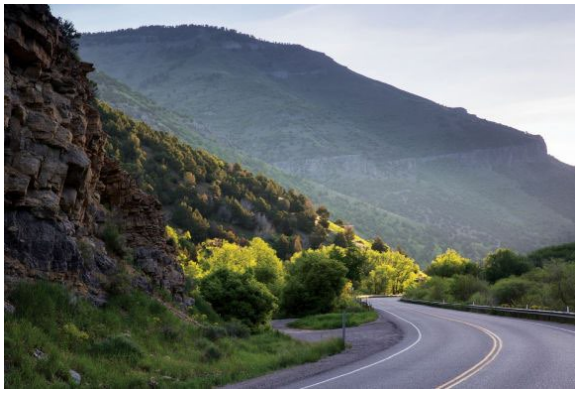
Western Transportation Research Consortium

Nevada DOT, North Dakota DOT, and Utah DOT 2024 Research Peer Exchange

FINAL REPORT

State Route 28, Incline Village, Nevada
(Source: Nevada DOT)

Four Bears Bridge, New Town, North Dakota
(Source: North Dakota DOT)



Logan Canyon National Scenic Byway, Logan Canyon, Utah
(Source: Utah DOT)

Submitted to:
Utah Department of Transportation
Lead State,
Western Transportation Research Consortium (WTRC)
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16. Abstract

Nevada Department of Transportation, North Dakota Department of Transportation and Utah Department of Transportation, in collaboration with the Western Transportation Research Consortium (WTRC), hosted a peer exchange on November 19 and 20, 2024, in Salt Lake City, Utah. The publication of this report fulfills the agencies' obligations to conduct a periodic peer exchange as part of the federal State Planning & Research program. The event focused on three themes: regional research coordination and collaboration; research and innovation program best practices; and how to best share research activities with DOT leadership. Participants of the two-day event included the staff from the WTRC members (the state DOTs of Alaska, California, Colorado, Idaho, Montana, Nebraska, New Mexico, Oklahoma, Texas, Washington State and Wyoming), the Louisiana Transportation Research Center and the Federal Highway Administration. Based on presentations and group discussions, participants shared what they saw as the strengths, challenges, and opportunities for the host agencies in the areas discussed, and takeaways for their home agencies.

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Host Agencies: Nevada Department of Transportation (NDOT), North Dakota Department of Transportation (NDDOT) and Utah Department of Transportation (UDOT).

Participating Agencies: Alaska Department of Transportation & Public Facilities (Alaska DOT&PF), California Department of Transportation (Caltrans), Colorado Department of Transportation, Idaho Transportation Department, Montana Department of Transportation, Nebraska Department of Transportation, New Mexico Department of Transportation, Oklahoma Department of Transportation, Texas Department of Transportation, Washington State Department of Transportation (WSDOT), Wyoming Department of Transportation, Louisiana Department of Transportation and Development, and the Federal Highway Administration (FHWA).

PEER EXCHANGE THEMES

Regional Research Coordination and Collaboration: In this first session, participants addressed challenges and best practices for a regional research consortium; this complemented business and planning discussions for the Western Transportation Research Consortium (WTRC).

Research and Innovation Program Best Practices: Attendees provided examples of program successes and best practices, strategies they have used to overcome obstacles, and current program challenges.

How to Best Share Research Activities with DOT Leadership: Research staff members discussed how their DOT's leadership interacts with their program, provided examples of sharing research activities with leadership and how they address barriers to engaging leadership.

TOP FINDINGS AND TAKEAWAYS

Regional Research Coordination and Collaboration

- **Create a process for WTRC research efforts.** Develop a research needs form and scoring sheet to assist members with selecting syntheses or other projects aimed at regional research needs.
- Undertake **quick turnaround synthesis** projects rather than applied research projects. A synthesis project can take six to nine months, while a research project can take two years or longer.
- **Leverage WTRC funds** by identifying projects that would be best served through the National Cooperative Highway Research Program (NCHRP) synthesis program or as WTRC efforts.
- Use a synthesis to **prepare a well-defined NCHRP problem statement from WTRC**.
- **Coordinate with other WTRC members to vote for NCHRP projects** that serve the interests of the region.

Research and Innovation Program Best Practices

- **Consider who may submit problem statements**, with the goal of keeping research focused on projects that are important to the agency. Some states prefer only agency subject matter experts or committed project champions. Other states prefer to cast a wider net at this stage.

