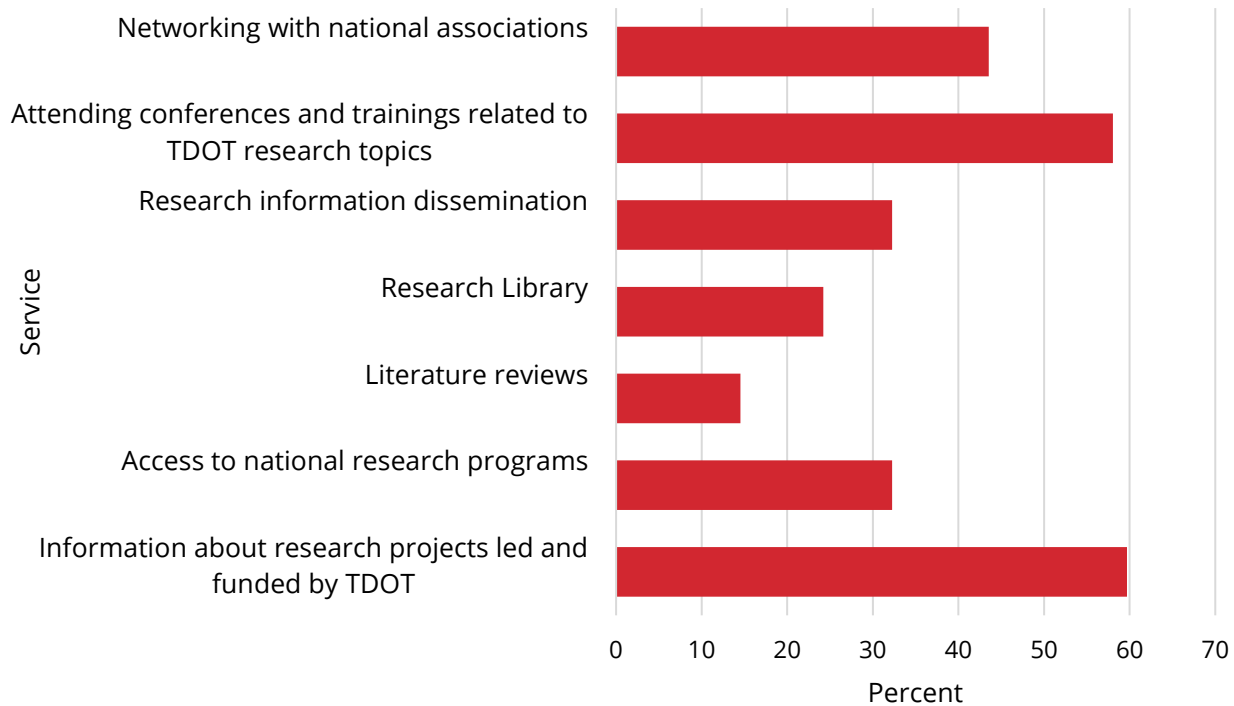


Figure 5. Survey Response on Research Program Services from Respondents with No Prior Interactions with the Research Program

For this group of respondents, ‘information about TDOT sponsored research’ was also the service that garnered the most interest, while attending conferences and trainings related to research topics’ ranked in a very close second. No other service was considered to be of interest by a majority of respondents. This could be due to a lack of awareness of what these services entail or how all employees may benefit. Respondents may also not be in positions that require an understanding of recent research in their field (i.e. Administrative positions).

Survey respondents were also asked to provide suggestions for additional services the program could provide. These responses are summarized in Table 6 below.

Table 6 Summary of Comments on Additional Services

Response Category	Number of Responses
<i>Increased Communication Efforts</i>	7
<i>Online Research Repository</i>	2
<i>Implementation & Technology Transfer Support</i>	2
<i>Funding Support for TDOT Staff</i>	1

The majority of responses (7 of 12) focused on increased communication from the Research Program, including information about projects; general information about research, such as the

purpose and goals of research; and information about the program as a whole, including information about current services and TDOT's research process. Two respondents suggested the creation of an easily navigable online portal for research reports to allow TDOT staff to easily search through reports.

Comments were also made by two respondents regarding the want for additional support and information regarding implementation efforts of research findings and to support training opportunities for staff for technology transfer efforts. Additionally, a suggestion was made to provide funding for TDOT staff to complete research as some needs are not properly addressed by University researchers.

Takeaways

From the survey questions on program services, it is obvious that the Research Office's services are not as well-known as they should be. These services are meant to be accessible to all TDOT employees interested in research, though for both those that have and have not interacted with the Research Office, a large percentage are not aware of how to get involved, approximately 50% and 85% respectively. Communication is definitely lacking.

For all service options presented, TDOT staff that have not been Lead Staff or have not been involved with the Research Office at all both take greatest interest in getting information about research projects led and funded by TDOT. Second was attending conferences and trainings related to TDOT research topics, then networking with national associations, cumulatively. There was a noticeable difference in that staff with Research Office experience were more interested in disseminating research, having access to a research library, and having access to national research programs. It is possible that those without experience do not have a need for these services, but they may also not yet realize how this information could be useful to them. Literature reviews were not of great interest to either group.

Overall, the areas with the greatest interest will be good gateways to get more interest in research at the state and national levels for all staff. The areas with more interest from the first group should be tailored to narrower interests at least initially. And for the first group, areas with the greatest discrepancies in use and interest should be reviewed for improvements in communication and access to those services.

From the suggestions provided at the end of the section, TDOT employees are aware that the Research Office should access more communication channels to provide them with information on TDOT's research efforts. The other comments were additionally helpful for consideration in efforts applicable to a research repository or implementation assistance. One comment from staff about funding support for Lead Staff will require extensive research and discussion for feasibility.

4.1.2 External Feedback

To better inform the Research Program, input was also sought from external partners, including the Tennessee Division of the FHWA and University researchers who have traditionally worked with TDOT on research projects. As the Department relies heavily on external partners to deliver the program and complete high-quality research for the Department, it was vital to consider their feedback to ensure a holistic approach was considered during the development of the plan.

FHWA-Tennessee Division

Staff from the Tennessee Division of FHWA were surveyed to get an understanding of their interaction with and awareness of research being conducted by TDOT. Additionally, FHWA staff were asked their interest level regarding serving on research committees in the future, which will help the Research Office better identify Federal representatives to provide their technical expertise for research projects. The survey received 10 responses; the most notable results are found in Table 7. Refer to Appendix B for the complete survey.

Table 7 Summary of FHWA Survey Responses

Question	Responses
<i>In interfacing with your TDOT partner(s), how often is research discussed? (N=10)</i>	Frequently 0
	Often 0
	Sometimes 7
	Seldom 2
	Never 1
<i>How aware are of you of research activities being led by your TDOT partner(s)? (N=10)</i>	Highly Aware 0
	Somewhat Aware 6
	Not Aware At All 4
<i>Do you know where to go to find research activities being led by your TDOT partner(s)? (N=10)</i>	Yes 2
	No 8
<i>Would you be interested in participating in TDOT's research needs identification process? (N=10)</i>	Yes 6
	No 4
<i>Would you be interested in serving on a technical advisory committee? (N=10)</i>	Yes 6
	No 4

Based on the results summarized in Table 7, more emphasis must be placed on keeping FHWA staff involved and aware of TDOT's research activities. While the majority of respondents did note discussing research activities sometimes with their TDOT partner, additional effort must be made to allow FHWA staff to lend their expertise to active research projects and to support implementation efforts. Greater awareness of research being conducted by the Department is also needed, as no respondent indicated being highly aware of TDOT's research activities and 8 respondents did not know where to find information about research activities. In a bolster for the program, 60% of respondents expressed interest in sitting on a committee for the program.

University Partners

For the 2021 Research Peer Exchange, TDOT worked with Vanderbilt University, the University of Memphis, and Tennessee State University on completing an “Innovation to Implementation” study. As part of the study, researchers from universities across the state were surveyed regarding TDOT’s research process and were given an opportunity to provide suggestions to improve the program. In total, 38 researchers from 8 Tennessee universities responded to the survey. The survey can be found in Appendix C.

Among other topics, the survey aimed to receive feedback on the research idea and proposal submission process and implementation of research findings.

Implementation

Researchers were asked if TDOT Lead Staff understood the link between research and implementation and if there was an implementation plan in place for the research. The responses are summarized in Table 8.

Table 8 Summary of University Partner Survey Responses on Implementation

Question	Responses	
<i>Of those who said the state project manager (PM) understood the link to implementation, was there an implementation plan for your project(s)? (N=17)</i>	Blank	3
	No	4
	Sometimes	1
	Yes	9
<i>Of those who had an implementation plan for any project, is your research being implemented? (N=10)</i>	Blank	2
	No	3
	Sometimes	3
	Yes	2
<i>Of those who said the state PM understood the link to implementation, is your research being implemented? (N=17)</i>	Blank	2
	No	6
	Sometimes	6
	Yes	3

Seventeen respondents said that Lead Staff understands the link between research results and implementation, yet only 9 said there was an implementation plan in place. Moreover, of the 9 who said there was an implementation plan in place, only 2 have seen successful implementation.