- Identify topics of special interest to the agency, like **Colorado's Areas of Emphasis** to strategically focus on research that benefits the state.
- **Communicate about the research program** across the department to drive awareness and to build credibility.
- **Develop Research Fact Sheets** to explain various aspects of the research process to help department staff better understand how to engage with the research program.
- Focus on putting road ready research and innovations quickly into practice, as **North Dakota's Transportation Innovation Program (TRIP)** does.
- **Leadership is needed**; build relationships with subject matter experts and leadership through regular outreach that describes research benefits and opportunities to get involved.
- Summarize research projects, their results, and opportunities for implementation through research briefs like **Oklahoma's *Research Highlighters*** or **Nebraska's Research Readiness Level Assessments**.
- **Use short videos that highlight innovations**, such as North Dakota's **Innovation Spotlights,** to spread the news about successful innovations.
- **Develop pre-project surveys** to help project committee members and researchers focus on project results and project barriers.
- **Create dashboards that highlight research activities** for a quick and effective way to inform leadership and all DOT staff.
- Collect **performance measures** on the research program to keep moving forward.

How to Best Share Research Activities with DOT Leadership

- **Interact with DOT leadership in multiple ways** to remind leaders of what the research program can do for them and the agency. Consistent interaction will build awareness and trust.
- **Become a resource for DOT leadership.** View DOT leaders as subject matter experts on the agency's strategic goals to find new ways for research to benefit leadership.
- **Track benefits from staff membership on national committees** to provide valuable information to DOT leadership.
- Communicate about research projects and the benefits of the research program using consistent **branding and marketing**. Use multiple communication methods (such as emails, newsletters, research briefs, videos, and webinars) to reach the widest audience.
- Increase awareness among staff using creative solutions **like Montana's research project poster scavenger hunt**.
- **Use dashboards to quickly and easily communicate information** to leadership and all staff.
- **Strengthen relationships with those who have direct access to leaders** so they can advocate on behalf of the research program.

MEETING INTRODUCTION AND OVERVIEW

NDOT, NDDOT and UDOT, in collaboration with the WTRC, hosted a peer exchange on November 19 and 20, 2024 in Salt Lake City, Utah. The publication of this report fulfills the agencies' obligations to conduct a periodic peer exchange as part of the federal State Planning & Research program. The peer exchange was funded by the WTRC pooled fund.

The peer exchange focused on three themes:

- Regional Research Coordination and Collaboration
- Research and Innovation Program Best Practices
- How to Best Share Research Activities with DOT Leadership

For each theme, participants shared their own agency's experiences and noted the host agencies' strengths and opportunities for enhancement.

PEER EXCHANGE PARTICIPANTS

The peer exchange included representatives from across and beyond the western region of the United States in order to represent a variety of interests and perspectives. Participants included NDOT, NDDOT, UDOT, 11 additional state DOTs representing the membership of WTRC, one guest state DOT from the southeastern region of the United States, and FHWA.

The following individuals participated in one or more of the sessions.

Host State DOTs

Nevada Department of Transportation
- Lucy Koury, Assistant Chief, Research

North Dakota Department of Transportation
- T.J. Murphy, Research Program Manager

Utah Department of Transportation
- Carlos Braceras, Executive Director
- Winston Inoway, Innovation and Implementation Manager
- Cameron Kergaye, Director of Research and Innovation
- David Stevens, Research Program Manager
- Kevin Nichol, Research Project Manager

Participating WTRC State DOT Research Programs

Alaska Department of Transportation & Public Facilities
- Cristina DeMattio, Acting Program Manager, Research, Development & Technology Transfer

California Department of Transportation
- Joe Horton, Chief, Office of Safety Innovation and Cooperative Research
- Sang Le, Cooperative Research Specialist
- April Nitsos, Deputy Division Chief, Research & Innovation

Colorado Department of Transportation
Steve Cohn, Director, Office of Applied Research

Idaho Transportation Department
Amanda Laib, Senior Research Analyst

Montana Department of Transportation
Rebecca Ridenour, Research Supervisor

Nebraska Department of Transportation
Mark Fischer, Research Program Manager

New Mexico Department of Transportation
Ed Halbig, Research and Climate Bureau Chief

Oklahoma Department of Transportation
Gary Hook, Engineering Manager

Texas Department of Transportation
Kevin Pete, Division Director, Research and Technology Implementation

Washington State Department of Transportation
Jon Peterson, Research Manager, Multimodal

Wyoming Department of Transportation
Enid White, Research Manager

Guest DOT

Louisiana Department of Transportation and Development
Tyson Rupnow, Associate Research Director, Louisiana Transportation Research Center (LTRC)

Federal Highway Administration

Zane Pulver, Utah Division Office

Staff from consulting firm CTC & Associates coordinated, facilitated and documented the peer exchange.

FORMAT

Participants (Figure 1) attended the in-person peer exchange at Radisson Hotel Downtown in Salt Lake City, Utah. The meeting agenda for the two-day event is included as Appendix A to this report.

Figure 1. Meeting Participants

From left to right: Steve Cohn, Lucy Koury, Enid White, Cristina DeMattio, Sang Le, T.J. Murphy, Jon Peterson, Ed Halbig, Tyson Rupnow, Kevin Pete, Joe Horton, Cameron Kergaye, Amanda Laib, Gary Hook, April Nitsos, Zane Pulver, Mark Fischer, Rebecca Ridenour, David Stevens, Winston Inoway, and Kevin Nichol.

TOPIC DISCUSSIONS

Participants discussed research-related themes of specific interest to the three host agencies. Each session included prepared presentations from the hosts, as well as additional presentations from participating states.

PEER EXCHANGE THEME 1—REGIONAL RESEARCH COORDINATION AND COLLABORATION

OVERVIEW

On the first day of the peer exchange, participants focused on the establishment and business of WTRC. Attendees refined the consortium charter and operating procedures, reviewed the consortium website, identified areas of potential research and additional consortium activities, and planned upcoming in-person meetings. This day also afforded an opportunity to explore best practices for regional research coordination and collaboration.

PRESENTATIONS

Joe Horton, Caltrans, reviewed the findings of the AASHTO Research Advisory Committee (RAC) Region 4 peer exchange in 2022, which were the impetus for the creation of WTRC. Tyson Rupnow, LTRC, provided guidance and best practices from his experience with the Southeast Transportation Consortium.

Appendix B. RAC 4 Peer Exchange: Research Collaboration to Leverage Funding, Joe Horton, Caltrans

Appendix C. Southeast Transportation Consortium, Tyson Rupnow, LTRC

DISCUSSIONS AND FINDINGS

Attendees identified opportunities for WTRC, including best practices, research topics and additional consortium activities.

TOP IDEAS are those that were highlighted by several participants.

Consortium Best Practices

- **Conduct research peer exchanges and WTRC meetings simultaneously** to use time and money efficiently.
- **Work with LTAPs** to coordinate future meetings and peer exchanges.
- Consider the **great networking opportunities** that WTRC meetings and peer exchanges can offer, especially for new or young RAC members.
- **Complete research efforts and prepare new ideas prior to in-person WTRC meetings** so the members can discuss next steps for current and future research at the meetings.
- **Invite subject matter experts to make technical presentations** on topics of interest to WTRC members.
- Provide an **online forum for dialogue between subject matter experts** from member agencies.
- **Consider unfunded research** from state members for WTRC research syntheses or projects.

- **Share member innovation activities** to better coordinate regional innovation efforts.

TOP IDEAS:

- **Create a process for WTRC research efforts.** Develop a research needs form and scoring sheet to assist members with selecting syntheses or other projects aimed at regional research needs.
- Undertake **quick turnaround synthesis** projects rather than applied research projects. A synthesis project can take six to nine months, while a research project can take two years or longer.
- **Leverage WTRC funds** by identifying projects that would be best served through the NCHRP synthesis program or as WTRC efforts.
- Use a synthesis to **prepare a well-defined NCHRP problem statement from WTRC**.
- **Coordinate with members to vote for NCHRP projects** that serve the interests of the region.

PEER EXCHANGE THEME 2—RESEARCH AND INNOVATION PROGRAM BEST PRACTICES

PRESENTATIONS

To kick off discussion on program best practices, the three host states and six participating states gave presentations on efforts at their agencies. These are reproduced as appendices to this report.

- Appendix D. Utah DOT – Research Program Best Practices: Utah Research Prioritization, David Stevens, UDOT
- Appendix E. North Dakota DOT – Research Program Summary, TJ Murphy, NDDOT
- Appendix F. Nevada DOT – Research and Innovation Program Best Practices, Lucy Koury, Nevada DOT
- Appendix G. Colorado DOT – Best Practices, Steve Cohn, Colorado DOT
- Appendix H. Idaho TD – Research and Innovation Programs, Amanda Laib, Idaho TD
- Appendix I. Nebraska DOT – Research and Innovation Program Best Practices, Mark Fischer, Nebraska DOT
- Appendix J. Oklahoma DOT – Research and Innovation Program Best Practices, Gary Hook, Oklahoma DOT
- Appendix K. Wyoming DOT – Western Transportation Research Consortium: Wyoming, Enid White, Wyoming DOT

Tyson Rupnow, LTRC, did not use slides for his presentation.