Evaluation Process

To better understand how to improve the research cycle, feedback was requested regarding the proposal evaluation process. Researchers were asked about the transparency regarding the process, reasons why the process may lack transparency, and suggestions to improve the process.

Does TDOT Have Adequate Transparency in the Proposal Evaluation?

■ No ▨ Somewhat ▩ Unsure ■ Yes

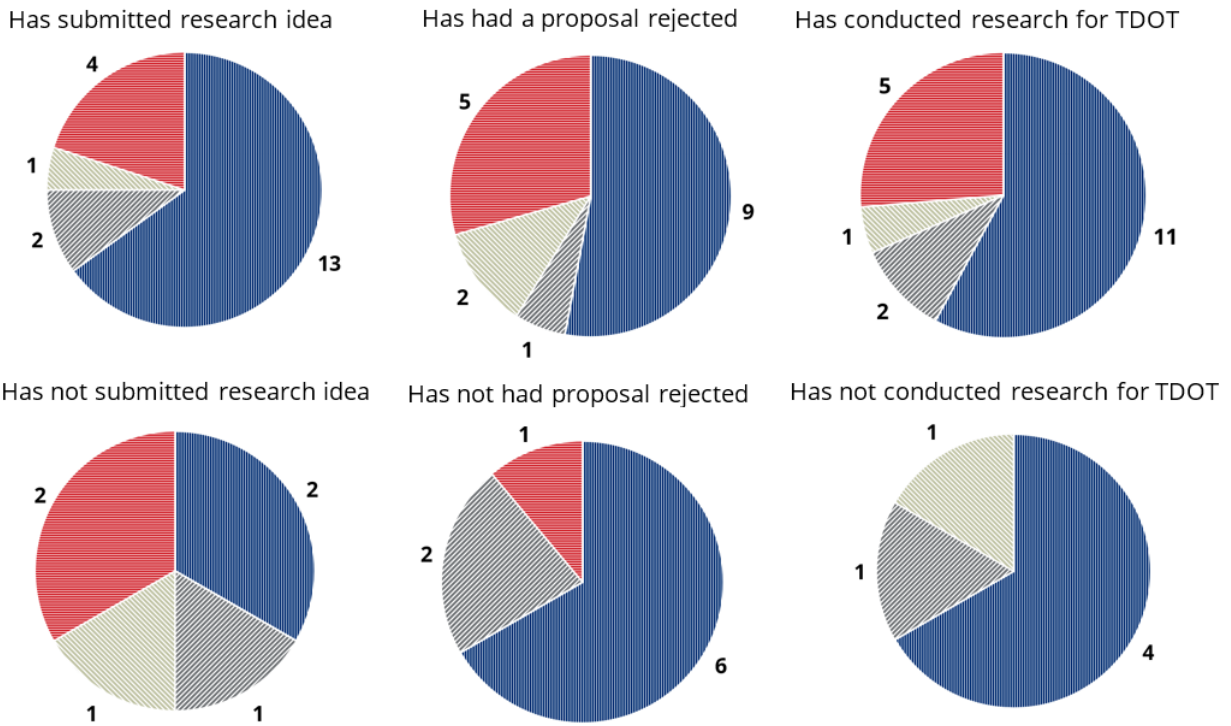


Figure 6 Researcher Perception of Transparency of Proposal Evaluation Process

Respondents were asked about why they felt the proposal evaluation process was not transparent and for recommendations to improve the proposal process, the responses are summarized in Tables 9 and 10, respectively.

Table 9 Summary of Researcher Responses Regarding Lack of Transparency

Response Category	Number of Responses
<i>Favoritism toward experienced PI's, major universities</i>	2
<i>Lack of internal communication at TDOT</i>	1
<i>Feedback only by request and largely vague</i>	8
<i>Little to no communication after submission</i>	2
<i>No announcement of winning proposal</i>	2

Table 10 Summary of Researcher Suggestions to Improve the Proposal Process

<i>Response Category</i>	<i>Number of Responses</i>
<i>Increased feedback and communication</i>	12
<i>Shorter timeline for proposal process</i>	3
<i>Transparency in the evaluation process</i>	2
<i>Blind evaluation process</i>	3
<i>Increased communication between RFP and submission</i>	2
<i>Consistent annual timeline</i>	4
<i>Addition of target funding amounts</i>	1

As seen in Figure 6, University respondents overwhelmingly thought the proposal evaluation process was not transparent enough, no matter the type of experience they have had with the program. When researchers were asked why the process lacked transparency (Table 9), most pointed to TDOT providing no feedback or vague feedback to the submitter on request. As shown in Table 10, the most common suggestion for improving the proposal process was to provide more feedback on proposals and increase communication throughout the process; additionally, a consistent timeline for the research cycle was a common suggestion among respondents. Other suggestions included a shorter timeline for the proposal process, a blind evaluation process, greater transparency, and the addition of targeted funding amounts. It should be noted that the last call did include targeted funding amounts for projects.

Takeaways

There is evidently a breakdown in the implementation process, as only a small fraction of researchers had their findings implemented, even when Lead Staff understood the link between research and implementation and there was an implementation plan in place. As the Research Office does not currently have a formal implementation planning process in place, it is unknown how extensive or robust implementation plans have been. Creating a formal process that engages the researcher, Lead Staff, and the Research Office early in the process may lead to more successful implementation and will create opportunities for TDOT staff to measure progress.

The process for requests for proposals garnered informational feedback from state researchers. Researchers are concerned with the transparency of the Research Program in how it conducts its funding opportunities. Like much of the other feedback so far, the researchers also suggest greater communication and consistency during the calls. They believe consistency can be met through an annual timeline for research (likely based on their academic year for timing and funding) as well as a shorter overall timeline for getting projects underway. The Research Office should note that while an annual timeline would be beneficial, limitations to the Research Office's staff may make this difficult to achieve within the timespan of this strategic plan.

Others also seek a more level playing field in the proposal process, citing that they believe there is favoritism and a lack of feedback on their proposals that are not selected. Their suggestions for blind evaluations could help alleviate their concerns about favoritism.

4.2 TDOT's 25-Year Long Range Transportation Plan

In 2016, TDOT updated its 25-year Long Range Transportation Plan (LRTP), which is particularly focused on helping achieve the agency's future vision. Three strategic objectives identified throughout the planning process, meant to guide transportation investments of both TDOT and the LRTP, are to promote efficiency, increase effectiveness, and emphasize economic competitiveness. For reference, the 25-year plan can be found at <https://www.tn.gov/content/tn/tdot/long-range-planning-home/25-year-transportation-policy-plan.html>.

To best guide TDOT to achieving its vision, the LRTP established Guiding Principles to ensure the needs of the Department are prioritized. The Research Strategic Plan, and the Research Program as a whole, must align TDOT's research activities with these principles. The Guiding Principles are as follows:

- **Preservation and Management of the Existing System** – Protect existing assets and maintain efficiency of the system through cost-effective management and new technologies.
- **Support the State's Economy** – Make transportation investments that support economic growth, competitiveness and tourism; build partnerships with communities and regions to link employment, commercial/retail areas and other key activity centers.
- **Maximize Safety and Security** – Reduce injuries and fatalities in all modes of transportation; minimize construction-related safety incidents; improve disaster preparedness and incident response.
- **Provide for the Efficient Movement of People and Freight** – Optimize the movement of people and goods by providing greater access to transportation services for all people and by building better connections among different modes of transportation.
- **Build Partnerships for Sustainable and Livable Communities** – Provide early and ongoing opportunities for broad public input on plans and programs; work closely with local public and private planning efforts; coordinate land use, transportation planning, and other public policies (health, education, workforce development, economic development, etc.).
- **Protect the Natural, Cultural, and Environmental Resources** – Maintain the integrity of communities and historical sites; minimize impacts on natural resources and conserve energy.
- **Emphasize Financial Responsibility** – Provide accountability; maximize Tennessee's share of federal transportation funding; develop alternative funding strategies; select projects based on identified regional needs; utilize innovative and alternative project delivery methods where appropriate; allow flexibility in local management of projects where feasible.

- **Innovation** – Lead in the development and deployment of innovative practices and technologies that improve and advance the safety, performance, and resiliency of Tennessee’s transportation system.

The Guiding Principles were included in the internal stakeholder survey (discussed in the previous section) distributed to TDOT staff to be ranked in order of importance to the Department. The principles were then used to inform the research strategic priorities for the program outlined in this plan, with the higher-ranking principles considered more heavily during the drafting of the strategic priorities for the program.

Table 11 Ranking of Guiding Principles

Rank	Guiding Principle
1	Maximize Safety and Security
2	Preservation and Management of the Existing System
3	Provide for the Efficient Movement of People and Freight
4	Support the State’s Economy
5	Innovation
6	Emphasize Financial Responsibility
7	Protect the Natural, Cultural, and Environmental Resources
8	Build Partnerships for Sustainable and Livable Communities

As reflected in Table 11, “Maximize Safety and Security” was considered the most important Guiding Principle by TDOT staff. “Preservation and Management of the Existing System,” “Provide for the Efficient Movement of People and Freight,” and “Support the State’s Economy” ranked second, third, and fourth, respectively. It should be noted that the top four principles seem to reflect the strategic objectives identified in the LRTP and discussed previously: to promote efficiency, increase effectiveness, and emphasize economic competitiveness. These objectives clearly still guide TDOT staff and have become institutionalized across the agency; these objectives were also considered to determine the research strategic priorities.