DISCUSSION AND FINDINGS

Attendees shared successes and best practices from their programs, as well as current challenges and the strategies they have successfully used to address them. These comments were collected during group discussions and in report-out forms that participants completed and submitted after the session.

Below are the best practices and ideas shared. **TOP IDEAS** are those that were highlighted by several participants.

Successes and Best Practices

- Colorado DOT
  - **Areas of Emphasis** strategically focus on research that benefits Colorado.
  - A **library is a useful resource** to support the research program and all DOT staff.
  - **Use research managers as technical experts** who can support research projects within their area of technical expertise.
- Idaho TD
  - A recent **successful FHWA Program Review** highlighted Idaho's well-documented research management process and robust final report process.

    - An in-house **process for developing and advertising RFPs and selecting researchers produced more proposals** from a wider pool of researchers.
    - **Pre-project surveys** help project committee members and researchers **focus on project results and barriers.**

- Louisiana Transportation Research Center
    - The center has a **robust research staff** who are committed to their work.
    - **A dedicated librarian** helps drive the success of LTRC's research program.

- Nebraska DOT
    - An **annual research program cycle** is important for success.
    - Using a modification of FHWA's **Research Readiness Level Assessment** framework helps Nebraska DOT **identify the immediate next steps for implementation** follow up. One-page write-ups summarize the research project and provide implementation recommendations.

- Oklahoma DOT
    - The 2024 **Oklahoma Transportation Research Day** involved 300 participants. The research program receives 30-40 problem statements annually.
    - A **research project flowchart streamlines the research process** for everyone.
    - A **two-page *Research Highlighter***, which summarizes a research project's process, results and potential benefits, is produced for every completed project.
    - The **Oklahoma Transportation Library** provides valuable support to the research program through transportation resources, technology transfer and literature reviews.

- Wyoming DOT
    - **Stay ahead of the curve** on state and local statutes, standards, best practices, and trends.
    - The research program **offers training** on intellectual property, Section 508, artificial intelligence, and federal regulations, such as Code of Federal Regulations Title 2, Part 200 on administrative, cost and audit requirements.
    - To keep progressing, **evaluate the research program every few years**.
    - Identify performance metrics and **measure the research program's performance.**
    - **Draft program manuals** so that information will be available for the future.

Challenges and Strategies

- Colorado DOT
    - The procurement process is long, complex and requires a lot of research staff effort. **Structured procurement interactions** can alleviate some issues.
    - Use **a formal implementation process** to help track and quantify implementation activities and benefits.
    - Address project champion turnover and lack of interest through **outreach to potential new champions and by securing managers' support of champions**.
    - **"Smile through the pain"** of corporate changes.
- Idaho TD
    - Most research project ideas are generated from the bottom up, so it's important to **align research priorities with the department's strategic goals.**
    - **Hire dedicated research project managers to alleviate the workload** of subject matter experts who pull double duty by managing research projects.
    - Competitively bid research projects require time from research program staff project champions. **Document templates help streamline the process**.
    - To create support for implementation, **build implementation into project tasks and deliverables**. Rely on project sponsors to champion implementation.
- Louisiana Transportation Research Center
    - **Implementing research results is the biggest challenge.**
- Nebraska DOT
    - **Limited DOT staff** and coordination with external researchers can slow down the research process. The research program strives to make things as easy as possible.
    - Research staff go onsite every year to **follow up on project implementation**, which takes up time.
    - Uploading project information to the SharePoint Site is done by a position with **a lot of turnover** so the process gets hung up.
- Oklahoma DOT
    - Keeping project champions **engaged throughout the research project** is a challenge.
    - Researchers don't always meet their **project deadlines**, which slows down the project.
    - **Meeting internal target dates** for annual activities timeline can be difficult.

- Wyoming DOT
    - **Get buy-in from DOT staff** so the program can fully support the agency.
    - Research program staff needs **clearly outlined duties** for peak effectiveness.

TOP IDEAS:

- **Consider who may submit problem statements**, with the goal of keeping research focused on projects that are important to the agency. Some states prefer only agency subject matter experts or committed project champions. Other states prefer to cast a wider net at this stage.
- Identify topics of special interest to the agency, like **Colorado's Areas of Emphasis** to strategically focus on research that benefits the state.
- **Communicate about the research program** across the department to drive awareness and to build credibility.
- **Leadership is needed**; build relationships with subject matter experts and leadership through regular outreach that describes research benefits and opportunities to get involved.
- Summarize research projects, their results, and opportunities for implementation through research briefs like **Oklahoma's *Research Highlighters*** or **Nebraska's Research Readiness Level Assessments**.
- **Develop pre-project surveys** to help project committee members and researchers focus on project results and project barriers.
- Collect **performance measures** on the research program to keep moving forward.

PEER EXCHANGE THEME 3—HOW TO BEST SHARE RESEARCH ACTIVITIES WITH DOT LEADERSHIP

PRESENTATIONS

To kick off discussion on sharing research activities with leadership, the three host states and six participating states gave presentations on efforts at their agencies. These are reproduced as appendices to this report.

- Appendix L. Utah DOT – How to Best Share Research Activities with DOT Leadership, Cameron Kergaye, Utah DOT
- Appendix M. North Dakota DOT – How to Best Share Research Activities with DOT Leadership, T.J. Murphy, North Dakota DOT
- Appendix N. Nevada DOT – How to Best Share Research Activities with DOT Leadership, Lucy Koury, Nevada DOT
- Appendix O. Alaska DOT&PF – Sharing Research Activities with DOT Leadership, Cristina DeMattio, Alaska DOT&PF
- Appendix P. Caltrans – Strategies for Communicating Research Activities to Leadership, April Nitsos, Caltrans
- Appendix Q. Montana DOT – Montana Research, Rebecca Ridenour, Montana DOT
- Appendix R. New Mexico DOT – NMDOT…Take Me to Your Leaders, Ed Halbig, New Mexico DOT
- Appendix S. Texas DOT – WTRC Meeting and Peer Exchange, Kevin Pete, Texas DOT
- Appendix T. Washington State DOT – Western Transportation Research Consortium – How to Best Share Research Activities with DOT Leadership, Jon Peterson, Washington State DOT

DISCUSSION AND FINDINGS

Attendees shared snapshots of how leadership typically interacts with their research programs, successful interactions with leadership, and current challenges to interacting with leadership and strategies to address them. These comments were collected during group discussions and in report-out forms that participants completed and submitted after the session.

Below are the best practices and ideas shared. **TOP IDEAS** are those that were highlighted by several participants.

Successes and Best Practices

- Alaska DOT&PF
    - **Communicate about research** through quarterly updates, project webinars, final reports and newsletters**.**
- Caltrans
    - Caltrans pursues new, **innovative communication strategies to share the research program** with leadership, stakeholders and the rest of Caltrans. These include:

        - Videos on individual research projects and research program highlights
        - Short written publications on research in progress and completed research
        - Webinars on research projects and the research program, open to all staff
        - Fact sheets and posters on research topics
        - Reports on accomplishments, pooled funds, the TRB Annual Meeting and Caltrans facts
    - **Caltrans repurposes resources** to address research and innovation needs through their Implementation Program and Innovation Team (iTeam).

- Montana DOT
    - **Display research project posters throughout the agency**. Develop a scavenger hunt and ask questions based on the posters. Offer small prizes. This will get staff to interact with the posters, and it provides information on the research program.
    - **Share research final presentations to the whole department**, not just the program panels.
    - **Post High Value Research projects on the DOT website** and provide the link in a newsletter story. This may inspire new project ideas.

- New Mexico DOT
    - To get staff involved in submitting research projects, **hold a webinar on the funding**. Send a teaser email that a webinar is happening. Send a follow up email with a bit more information. Email the full presentation right before the webinar, and then conduct the webinar. This process will produce a well-attended webinar with lots of Q&A and result in many project submissions.

- Texas DOT
    - When Research staff meets with DOT leadership, they **focus on one or two hot topics** or projects in an area of interest, **share program benefits** and impacts, and **present research awards** to project champions.
    - **Develop a dashboard to share research program and division activities quarterly**. The information provides leaders with insight into the research program.

- Washington State DOT
    - The agency defines technology transfer as **sharing results of WSDOT-funded research with WSDOT staff**, its primary audience.
    - The **Webinar Wednesdays series** shares research findings to encourage technology transfer and implementation of research results. Attendance has increased since it began in 2017.

- WSDOT's electronic newsletter, TRAC e-News, **highlights information and projects** to reach a wider audience.
- **Good relationships** with subject matter experts, researchers, panel members, and management **makes them research champions**.

Challenges and Strategies

- Alaska DOT&PF
  - Getting direct feedback from DOT leaders is a challenge. **Developing dashboards to quickly communicate information** about the research program will help**. Use the department's strategic goals as guidance.**
- Caltrans
  - It can be hard to **get more time with leadership**.
- Montana DOT
  - **Increase employee awareness** of the research program **through branding and marketing**. Explain how research can benefit staff in ways they may not be aware of through Lunch & Learns, biweekly announcements, posters and direct communication with specific work units.
- New Mexico DOT
  - While research may not have direct access to DOT leadership, they do have access to staff that directly interact with leaders. **Use these relationships to let leadership know that research is accessible, available, and capable**.
- Texas DOT
  - Increase awareness of the research program through **webinars, videos, division meetings, news posts, and social media**.
  - **Secure booth space at conferences** to show specific research projects and activities that benefit the conference-sponsoring division.
- Washington State DOT
  - Determine the **effectiveness of how research deliverables** are communicated.
  - Understand the **impact of research results beyond the project team**.
  - **Communicate research deliverables** within the agency constraints around the website and social media.