It should be noted that though Innovation was listed fifth-most important to TDOT staff, the Research Office considers innovation to be one of its greatest benefits and purposes. Thus, it should be thought of as innovative research that supports the important guiding principles as opposed to innovation for the sake of innovation. As TDOT reviews and updates the LRTP, the updated objectives and Guiding Principles will be considered and integrated into future updates of the Research Strategic Plan. This is discussed further in Section 6.

4.3 Program Management Assessment and Review

A high-level internal program assessment was completed to assess the current state of the Research Program through a strengths, weakness, opportunities, and threats (SWOT) analysis. An external program review completed by FHWA was also considered throughout the

development of the Research Strategic Plan to certify TDOT’s research activities both fulfill the needs of the Department and complies with the regulations governing the program.

4.3.1 Internal Assessment

Research staff completed an internal assessment of the program through SWOT analysis. The SWOT analysis performed conveys where the program gets support and where it can leverage its strengths. It will also help the Research Office understand where improvements are necessary and how risks can be reduced within the program. Table 12 provides an overview of the assessment from January 2021.

Table 12 Internal SWOT Analysis

	Positive	Negative
Internal Factors	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">STRENGTHS</p> <ul style="list-style-type: none"> • Support from newly hired executive leadership to transform the Research Program • Adequate funding available for the Research Program • New staff with energy and ideas to advance and innovate the program • Good working relationships with partners, including FHWA and PIs • Access to tools and web applications that can assist with program tracking </div>	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">WEAKNESSES</p> <ul style="list-style-type: none"> • Lack of exposure throughout the Department, many are unaware of the role of the program within TDOT • Limited communication of the value of research and specific research projects • “Green” research and leadership staff, lack of experience leading to no agreed upon vision for the program • Substantial reliance on Lead Staff/Subject Matter Experts • Effectiveness/performance is not assessed, value obtained from research is unknown </div>
External Conditions	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">OPPORTUNITIES</p> <ul style="list-style-type: none"> • Harness specialty expertise both within the organization and external to TDOT • Leverage national research programs to address the agency’s research needs, such as NCHRP or pooled fund studies • Enhance coordination and partnerships with stakeholders, including FHWA and University researchers • Increase leadership involvement with decision-making and interacting with the rest of the Department about research </div>	<div style="border: 1px solid black; padding: 5px;"> <p style="text-align: center;">THREATS</p> <ul style="list-style-type: none"> • Funding may be limited in the future due to unforeseen circumstances (e.g. COVID-19, recessions, etc.) • Finding interested candidates with the proper qualifications • Loss of institutional knowledge due to potential turnover • Not having set processes in place for the entirety of the Research Program to provide an iterative process that can perpetuate its timelines and efficacy </div>

Takeaways

The purpose of the SWOT analysis was to get internal staff perspective on the current program as it is run and to help determine how findings and perspectives from other aspects of the review can be deployed. Through the analysis, the Research Office realizes the past communications have been lacking and that having an entire staff with less than two years of experience are large obstacles. Leaning on relationships with leadership and with federal representatives can help bolster the program. Greater flexibility in achieving this is also afforded by having a newer staff and through the broad federal regulations that enable the program to be creative. The State also has strong University institutions to lean on for valuable research ideas and research products.

The Research program should be careful to improve its capabilities in knowledge transfer as the loss of institutional knowledge has been a threat to the program. The lack of processes and procedures for the entirety of the program has also been a threat to its abilities. Lastly, the program has suffered from lack of interest in some positions; this has also been an issue throughout the Long Range Planning Division. The Research Office should work to address these issues

4.2.3 External Review

In 2020, the FHWA Tennessee Division completed a review of TDOT’s Research Program as required by 23 CFR § 420.209(d). The review focused on TDOT’s process for administering federal funds associated with the Research Program, including the procedures for the selection and implementation of research activities. In this section, an overview of the recommendations from the report is provided. These takeaways will inform the Action Plan steps in Section 7.

The findings of the review are summarized in Table 13.

Table 13 Summary of FHWA Review Findings

<i>Review Category</i>	<i>Findings</i>
Program Management & Project Development	Recommendation: TDOT should continue efforts to update the Standard Operating Procedures for the Research Program. The updated procedures should be informed by the Federal program review, the peer exchange, stakeholder outreach, and by best practices learned from other programs across the nation.
Identification & Prioritization of Research Activities	Recommendation: FHWA recommends TDOT to install a standing committee, or several committees, to help provide oversight to the program, including the identification of research needs for the Department. FHWA-TN staff should be included, as well as subject matter experts within and external to TDOT.

	Recommendation: TDOT should review best practices regarding the research needs identification process and revise and enhance the process appropriately.
Managing & Programming Research Funding	Recommendation: TDOT should ensure the program management software currently in development has the capability to manage the entire scope of the program, including tracking individual research projects but also tracking the revenue, obligations, and expenditures for the program as a whole.
Tracking & Managing Research Activities	Recommendation: Expectations of Lead Staff should be clarified and well communicated. Best practices should be reviewed and considered to ensure research projects are properly managed and guided by subject matter experts.
Effectiveness of Research Program	Recommendation: The 2021 research peer exchange should be tailored to provide information on implementation planning, roles and responsibilities in the implementation process, performance measures, communicating the value of research, and other topics to ensure the effectiveness of the program.

The full FHWA review can be found <https://www.tn.gov/content/dam/tn/tdot/long-range-planning/research/resources/2020%20RDT%20Process%20Review%20-%20Transmittal%20and%20Report.pdf>.

Takeaways

The FHWA review emphasizes additional procedural documentation beyond the minimum federal requirements is necessary, stronger committee structures to leverage the expertise throughout the Department, greater communication with Lead Staff, using available applications to best track the entire research lifecycle to its full extent possible, and improving implementation capabilities of the Research Office. Indeed, the emphasis on ensuring the Research Office has the proper documentation and software supports will make a huge difference in the capabilities of the program at large and will be a great focus of the analysis and Action Plan.

4.4 Peer Exchange

The Peer Exchange occurred on April 5th and 6th. This section will be amended as the final report for the Peer Exchange is drafted and shared with the Research Office.

5 Synthesis of Findings

Specific needs to improve the value of the Research Program for the Department emerged repeatedly from the various inputs considered for the development of the Research Strategic Plan, including:

- increased communication, outreach, and collaboration,
- improved partnerships with both internal and external stakeholders,
- additional support for quality deliverables and implementation efforts, and
- streamlining research documentation and increasing transparency.

The below analysis expands upon these findings. The program goals and action plan established in Section 7 have been developed to specifically address the needs identified throughout the strategic planning process.

5.1 Analysis

Increased communication, outreach, and collaboration

This was the most consistent finding from the interviews, surveys, and reviews. All stakeholders desire greater communication from the Research Office.

From the perspective of TDOT Division Directors and internal staff in Section 4.1.1, the communication process should be about:

- communicating what research each office is currently working on,
- which training and conference opportunities are available at the state and national levels,
- what guidance should be followed by Lead Staff, and
- greater communication on the research lifecycle more broadly.

Collaboration among Divisions was seen as difficult. This requires:

- more centralized assistance from the Research Office to encourage it.

As expressed through the previous sections, internal staff should be more regularly updated with what the Research Office is doing and where it currently is in its research development process for calls, final reports, etc. While some are aware of what is going on within their Divisions, greater communication on what other Divisions are doing would be helpful as well.

Additionally, the creation of a standing committee for research could help with regular top-down communications on current research. This both meets communication and collaboration needs while incorporating recommendations from FHWA. The standing committee can also act as a means for bringing up the level of awareness for TDOT staff who have had little or no interaction with the program. Other technical advisory committees for cross-division research projects can

also bring in more subject matter experts to share the workload and provide products that are useful to more than one Division.

From the internal survey feedback, the Research Office recognizes that its services are not well-established within the program, and communication about these services is also lacking. Research staff must work to boost the program to better communicate the services respondents are most interested in and also ensure the services are easily accessible. These responses strengthen the need for the program to ensure information about completed and ongoing research projects being led by the Department is properly communicated and accessible to all staff at the levels in which they can participate. Greater discussion of available conferences and trainings would be best developed through a newsletter that can disseminate information about events that align with stakeholder's interests like TRB webinars, regional and national research committees, and research events that happen every so often. Relying on word-of-mouth or emails, which are currently used, are clearly not being successful.

From the survey, it is clear Lead Staff must be provided with well-defined expectations by the Research Program. The Research Office also should certify Lead Staff are aware of what leading a research project entails, that the research process is properly communicated, and must develop training and reference materials that define the roles and responsibilities of PIs, Lead Staff, and the Research Office. However, the program should take care to not make new materials cumbersome to the work Lead Staff already do. Staff time appeared to be a consideration for both Division Directors and staff that the Research Office should remain cognizant of in its documentation development.