TOP IDEAS:

- Communicate about research projects and the benefits of the research program using consistent **branding and marketing**. Use multiple communication methods (such as emails, newsletters, research briefs, videos, and webinars) to reach the widest audience.
- Build awareness and trust through regular interaction and sharing with leadership.
- Increase awareness among staff using creative solutions **like Montana's research project poster scavenger hunt**.
- **Use dashboards to quickly and easily communicate information** to leadership and all staff.
- **Strengthen relationships with those who have direct access to leaders** so they can advocate on behalf of the research program.

OPPORTUNITIES FOR HOST STATES

A measure of a successful peer exchange is how the host states learn from others and identify the tools and practices that may solve their problems and help grow their programs. Throughout the peer exchange and in submitted report-out forms, attendees praised the many impressive achievements of each host state's research program and highlighted strategies to address the challenges that each agency had presented.

NEVADA DOT

Nevada's Strengths

Attendees noted the many ways that NDOT's research program excels:

- Nevada **cultivates strong relationships with its project champions through active communication**.
    - NDOT gave a department-wide presentation to inform staff about the research program.
    - Nevada **frequently touches base with project champions though direct contact**, including one-on-one conversations.
    - By being **friendly and reliable**, NDOT research staff have proven to be a valuable resource to the department.
    - NDOT **emphasizes follow-through and follow-up** with agency staff.
    - Nevada research staff **attends events and conferences** as another way to interact with agency staff.
- Nevada **admits specific knowledge gaps** and works to fill them.
- By revamping its problem statement and solicitation and proposal review processes, Nevada is able to **encourage researchers to get insight on research needs directly from project champions**.
- NDOT removes champions from the evaluation committees, **allowing them to talk freely** with potential researchers about their needs.
- Using **Research Fact Sheets** to explain various aspects of the research process helps department staff better understand how to engage with the research program.
- **Holding short, in-person, targeted meetings** with research program management helps **to educate leaders** on what the research program does and how it benefits leadership and the agency.
- Nevada works to **get buy-in from their direct management** to break down a gatekeeper mentality and open up the lines of communication between the research program and leaders.

Opportunities for Nevada

Attendees also offered suggestions to enhance NDOT's research program:

- To understand the impact of the research program, Nevada might consider **tracking implementation and research successes.**
- NDOT may want to consider **investigating why fewer or lower quality ideas are submitted** some years and **develop new methods of internal outreach**.
- **Joining more pooled funds** is a good investment for funds.
- Nevada staff should **maintain their enthusiasm** for research and continue to **express their gratitude for continued engagement** with the DOT leaders.
- **Consider DOT leaders to be subject matter experts on the agency's strategic goals** to find new ways for research to benefit leadership.

NORTH DAKOTA DOT

North Dakota's Strengths

Attendees noted the many ways that NDDOT's research program excels:

- North Dakota's **Transportation Innovation Program (TRIP) focuses on putting road-ready research and innovations quickly into practice**. NDDOT has moved away from traditional research project submissions toward technology readiness.
    - **Any NDDOT staff member can submit an idea** to TRIP.
    - To **ensure submissions are at the correct readiness phase**, they are required to be at levels 6-9 on FHWA's Technology Readiness Levels (TRL) scale.
    - There is **a different theme every year** for TRIP submissions.
- **Innovation Spotlights – short videos that highlight innovations** – are an excellent way to spread the news about successful NDDOT innovations.
- North Dakota is able to **do a lot with limited staff**.
- Because NDDOT is a small, connected organization, NDDOT research staff **have a strong, two-way relationship** with leadership.
- North Dakota **connects with DOT leadership in several ways**: annual RAC meeting, annual research program approval, attending the TRB Annual Meeting, NCHRP research cycle, TRIP submissions approval and responding to leadership requests.
- Use **Research One Pagers** for easy digestion of complex research for busy leaders.

Opportunities for North Dakota

Attendees also offered suggestions to enhance NDDOT's research program:

- Work with areas of the DOT that are **currently underserved by the research program**.
- To address the lack of DOT staff, investigate **using subject matter experts from regional or local transportation agencies** for research projects.
- **Develop a dashboard** to quickly communicate information about the research program to leadership.