Suggestions for improving communications:

- *a larger communications plan,*
- *implementing a bi-monthly newsletter,*
- *a regular training for new and continuing Lead Staff,*
- *a rotating standing research committee made up of TDOT leadership and research champions,*
- *technical advisory committees for cross-sectional research projects, and*
- *use of WebGrants for individual project communication in the future.*

Improved partnerships with both internal and external stakeholders

While improving communication and collaboration will naturally improve partnerships with internal and external stakeholders, there are also a few other items from the feedback that should be considered. TDOT Division Directors expressed that time for research among their staff may be cumbersome, which could lead to other deleterious effects. Internal staff conveyed a need for greater process consistency and accessibility to services. The external feedback uncovered that FHWA staff members are interested in research but are rarely tapped for their expertise. And then researchers expressed a lot of uncertainty about their relationship with the Research Office.

These issues indicate that there are places where the Research Office can improve its presence, availability, and associations with each of these groups. This can be achieved by:

- Adding elements to processes that require partnership outreach
- Emphasizing the use of templates, tools, and checklists that ask the right questions and get focused answers
- Transparency throughout the research process in ways that promote comradery and industry collaboration

Research is about what all interested parties can achieve when working together, and this will help encourage improving partnerships through the Research Office's conduct and through its intrinsic practice.

Current processes and procedures do not convey who requires outreach and communication at critical parts of the research process. An aspect of improving partnerships can come from written procedure requiring it. Efforts for this might include always asking FHWA to inquire about technical advisory committee inclusion or informing leadership about research project presentations. As a result, partnerships are formed and improved simply through proper execution of policy.

The use of templates, tools, and checklists can be critical in clarifying and ensuring partnerships. These instruments can provide clarity for partners about what is expected of them. It can also help reduce anxiety over what a good research project looks like. Currently, that is left up to the Lead Staff and researcher, when there should be more supports. In an effort to reduce staff time needed to ensure research quality, automation through these options asking the right questions and keeping data and correspondences without additional brain power can keep stakeholders happy and in-the-know.

The research process may seem unclear or daunting to those that are not in the Research Office. Improvements to the Research Office's own conduct and accessibility can help the program to appear more in line with all stakeholders' needs. In doing this, the program can make sure that the available products are readily accessible and attend to what stakeholders want from the program's services. Additionally, the Research Office should look to relying on leadership in the Long Range Planning Division to provide a strong appearance of caring about research and how it is administered and applied. Leadership should also emphasize how much the partnerships with University researchers are appreciated, as they produce the work that helps improve Tennessee's transportation system.

Suggestions for partnership improvement:

- *procedures that convey acceptable stakeholder conduct and expectations,*
- *using leadership to provide appreciation and convey importance,*
- *make instruments accessible and intentional, and*
- *Research Office procedures should include partner inclusion requirements.*

Additional support for quality deliverables and implementation

Every stakeholder group interviewed (except for researchers who were not asked about this topic) mentioned implementation concerns as part of their comments. TDOT Directors were unsurprisingly more concerned with the quality of the deliverables they received. Both TDOT Directors and staff discussed wanting additional help with implementation planning. When research does not readily move into the implementation process, facilitation at the Division level does not readily occur as it is outside the purview of many staffs' job descriptions. Additionally, the Research Office has recognized its dearth of implementation assistance options while FHWA's review strongly encouraged looking toward getting more information on implementation as well as looking to the Peer Exchange for further guidance.

From this, the Research Office can take these steps in the next 5 years:

- Establish an implementation plan and accompanying processes
- Establish funding set aside for implementation that requires additional work by the researchers
- Develop quality controls for deliverables
- Develop a database for deliverables that allows for greater access within the Department
- Integrate these needs into the job descriptions of Research Office staff, perhaps creating a position that is responsible for implementation and deliverables specifically

To support implementation efforts, the Research Program must establish processes to ensure implementation is at the forefront of the project when the research is first initiated rather than once a project has been completed. Other state research programs use Implementation plans to achieve this. Other work must be accomplished in order to set a proper implementation plan in motion. Another, small-scale option will need to be developed for the RES2019 and RES2020 projects which will be closing during the 2021 calendar year. More will be discussed in the Action Plan regarding short-term versus long-term options.

Additionally, funding could be set aside to support implementation activities when necessary. With the next call still being planned, a small amount of funding can be set aside for projects for additional implementation assistance. Fortunately, the tech transfer process is eligible for 100% FHWA-funded SPR Part B funds. This may also help stretch State dollars further for the program.

For deliverables, the Research Office should ensure objectives are fulfilled. Lead Staff must be involved during the proposal selection and negotiation process, this way the project is scoped correctly from the onset and issues with deliverables can be addressed throughout the project lifecycle. Emphasizing the importance of deliverables should also be a priority of the Research Office. This can be made clear by adding deliverable questions and discussions to the implementation plan that is ultimately developed. The Research Office can also make sure to provide a packet of IT related requests that will help integrate deliverables into TDOT's available software and support capabilities. Lastly, deliverables can be hosted in a library or database that can be shared and used internally by TDOT.

Lastly, the Research Program has suffered from lack of interest in some positions; this has also been an issue throughout Long Range Planning. The reason this is important to mention is because this can also have an effect on the program's outputs. When position qualifications and actual position descriptions do not appropriately line up with position requirements and pay, the Research Office is significantly impacted by the pool of well qualified candidates or candidates that readily move onto other jobs. Ameliorating this dissonance in the next 5 years should be considered of high importance.

Suggestions for quality deliverables and research implementation:

- *develop an implementation plan that encompasses the research project from beginning to end,*
- *set aside a small amount of funding for implementation/deployment/tech transfer activities,*
- *add deliverable planning to the implementation plan,*
- *ensure Lead Staff are versed in what quality deliverables look like,*
- *create a library specifically for deliverable data and documents for internal use, and*
- *ensure job descriptions and job qualifications for Research Office staff sought match with competitive pay for similar opportunities in Tennessee.*

Streamlining the research process and increasing transparency

The last common item that each stakeholder group discussed was consistency. Whether it be consistency in communication, consistency in timing for research projects, or consistency in documentation, this theme ultimately told the Research Office that ways to streamline the research process must be considered to increase consistency and transparency.

From this, the Research Office can take these steps in the next 5 years:

- Establish an annual or biannual timeline in the research cycle
- Improve template efficacy to ensure feedback will be provided to all stakeholders
- Lay out processes and procedures that can guarantee program reliability
- Increase tracking and performance measures collected and analyzed from projects

Improving consistency clearly requires establishing a consistent, achievable timeline. Previously, the Research Office had attempted an annual timeline, which quickly fell apart when turnover occurred within the Research Office. As a result, the timeline establishment should also come with clear guidelines on how the timeline should be conducted and who should be relied upon for certain aspects of the research cycle should one position not be available (Lead Staff, Research Manager, etc.). While this is a clear goal, it is also clear that it must be maintainable before it becomes actionable.

The Research Office currently has some templates on file to assist with documenting the research process. While these documents are enough to provide the bare bones requirements for FHWA, they currently do not provide much assistance to other stakeholders. These documents will be reviewed and updated while some additional templates will need to be made for areas like program evaluation. The Research Office has already finished updating its Final Report requirements, additional work on these templates will come sooner in the strategic plan period

than in other areas as improvements to these documents can impact the current research projects' effectiveness.

The Research Office recently updated with Standard Operating Procedures document that makes the program compliant with FHWA's requirements. However, this document does not encompass the policies and procedures needed to administer the entire program. Other policies and procedures will be developed in the various categories the Research Office oversees in order to create a more reliably consistent program while providing written guidelines that can be applied equally to all stakeholders instead of being beholden to the current Research Staff. Approvals for these policies must come from leadership, who should also be involved in the development process.

In the document updates and document creation, the Research Office should also focus on adding fields that can assist with data collection both about the program and about the efficacy of any individual project. Being able to track instances quantitatively or qualitatively throughout the project lifecycle that point to improvements for other Divisions will help show the benefits of the program and help communicate the added benefits of research to the Department as a whole. This will require additional development of best practices and integration of the new web application (WebGrants) in collecting useful data and feedback. Hence, developing finalized performance goal metrics will take at least a couple years to set. Another benefit to performance metrics will also allow for TDOT to better inform researchers of what TDOT looks for in every aspect of the research lifecycle from research idea to post-project evaluation. Better feedback will lead to greater transparency and a better program overall.

Suggestions for a streamlined and transparent process:

- *determine what is needed to be in place before a consistent research timeline can be set,*
- *develop job descriptions that will be able to cover the entirety of the program and help fill in gaps should assistance be needed,*
- *update and clarify use of templates,*
- *develop new templates for areas like implementation planning and project evaluation,*
- *establish procedures that provide consistent application of rules and guidelines, and*
- *research and develop performance metrics for the program and for individual projects (include SMEs in these discussions).*

From Peer Exchange

This section is forthcoming as we are working with the research team (Vanderbilt University, Tennessee State University, and University of Memphis) on the final report for the Peer Exchange.

6 Strategic Research Priorities

Based on the research needs discussed in the outreach meetings with directors and the prioritization of TDOT's Guiding Principles identified by the LRTP, the strategic research priorities for the Research Program were established. These priorities will be further discussed with the Research Oversight Task Force (ROTF) to determine research themes for proximate Research Calls. The priorities below reflect what was heard thus far from stakeholders. This section of the Strategic Plan is informed by Table 3 from Section 4.1.1 and Table 11 from Section 4.2. These tables delineate the importance topics from TDOT Division Directors and the survey respondents' opinions on the importance of TDOT's guiding principles.