UTAH DOT

Utah's Strengths

Attendees noted the many ways that UDOT's research program excels:

- Utah has **a clear research process and timeline** that is familiar to agency staff.
- UDOT **relies on subject matter experts to prioritize research**, rather than senior leadership.
- While researchers can co-author a problem statement, **only a Utah champion can submit a problem statement**.
- The **virtual Research Workshop**, held annually, identifies and prioritizes research needs.
- To reduce the time burden on UDOT staff, problem statement presentations have been eliminated in favor of **written questions and answers distributed prior to the workshop**.
- Utah uses **spreadsheets that are shared by a subject group** to streamline the process of evaluating problem statements.
- **Dashboards highlight research activities** for a quick and effective way to inform leadership.
- Research staff **interacts with DOT leadership in multiple ways:** semi-annual meetings, post-TRB Annual Meeting follow up, annual research program approval, emails and newsletter articles, an annual Innovation Awards luncheon and responding to on call research requests.
- **UDOT tracks benefits from staff membership on national committees** to provide valuable information to DOT leadership.

Opportunities for Utah

Attendees also offered suggestions to enhance UDOT's research program:

- Utah can **increase opportunities for subject matter expert engagement** through a **research round-up** event where DOT and university staff can meet and discuss ideas. A **tailgate talk**, where subject matter experts gather to informally discuss topics of mutual interest, is another engagement method.

- **New methods of communicating with leadership**, such as webinars, videos and other presentations, may increase knowledge of the research program.
- To ensure maximum impact, **structure meetings with DOT leaders to share important information** and remind them of how the research program benefits the department.

APPENDIX A. WTRC 2024 MEETING AND PEER EXCHANGE AGENDA

Western Transportation Research Consortium

Meeting and Peer Exchange Agenda

November 19-20, 2024 | Radisson Hotel Salt Lake City Downtown | Salt Lake City, Utah

Updated November 16, 2024

All times are **Mountain** — Breaks will be taken as needed

Tuesday, November 19

Time	Activity
7:30 a.m.	Continental Breakfast available in the meeting room
8:00 to 8:45	**Utah DOT Executive Director Welcome**, Carlos Braceras, UDOT **PEER EXCHANGE THEME 1: REGIONAL RESEARCH COORDINATION AND COLLABORATION** **Call to Order**, Cameron Kergaye, UDOT **Lead State Welcome,** Cameron Kergaye and David Stevens, UDOT **Meeting Goals**, Brian Hirt, CTC & Associates **Introductions**, All
8:45 to 9:00	**2022 Region 4 Peer Exchange Findings** — Joe Horton, 15 minutes
9:00 to 9:40	**UDOT and CTC Roles** **Transportation Pooled Fund (TPF) Management** • Budget Review — David Stevens; Kirsten Seeber, CTC & Associates • TPF deadlines • Interim reports
9:40 to 10:00	Break
10:00 to 10:20	**Southeast Transportation Consortium — Best Practices and Guidance**, Tyson Rupnow, Louisiana DOTD
10:20 to 11:20	**Charter and Operating Procedures** • Draft for discussion • Vote to ratify or determine other next steps if necessary
11:20 to 12:00 p.m.	**AASHTO RAC Region IV Meeting**, Kevin Pete, Texas DOT
12:00 to 1:00	**Working Lunch**

(Continued)

Western Transportation Research Consortium

Meeting and Peer Exchange Agenda

November 19-20, 2024 | Radisson Hotel Salt Lake City Downtown | Salt Lake City, Utah

Updated November 16, 2024

All times are **Mountain** — Breaks will be taken as needed

Tuesday, November 19, continued

Time	Activity

1:00 to 2:00	**Research Identification — Year 1**
	• Review parameters for research topics to be considered
	• Brainstorm and prioritize quick-turnaround research
	  ○ Compile ideas and Menti vote
	  ○ Double-check against national research efforts
	  ○ Steps, timeline and deliverables

2:00 to 2:30	**Research Coordination — Year 2 and Forward**
	• Need identification and statement development
	  ○ SME meetings/network
	  ○ Other paths
	• NCHRP voting and coordination
	• Coordinating with RAC Region IV
	• Other grants and upcoming opportunities

2:30 to 2:50	Break
2:50 to 3:10	**WTRC Website** • Policies and procedures • Desired functionality
3:10 to 3:40	**Additional WTRC Activities** • Technical presentations on consortium-requested topics • Communication and outreach • Liaison with other state, regional and national committees • Other topics
3:40 to 4:00	**Future Planning** • Set schedule for quarterly meetings • Identify Year 2 WTRC Meeting: location and month • Identify Year 2 Peer Exchange: co-hosts; format
4:00	**Adjourn Day 1,** Cameron Kergaye