6.1 Security, Preservation, and Enhancement of the Existing System

The preservation of the Tennessee's existing transportation infrastructure, including interstates and state routes, bridges, railways and ports, intermodal facilities, and other structures, is vital for TDOT to achieve its mission. As the State's infrastructure ages and deteriorates, the transportation system can no longer accommodate the current and future travel demand, threatening the safety and efficiency of the network. While maintenance of the system presents various challenges for the agency, it also creates opportunities to discover innovative methods to enhance the system. Through research, the agency can learn to better leverage its resources and incorporate advanced methods to preserve and enhance Tennessee's transportation system.

6.2 Emerging and Enabling Transportation Technologies Implementation

The pace of technology innovations and improvements are ever-increasing, demanding TDOT to explore opportunities to adopt emerging technologies and leverage enabling technology to drive performance. Technology has always been central to the transportation industry, solving complex problems and improving the movement of goods and people. Research can assist the agency to discover and develop technology to create a safer and more efficient transportation system, while also determining the challenges and opportunities associated with adopting innovative technology. As new technologies can often require heavy testing and years of research before governments are willing to invest, the Research Office can help bridge this connection for all Divisions and Regions at TDOT.

6.3 Organizational Transformation

As priorities shift and challenges arise, organizational change is necessary to ensure TDOT is functioning as efficiently and effectively as possible. To appropriately respond to both internal and external conditions, the Department must be able to examine and assess current practices and find avenues to develop new processes and procedures. Research can guide TDOT on determining when change is necessary and how to best implement change within the organization.

6.4 Multimodal Mobility Solutions Benefiting Safety and the Tennessee Economy

TDOT is essential to improving mobility and accessibility options for all Tennessee travelers, no matter which transportation option they may choose. Multimodal mobility solutions and innovations create an integrated transportation network, including first and last-mile connectivity to efficiently move both people and goods, creating opportunities to support the state's economy. Research is a key component to finding these solutions to expand transportation accessibility and mobility services in urban and rural areas across Tennessee.

7 Program Goals

To best improve the Research Program and incorporate the findings uncovered through the development of the Research Strategic Plan, five goals have been identified to guide the program over the next five years. The action plan below identifies strategies and actions that will help the program achieve each goal. The Research Program goals are:

1. Enhance and streamline the research cycle processes and procedures
2. Develop and strengthen relationships with stakeholders
3. Increase the visibility and accessibility of the Research Program
4. Increase the effectiveness of the Research Program
5. Drive innovation and technology transfer efforts

7.1 Action Plan

To help achieve the goals established for the Research Program, an action plan for the next five years has been developed, including strategies and near-and mid-term actions to provide a roadmap to achieving these goals. For each goal, measures of success should be considered to achieve these goals. Some ideas are presented, but nothing is set in stone.

For each Goal, the Action Plan steps are separated into short-, mid-, and long-term actions, as some aspects of the program will have higher priority due to time sensitivity and chronological necessity. Short-term actions are those that can be taken within a year. Mid-term actions can be taken in 2-3 years, and long-term actions are more than 4-years away from being completed.

Goal 1: Enhance and streamline the research cycle processes and procedures

Strategy 1.1: Improve the research needs identification process

Short-term actions:

- Identify best practices for the research identification process based on other state DOT and national research programs.
- Simplify the research needs statement template and information required to submit a research idea.
- Consider soliciting research ideas from additional external partners, such as Metropolitan Planning Organizations and Rural Planning Organizations.
- Ensure the process is clearly outlined and documented for all stakeholders submitting ideas.

Mid-term actions:

- Fully integrate external partners into research idea solicitation through inclusion in communications and procedural requirements for calls.

- After the next solicitation cycle, determine successes and make improvements for the next iteration. Update policies and procedures accordingly.

Strategy 1.2: Enhance oversight of research activities

Short-term actions:

- Establish a standing Research Oversight Task Force (ROTF) that meets quarterly to oversee the research needs prioritization process, proposal selection process, and supports TDOT's involvement in national research programs.

Mid-term actions:

- Establish a Technical Advisory Committee (TAC) for all research projects to provide additional direction and technical expertise.
 - One TAC can run multiple projects with different people spearheading the effort.

Strategy 1.3: Clearly define roles and responsibilities

Short-term actions:

- Update the Research Manual outlining all current research processes and procedures.
- Develop clear guidelines regarding expectations for all research PIs, including the research proposal process and final report requirements.
- Develop training materials for Lead Staff outlining responsibilities and expectations for managing a research project, including a required training session for all staff sponsoring a project.

Mid-term actions:

- Set job descriptions for Research Office staff.
- Determine roles and responsibilities for the research life cycle.

Strategy 1.4: Establish a consistent research cycle

Short-term actions:

- Evaluate the academic calendar year to identify the best timeframe for research projects to kick off.
- Develop a set schedule for Call for Research Needs Statements and the Call for Proposals to ensure all internal and external partners can prepare accordingly.

Mid-term actions:

- Work with Long Range Planning leadership and the ROTF to develop a cyclical communication plan.

Long-term actions:

- Assess research cycle frequency again with stakeholders. Update program as needed.

Strategy 1.5 Integrate an implementation and data management plan into the research cycle

Short-term actions:

- Develop plans that can assist Lead Staff and the program in spurring implementation through guiding documents and materials that ask the right questions and determine feasibility.
- Identify best practices for implementation and data management based on other state DOT and national research programs.

Mid-term actions:

- Develop a data management plan to establish how data for research projects will be managed and stored.

(Further discussion on implementation and data management planning are under Goals 2 & 3.)

Potential Measures of Success: Development of an implementation plan, use of implementation plans, template improvement, Performance Measure development from templates, consistent programmatic calls for proposals annually or biannually, quarterly meetings of the ROTF, and documentation of the research cycle.

Goal 2: Develop and strengthen relationships with stakeholders

Strategy 2.1: Foster existing University partner relationships

Short-term actions:

- Use leadership to emphasize the importance of research and to discuss its benefits. This will be particularly vital while the Research Office is still in transition.

Mid-term actions:

- Create opportunities for PIs and research teams to communicate the value of their research findings at both the state and national levels.

Long-term actions:

- Establish additional avenues to allow University partners to provide research and consulting services to the Department.

Strategy 2.2: Expand outreach efforts with University partners to form new connections

Long-term actions:

- Host informational sessions to researchers who TDOT has yet to partner with to provide them an overview of the Research Program and opportunities for funding.
- Visit Universities to interact with researchers in their element and provide on-campus guidance and assistance through meetings or seminars.

Strategy 2.3: Provide opportunities for Federal partners to be involved in research activities

Short-term actions:

- Designate at least one FHWA representative to serve on the standing Research Oversight Task Force (once established).
- Identify FHWA staff to serve on TACs to provide their technical expertise and ensure the research is informed by a federal perspective.

Strategy 2.4: Increase national presence

Short-term actions:

- Communicate opportunities to TDOT staff to serve on TRB committees and TRB Cooperative Research Programs (NCHRP, ACRP, BTSCR, and TCRP) project panels through the most convenient and widely used channel available.

Mid-term actions:

- Identify research needs of national concern for research calls for cooperative research programs or lead a Transportation Pooled Fund (TPF) study.
- Utilize the Research Oversight Task Force to identify and approve TPF studies for the Department to join.

Measures of Success: Increased membership on TRB and TRB Cooperative Research Program (NCHRP, ACRP, BTSCR, and TCRP) committees from TDOT, selection of a project for Sweet Sixteen High Value Research, leading TPF study(ies), FHWA staff on one or multiple internal committees for research, and attending University visits for sessions and meetings about the Research Office and its projects.

Goal 3: Increase the visibility and accessibility of the Research Program

Strategy 3.1: Communicate research activities to TDOT staff

Short-term actions:

- Develop a bi-monthly research newsletter to be distributed to agency staff to report on completed research projects and relevant findings, implementation efforts, and general research activities.
- Establish opportunities to allow University researchers to present and highlight their research findings to TDOT staff.
- Create two-page summary reports for all projects completed July 2021 or later to increase the accessibility of research projects and relevant findings.

Strategy 3.2: Improve the Research Program's web presence

Short-term actions:

- Review other state DOT research program websites to identify best practices to inform the program's own website structure.
- Review and update the Research Program's website to ensure information is communicated in an organized, easily accessible, and visually appealing manner.

Mid-term actions:

- Create a more searchable and user-friendly online research library to allow internal and external stakeholders to access TDOT's research reports and other resources.

Strategy 3.3: Develop a repository or library for reports, deliverables, and data.

Mid-term actions:

- Work with IT to develop a database for products developed through the research program.
- Develop sharing system and rules for internal and external users.
- Introduce a data management plan for research projects to ensure deliverables are received by the intended recipients at TDOT and can be made accessible to other internal users.

Measures of Success: Data management plan development, two-page overview document creation and use, documented website improvements, data on website visits to learn more about engagement, development of consistent newsletter for the Research Office and creation/measurement of an active recipient list, creation of an online repository.

Goal 4: Increase the effectiveness of the Research Program

Strategy 4.1: Strengthen implementation efforts of research findings

Short-term actions:

- Include implementation planning as a primary criterion for research prioritization process.
- Establish a test implementation process for research projects to guide Lead Staff and PIs on successfully implementing research results.

Mid-term actions:

- Determine a formal implementation process and develop procedures to provide funding for implementation of valid research findings.
- Require each project to have an implementation plan in place, developed in coordination by Lead Staff, the TAC, and the PI/research team.

Strategy 4.2: Evaluate implementation of research findings

Short-term actions:

- Identify best practices for tracking implementation based on other state DOT research programs and the national research community.
- Develop a process to track and measure research implementation efforts.

Mid-term actions:

- Conduct an analysis of research projects completed in the last 4 years to evaluate implementation trends and opportunities.

Long-term actions:

- Regularly use implementation findings to determine best practices for the Research Office. Reports should be done to document the effectiveness of implementation efforts.

Strategy 4.3: Track the performance of the Research Program

Mid-term actions:

- Identify best practices for establishing performance measures by evaluating successful efforts of other state DOT research programs and the national research community.
- Establish a definition of performance for the Research Program.
- Define which areas of activity are to be measured and how (qualitative or quantitative measures).
- Develop performance measures for the program. Use SMEs and ROTF for guidance in developing these metrics for individual Divisions.

Measures of Success: Development of performance measures for effective research projects, development of evaluation processes that have measurable insights from stakeholders and further research, implementation plan creation, completion of an analysis of previous years' projects and their effects on the research program and TDOT at large.

Goal 5: Drive innovation and technology transfer efforts

Strategy 5.1: Use national associations, programs, and forums to increase participation in innovative efforts

Short-term actions:

- Engage with TDOT's State Transportation Innovation Council (STIC).
- Emphasize the use of TPF studies to engage in innovative research and technology transfer efforts.
- Support Every Day Counts (EDC) innovations pursued by the Department through research as applicable.

Mid-term actions:

- Incorporate these programs into the day-to-day operations of the Research Office. Ensure national presence of the Research Office for these programs.

Strategy 5.2: Internally encourage innovation and technology transfer activities at TDOT.

Short-term actions:

- Take advantage of existing University relationships from projects to further discuss options for technology transfer activities which can be supported by SPR Part B funds.

Mid-term actions:

- Develop procedures and set aside funds to provide funding for projects that test a new practice, equipment, or process.
- Report on tech transfer improvements indicated through performance measures and feedback.

Measures of Success: Notable adoption of innovations through research conducted at TDOT, set aside funds specifically for tech transfer use from SPR Part B funds, leadership providing outreach to entice the use of funds for these activities, use of newsletter to regularly inform readers of innovation and tech transfer-related opportunities.

8 Conclusion

There are countless opportunities for TDOT's Research Program. With the Research Strategic Plan, the Research Program is positioning itself to conduct research with significant impacts to ultimately change how TDOT does business. The plan identifies the strategic research priorities most critical to supporting the agency's mission and provides the blueprint for the program for the next five years. To effectively implement the action plan outlined in this document, the program will require the support of TDOT leadership, research champions across the agency, and external partners.

Overall, the feedback received revealed that the Research Office has a few immediate needs to address: communication, consistency, transparency, and greater collaboration across the Department. Other feedback, both internal and external, provided further insights on the current understanding of the program and areas for process and procedural improvement. Ultimately, an Action Plan was developed in Section 7 to provide a comprehensive list of the necessary steps for the Research Office to make the research cycle an iterative and convenient mechanism to propel TDOT's transportation research program.

9 Appendices

Appendix A

Internal Stakeholder Survey

Internal Stakeholder Survey

1. Which division are you in?
(drop down menu)
2. Have you ever been assigned as Lead Staff on a TDOT research project?
 - a. Yes (skip to question 4)
 - b. No (go to question 3)
3. Have you ever interacted with the Research Office at TDOT?
 - a. Yes (skip to question 14)
 - b. No (skip to question 22)

Lead Staff

4. How many research projects have you been the Lead Staff on?
 - a. 1
 - b. 2
 - c. 3
 - d. 4 or more
5. As Lead Staff, how many hours on average per month do you spend managing research projects?
 - a. Less than 5 hours
 - b. 5-10 hours
 - c. 10-15 hours
 - d. 15-20 hours
 - e. More than 20 hours
6. Have you received or have you seen the "Tips for Lead Staff" one-pager from the Research Office regarding conduct as a Lead Staff person for research projects?
 - a. Yes
 - b. No
7. Are you aware of what the Research Office desires from Lead Staff performance?
 - a. Yes
 - b. No
8. Are you happy with the way the projects you have worked on turned out?
 - a. Yes
 - b. No
 - c. N/A (have not worked on a project that has been completed)
9. What other questions would you want to clarify with the Research Office about project outcomes (i.e. final reports, deliverable quality, etc.)?
(Comment Box)
10. Do you feel you have support of your division leadership and colleagues for research projects you are the lead on?

- a. Yes
- b. No

11. Do you want more guidance from the Research Office or from your division director about the research you are helping conduct?

- a. Yes, I would like more guidance from both the Research Office and my division director
- b. Yes, I would like more guidance from the Research Office
- c. Yes, I would like more guidance from my division director
- d. No, I have received sufficient guidance

12. Do you have any suggestions on how we can improve the Research Program and the role of Lead Staff?

(Comment box)

13. Are there any specific research topics or initiatives your division needs to know more about to better improve outcomes and achieve the goals of your division?

(Comment box)

Non-Lead Staff but Interacted with Research Office

14. When have you had to interact with the Research Office?

(Comment Box)

15. How valuable have the interactions with the Research Office been to you?

(Rating scale)

16. Of the services below, which have you used? (select all that apply)

- a. Information about research projects led and funded by TDOT
- b. Access to national research programs (such as Transportation Pooled Fund (TPF) Studies and National Cooperative Highway Research Program (NCHRP) projects)
- c. Literature reviews
- d. Research library
- e. Research information dissemination (NCHRP reports, Transportation Research Board (TRB) webinars)
- f. Attending conferences and trainings related to TDOT research topics
- g. Networking with national associations (such as TRB, American Association of State Highway Transportation Officials (AASHTO), etc.)

17. Of the services listed below, which are or would be of most interest to you? (select all that apply)

- a. Information about research projects led and funded by TDOT
- b. Access to national research programs (such as TPF Studies and NCHRP projects)
- c. Literature reviews
- d. Research library
- e. Research information dissemination (NCHRP reports, TRB webinars)

- f. Attending conferences and trainings related to TDOT research topics
 - g. Networking with national associations (such as TRB, AAASHTO, etc.)
18. Are you aware of opportunities to be involved in research, such as leading a research project or submitting research needs to the Research Office?
- a. Yes
 - b. No
19. Do you have interest in leading research or being a part of a research committee within TDOT?
- a. Yes (If yes, question 20)
 - b. No (if no, skip to question 21)
20. If you are interested in leading research or being a part of a research committee within TDOT, please leave your email address to allow us to follow up.
(Comment box)
21. In what other ways can the Research Office help you? What additional services would you like the Research Office to provide?
(Comment box)

Has Not Interacted with the Research Office

22. Why have you not interacted with the Research Office?
- a. Did not know about the Research Office
 - b. Did not know about the services offered by the Research Office
 - c. Prefer to do my own research
 - d. Have not identified any research needs
23. Are you aware of opportunities to be involved in research, such as leading a research project or submitting research needs to the Research Office?
- a. Yes
 - b. No
24. Do you have interest in leading research or being a part of a research committee within TDOT?
- c. Yes (If yes, question 25)
 - d. No (if no, skip to question 26)
25. If you are interested in leading research or being a part of a research committee within TDOT, please leave your email address to allow us to follow up.
(Comment box)
26. Of the services listed below, which are or would be of most interest to you? (select all that apply)
- a. Information about research projects led and funded by TDOT

- b. Access to national research programs (such as Transportation Pooled Fund (TPF) Studies and National Cooperative Highway Research Program (NCHRP) projects)
- c. Literature reviews
- d. Research library
- e. Research information dissemination (NCHRP reports, Transportation Research Board (TRB) webinars)
- f. Attending conferences and trainings related to TDOT research topics
- g. Networking with national associations (such as TRB, American Association of State Highway Transportation Officials (AASHTO), etc.)

27. In what other ways can the Research Office help you? What additional services would you like the Research Office to provide?

(Comment box)

ALL

28. TDOT's current 25-Year Long-Range Transportation Policy Plan contains 8 guiding principles. Rank order these principles from 1 to 8, with 1 being MOST IMPORTANT and 8 being LEAST IMPORTANT as it relates to the focus of TDOT's Research Program:

- a. **Preservation and Management of the Existing System** | Protect existing assets and maintain efficiency of the system through cost-effective management and new technologies.
- b. **Support the State's Economy** | Make transportation investments that support economic growth, competitiveness and tourism; build partnerships with communities and regions to link employment, commercial/retail areas and other key activity centers.
- c. **Maximize Safety and Security** | Reduce injuries and fatalities in all modes of transportation; minimize construction-related safety incidents; improve disaster preparedness and incident response.
- d. **Provide for the Efficient Movement of People and Freight** | Optimize the movement of people and goods by providing greater access to transportation services for all people and by building better connections among different modes of transportation.
- e. **Build Partnerships for Sustainable and Livable Communities** | Provide early and ongoing opportunities for broad public input on plans and programs; work closely with local public and private planning efforts; coordinate land use, transportation planning, and other public policies (health, education, workforce development, economic development, etc.).
- f. **Protect the Natural, Cultural, and Environmental Resources** | Maintain the integrity of communities and historical sites; minimize impacts on natural resources and conserve energy.
- g. **Emphasize Financial Responsibility** | Provide accountability; maximize Tennessee's share of federal transportation funding; develop alternative funding strategies; select projects based on identified regional needs; utilize innovative and

- alternative project delivery methods where appropriate; allow flexibility in local management of projects where feasible.
- h. **Innovation** | Lead in the development and deployment of innovative practices and technologies that improve and advance the safety, performance, and resiliency of Tennessee's transportation system.
29. Are you involved with, or interested in, research-related associations? (such as Transportation Research Board (TRB) committees, National Cooperative Highway Research Program (NCHRP), American Association of State Highway Transportation Officials (AASHTO))
- Yes (continue to question 30)
 - No (skip to question 33)
30. Which programs/research offerings would you be interested in learning more about?
- AASHTO
 - NCHRP
 - TRB
 - Transportation Pooled Fund (TPF)
 - American Society of Civil Engineers (ASCE)
31. Are you part of a Committee for any of these organizations?
- Yes (go to question 32)
 - No (skip to question 33)
32. Which committees are you part of?
(Comment box)
33. Are you interested in learning more about or being a part of a research committee at the national/regional level?
- Yes (If yes, question 34)
 - No (If no, skip to question 35)
34. If you are interested in learning more about or being a part of a research committee at the national/regional level, please leave your email address to allow us to follow up.
(Comment box)
35. Are you interested in receiving information from the Research Office? If so, what types of information? (select all that apply)
- Research reports from external sources (TRB, AASHTO, NCHRP)
 - Research reports completed by TDOT
 - At-a-glance reports summarizing research completed by TDOT
 - Email updates on national research programs and activities
 - I am not interested in receiving information from the Research Office (Skip to question 37)
 - Other (please specify)
36. How often would you like to receive information from the Research Office?

- a. As information is available (via forwarded email)
 - b. Monthly (in a brief newsletter)
 - c. Quarterly (with an extended newsletter)
 - d. Other (please specify)
37. Please provide any additional comments or suggestions.
(Comment box)

Appendix B

FHWA-TN Division Stakeholder Survey

FHWA-TN Division Stakeholder Survey

1. Name:
(Comment box)
2. Which TDOT Division(s) do you primarily interface with?
(Drop-down menu)
3. In interfacing with your TDOT partner(s), how often is research discussed? This would include potential research ideas/needs as well as ongoing research activities and research interests.
 - a. Frequently
 - b. Often
 - c. Sometimes
 - d. Seldom
 - e. Never
4. How aware are you of research activities being led by your TDOT partner(s)?
 - a. Highly aware
 - b. Somewhat aware
 - c. Not aware at all
5. Do you know where to go to find research activities being led by your TDOT partner(s)?
 - a. Yes
 - b. No
6. If you or your TDOT partner(s) identify a potential research idea/need (through routine oversight, research best practices, information learned from AASHTO/TRB/NCHRP, etc.), would you know how to advise them on pursuing Federal funding to explore the idea?
 - a. Yes
 - b. No
7. Would you be interested in participating in TDOT's research needs identification process (through participation in an advisory/oversight committee, assistance with research project application development and review, etc.)?
 - a. Yes
 - b. No
8. Would you be interested in serving on a technical advisory committee for a TDOT sponsored research project to help guide the project and review the technical content of research deliverables?
 - a. Yes
 - b. No
9. Do you have any suggestions on how TDOT's RD&T program can best support the work that you and your TDOT partner(s) carry out?
(Comment box)

10. Do you have any additional comments or suggestion related to TDOT's research program?

(Comment box)

Appendix C

University Partner Stakeholder Survey

University Researcher Stakeholder Survey

1. What university do you affiliate with?
(Comment Box)

2. What do you consider your area of expertise? (Mark all that are applicable)

<input type="checkbox"/>	Administration	<input type="checkbox"/>	Environment/Sustainability	<input type="checkbox"/>	Pipelines
<input type="checkbox"/>	Aviation	<input type="checkbox"/>	Freight Transportation	<input type="checkbox"/>	Planning and Forecasting
<input type="checkbox"/>	Bridges and Other Structures Construction	<input type="checkbox"/>	Hydraulics and Hydrology	<input type="checkbox"/>	Public Transportation
<input type="checkbox"/>	Construction	<input type="checkbox"/>	Human Factor/Behavior	<input type="checkbox"/>	Public Health
<input type="checkbox"/>	Cyber-physical Systems		Law/Policy		Rail
<input type="checkbox"/>	Data/Information and IT	<input type="checkbox"/>	Maintenance and Preservation	<input type="checkbox"/>	Resilience and Sustainability
<input type="checkbox"/>	Design	<input type="checkbox"/>	Marine Transportation	<input type="checkbox"/>	Safety
<input type="checkbox"/>	Earthquake/Seismic Design	<input type="checkbox"/>	Materials	<input type="checkbox"/>	Security and Emergencies
<input type="checkbox"/>	Economics/ Finance	<input type="checkbox"/>	Operations and Traffic Management	<input type="checkbox"/>	Society
<input type="checkbox"/>	Education and Training	<input type="checkbox"/>	Pavements	<input type="checkbox"/>	Terminals and Facilities
<input type="checkbox"/>	Energy	<input type="checkbox"/>	Pedestrians and Bicyclists	<input type="checkbox"/>	Other

3. To what extent have you participated in state DOT sponsored research program(s) previously? (mark all that are applicable)

- a. Submitted research ideas
- b. Submitted one or more research proposals, but was not selected to do research
- c. Conducted or participated in research for the state DOT
- d. Was not aware of opportunity to participate in research partnership with the state DOT

4. How did you find out about the research opportunity/solicitation?

- a. Email from state DOT
- b. State DOT website
- c. Colleague or friend at your university or another university
- d. Other: _____

5. Did you have interactions/communications with state DOT staff prior to submitting to address any questions you may have had about the research (on any proposal)?
(Comment Box)

6. Do you feel there is adequate transparency in the process for evaluating research proposals? If not, why so?
(Comment Box)

7. Do you feel there is adequate transparency in the process for evaluating research proposals? If not, why so?
(Comment Box)
8. What recommendations would you make for improving the process of proposal submission and/or review?
(Comment Box)
9. Do you feel you were "on the same page" with the state DOT project manager/staff member(s) during the project? If not, can you explain?
(Comment Box)
10. Did the state DOT project manager/staff member(s) understand the linkage between research results and implementation?
(Comment Box)
11. Did you receive adequate feedback/direction during the project from the state DOT project manager/staff member?
(Comment Box)
12. Were there any factors that hindered the conduct of your research with the state DOT? If so, what were they?
(Comment Box)
13. What were the outcomes/deliverables that came from your study/studies?
 - a. Report(s) to state DOT/FHWA
 - b. Peer reviewed journal article(s)
 - c. Conference presentation(s)
 - d. Other: _____
14. Was there an implementation plan for any of your projects? Yes/No - please provide example if possible.
(Comment Box)
15. Do you feel like your research is just another report on a shelf collecting dust or do you think the state DOT(s) are using the results of your findings to improve operations/maintenance activities, technology, design, etc.?
(Comment Box)
16. Do you know if any of your findings/results have been implemented by the state DOT sponsor or others into day-to-day practices? If so, please explain.
(Comment Box)
17. Have you worked with more than one state DOT on research? If so, how many different state DOTs?
(Comment Box)
18. What is your level of interest level in conducting research sponsored by the state DOT in the future?

(Rating Scale)

19. Which of the following state DOT divisions do you feel could benefit from research?

- a. Aeronautics
- b. Construction
- c. Environmental
- d. Geotech
- e. Human Resources
- f. Hydraulics and Hydrology
- g. Information Technology
- h. Maintenance
- i. Materials, pavement, etc.
- j. Planning
- k. Safety
- l. Structures
- m. Traffic Operations
- n. Other

20. From this list of innovation areas, which should be prioritized based on potential for translation of research to DOT practice? Place a number next to each priority. (1 = high and 5 = low priority)

Innovation Area	1	2	3	4	5
Administration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Aviation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bridges and Other Structures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Construction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cyber-physical Systems	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data/Information and IT	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earthquake/Seismic Design	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Economics/ Finance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Education and Training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Energy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Environment/Sustainability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Freight Transportation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hydraulics and Hydrology	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human Factor/Behavior	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Law/Policy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Maintenance and Preservation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Marine Transportation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Materials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Operations and Traffic Management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pavements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pedestrians and Bicyclists	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Pipelines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Planning and Forecasting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public Transportation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public Health	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rail	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Resilience and Sustainability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Security and Emergencies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Society	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Terminals and Facilities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

21. Are there any specific activities or focus areas (beyond those listed previously) that you feel could benefit from research based upon your experience? If so, please explain.
(Comment Box)
22. Have you experienced or are you aware of barriers to successful research collaboration with universities by state DOTs? If yes, please explain.
(Comment Box)
23. Do you have suggestions on how state DOTs could increase and/or improve collaborations with universities?
(Comment Box)
24. Do you have recommendations for improving implementation of research into practice by state DOTs?
(Comments Box)

Appendix D

Action Plan Matrix

Table 14 Action Plan Matrix

Goal 1: Enhance and streamline the research cycle processes and procedures	
Strategy 1.1: Improve the research needs identification process	<p>Short-term actions:</p> <ul style="list-style-type: none"> Identify best practices for the research identification process based on other state DOT and national research programs. Simplify the research needs statement template and information required to submit a research idea. Begin soliciting research ideas from additional external partners ideas, including Metropolitan Planning Organizations and Rural Planning Organizations. Ensure the process is clearly outlined and documented for all stakeholders submitting ideas. <p>Mid-term actions:</p> <ul style="list-style-type: none"> Fully integrate external partners into research idea solicitation through inclusion in communications and procedural requirements for calls. After the next solicitation cycle, determine successes and make improvements for the next iteration. Update policies and procedures accordingly.
Strategy 1.2: Enhance oversight of research activities	<p>Short-term actions:</p> <ul style="list-style-type: none"> Establish a standing Research Oversight Task Force (ROTF) that meets quarterly to oversee the research needs prioritization process, proposal selection process, and supports TDOT's involvement in national research programs. <p>Mid-term actions:</p> <ul style="list-style-type: none"> Establish a Technical Advisory Committee (TAC) for all research projects to provide additional direction and technical expertise. <ul style="list-style-type: none"> One TAC can run multiple projects with different people spearheading the effort.
Strategy 1.3: Clearly define roles and responsibilities	<p>Short-term actions:</p> <ul style="list-style-type: none"> Update the Research Manual outlining all current research processes and procedures. Develop clear guidelines regarding expectations for all research PIs, including the research proposal process and final report requirements. Develop training materials for Lead Staff outlining responsibilities and expectations for managing a research project, including a required training session for all staff sponsoring a project.

	<p>Mid-term actions:</p> <ul style="list-style-type: none"> • Set job descriptions for Research Office staff. • Determine roles and responsibilities for the research life cycle.
Strategy 1.4: Establish a consistent research cycle	<p>Short-term actions:</p> <ul style="list-style-type: none"> • Evaluate the academic calendar year to identify the best timeframe for research projects to kick off. • Develop a set schedule for Call for Research Needs Statements and the Call for Proposals to ensure all internal and external partners can prepare accordingly.
	<p>Mid-term actions:</p> <ul style="list-style-type: none"> • Work with Long Range Planning leadership to develop a cyclical communication plan.
	<p>Long-term actions:</p> <ul style="list-style-type: none"> • Assess research cycle frequency again with stakeholders. Update program as needed.
Strategy 1.5: Integrate an implementation and data management plan into the research cycle	<p>Short-term actions:</p> <ul style="list-style-type: none"> • Develop plans that can assist Lead Staff and the program in spurring implementation through guiding documents and materials that ask the right questions and determine feasibility. • Identify best practices for implementation and data management based on other state DOT and national research programs.
	<p>Mid-term actions:</p> <ul style="list-style-type: none"> • Develop a data management plan to establish how data for research projects will be managed and stored.
Goal 2: Develop and strengthen relationships with stakeholders	
Strategy 2.1: Foster existing University partner relationships	<p>Short-terms actions:</p> <ul style="list-style-type: none"> • Use leadership to emphasize the importance of research and to discuss its benefits. This will be particularly vital while the Research Office is still in transition.
	<p>Mid-term actions:</p> <ul style="list-style-type: none"> • Create opportunities for PIs and research teams to communicate the value of their research findings at both the state and national levels.
	<p>Long-term actions:</p> <ul style="list-style-type: none"> • Establish additional avenues to allow University partners to provide research and consulting services to the Department.

<p>Strategy 2.2: Expand outreach efforts with University partners to form new connections</p>	<p>Long-term actions:</p> <ul style="list-style-type: none"> • Host informational sessions to researchers who TDOT has yet to partner with to provide them an overview of the Research Program and opportunities for funding. • Visit Universities to interact with researchers in their element and provide on-campus guidance and assistance through meetings or seminars.
<p>Strategy 2.3: Provide opportunities for Federal partners to be involved in research activities</p>	<p>Short-term actions:</p> <ul style="list-style-type: none"> • Designate at least one FHWA representative to serve on the standing Research Oversight Task Force (once established). • Identify FHWA staff to serve on TACs to provide their technical expertise and ensure the research is informed by a federal perspective.
<p>Strategy 2.4: Increase national presence</p>	<p>Short-term actions:</p> <ul style="list-style-type: none"> • Communicate opportunities to TDOT staff to serve on TRB committees and TRB Cooperative Research Programs (NCHRP, ACRP, BTSCR, and TCRP) project panels through the most convenient and widely used channel available.
	<p>Mid-term actions:</p> <ul style="list-style-type: none"> • Identify research needs of national concern for research calls for cooperative research programs or lead a Transportation Pooled Fund (TPF) study. • Utilize the Research Oversight Task Force to identify and approve TPF studies for the Department to join.
<p>Goal 3: Increase the visibility and accessibility of the Research Program</p>	
<p>Strategy 3.1: Communicate research activities to TDOT staff</p>	<p>Short-term actions:</p> <ul style="list-style-type: none"> • Develop a bi-monthly research newsletter to be distributed to agency staff to report on completed research projects and relevant findings, implementation efforts, and general research activities. • Establish opportunities to allow University researchers to present and highlight their research findings to TDOT staff. • Create two-page summary reports for all projects completed July 2021 or later to increase the accessibility of research projects and relevant findings.
<p>Strategy 3.2: Improve the Research Program's web presence</p>	<p>Short-term actions:</p> <ul style="list-style-type: none"> • Review other state DOT research program websites to identify best practices to inform the program's own website structure.

	<ul style="list-style-type: none"> Review and update the Research Program’s website to ensure information is communicated in an organized, easily accessible, and visually appealing manner.
<p>Strategy 3.3: Develop a repository or library for reports, deliverables, and data</p>	<p>Mid-term actions:</p> <ul style="list-style-type: none"> Create a more searchable and user-friendly online research library to allow internal and external stakeholders to access TDOT’s research reports and other resources.
<p>Goal 4: Increase the effectiveness of the Research Program</p>	
<p>Strategy 4.1: Strengthen implementation efforts of research findings</p>	<p>Short-term actions:</p> <ul style="list-style-type: none"> Include implementation planning as a primary criterion for research prioritization process. Establish a test implementation process for research projects to guide Lead Staff and PIs on successfully implementing research results. <p>Mid-term actions:</p> <ul style="list-style-type: none"> Determine a formal implementation process and develop procedures to provide funding for implementation of valid research findings. Require each project to have an implementation plan in place, developed in coordination by Lead Staff, the TAC, and the PI/research team.
<p>Strategy 4.2: Evaluate implementation of research findings</p>	<p>Short-term actions:</p> <ul style="list-style-type: none"> Identify best practices for tracking implementation based on other state DOT research programs and the national research community. Develop a process to track and measure research implementation efforts. <p>Mid-term actions:</p> <ul style="list-style-type: none"> Conduct an analysis of research projects completed in the last 4 years to evaluate implementation trends and opportunities. <p>Long-term actions:</p> <ul style="list-style-type: none"> Regularly use implementation findings to determine best practices for the Research Office. Reports should be done to document the effectiveness of implementation efforts.

<p>Strategy 4.3: Track the performance of the Research Program</p>	<p>Mid-term actions:</p> <ul style="list-style-type: none"> • Identify best practices for establishing performance measures by evaluating successful efforts of other state DOT research programs and the national research community. • Establish a definition of performance for the Research Program. • Define which areas of activity are to be measured and how (qualitative or quantitative measures). • Develop performance measures for the program. Use SMEs and ROTF for guidance in developing these metrics for individual Divisions.
<p>Goal 5: Drive innovation and technology transfer efforts</p>	
<p>Strategy 5.1: Use national associations, programs, and forums to increase participation in innovative efforts</p>	<p>Short-term actions:</p> <ul style="list-style-type: none"> • Engage with TDOT’s State Transportation Innovation Council (STIC). • Emphasize the use of TPF studies to engage in innovative research and technology transfer efforts. • Support Every Day Counts (EDC) innovations pursued by the Department through research as applicable. <p>Mid-term actions:</p> <ul style="list-style-type: none"> • Incorporate these programs into the day-to-day operations of the Research Office. Ensure national presence of the Research Office for these programs.
<p>Strategy 5.2: Internally encourage innovation and technology transfer activities at TDOT</p>	<p>Short-term actions:</p> <ul style="list-style-type: none"> • Take advantage of existing University relationships from projects to further discuss options for technology transfer activities which can be supported by SPR Part B funds. <p>Mid-term actions:</p> <ul style="list-style-type: none"> • Develop procedures and set aside funds to provide funding for projects that test a new practice, equipment, or process. • Report on tech transfer improvements indicated through performance measures and feedback.