Western Transportation Research Consortium

Meeting and Peer Exchange Agenda

November 19-20, 2024 | Radisson Hotel Salt Lake City Downtown | Salt Lake City, Utah

Updated November 16, 2024

All times are **Mountain** — Breaks will be taken as needed

Wednesday, November 20

Time	Activity
7:30 a.m.	Continental Breakfast available in the meeting room
8:00 to 8:15	**Welcome, Meeting Goals**, Cameron Kergaye and Brian Hirt • Menti report-out preparation • Report-out form for note-taking (Optional)

8:15 to 11:30	**PEER EXCHANGE THEME 2. RESEARCH AND INNOVATION PROGRAM BEST PRACTICES**
	• Presentations and perspectives — successes and challenges, and how did you get there? (15-20 minutes each, including Q-and-A)
	  ○ Presentations from UT, ND and NV
	  ○ Presentations from CO, ID, LA, NE, OK and WY
	• Round table discussion with perspectives from remaining states and group Q&A
	• Menti-based report-out
	  ○ Where host states are excelling
	  ○ Opportunities for improvements for host states
	  ○ Great ideas from peers to bring home

11:30 to 12:30 p.m.	**Working Lunch**

12:30 to 4:00	**PEER EXCHANGE THEME 3. HOW BEST TO SHARE RESEARCH ACTIVITIES WITH DOT LEADERSHIP**
	• Presentations and perspectives — successes and challenges, and how did you get there? (15-20 minutes each, including Q-and-A)
	  ○ Presentations from UT, ND and NV
	  ○ Presentations from AK, CA, MT, NM, TX and WA
	• Round table discussion with perspectives from remaining states and group Q&A
	• Menti-based report-out
	  ○ Where host states are excelling
	  ○ Opportunities for improvements for host states
	  ○ Great ideas from peers to bring home

4:00	**Adjourn Meeting,** Cameron Kergaye

APPENDIX B. CALTRANS – RAC 4 PEER EXCHANGE: RESEARCH COLLABORATION TO LEVERAGE FUNDING

FINDINGS

RAC 4
PEER EXCHANGE
Research Collaboration to Leverage Funding

California Department of Transportation (Caltrans) hosted a two-day Peer Exchange

- Caltrans hosted a two-day Peer Exchange on October 5 and 6, 2022
- Goal was to identify opportunities for research collaboration to leverage funding sources.
- Participants included leadership from the western state members of the American Association of State Highway and Transportation Officials (AASHTO) Research Advisory Committee (RAC), Region 4.
- In total, 12 of the 18 RAC 4 member states departments oftransportation (DOTs) were represented –California, Idaho, Washington, Oklahoma, Alaska, Arizona, Montana, North Dakota, Texas, New Mexico, Oregon, and Utah.

Session Themes

- Peer Exchange participants responded to the questions posed by Caltrans prior to the event.
- What is the size of your research program in funding?
- What are your Agency's strategic priorities?
- What are issues that you are facing that have a regional impact, (i.e., wildfires, drought, equity, innovation delivery)?
- How can RAC4 help you with your national engagement needs? National engagement includes engagement with other states, AASHTO, TRB, NCHRP, Tribal Councils and others.
- What other issues should we be discussing as a Region?.

Size of Research Program

- Largest around $30M
- Smallest around $2.5M
- Average for twelve states around $8.7M

Agency's strategic priorities

- Equity
- Safety
- Technology & Innovation
- Workforce Development
- Multimodal Transportation
- Efficient Operations
- Climate Action

Issues that have a regional impact?

- Climate Change
- Traffic/Pedestrian Fatalities
- Workforce Management
- Service Delivery
- Funding available for research and development
- DEI
- Aging infrastructure

Session Themes (detail)

4. How can RAC4 help you with your national engagement needs?

- Prioritize RAC 4 issues and focus on high priorities for information sharing, communication, and project development.
- Pooling regional resources and funds where possible.
- Collaboration on NCHRP projects, for example:
- The formation of an Alliance Of States For FHWA/US DOT Issues.
- Implementation of TRB AM Presented Research.
- Leading agency for Transportation Pooled Fund (TPF) studies,
- To the extent practical maximize the flexibility in the use of federal funds for research
- Help maintain the autonomy/independence of the states in the administration of our SPR research programs.
- Support and coordinate our ability to leverage key NCHRP and other TRB work products.
- Support the integration of completed SPR and State research findings into updates of AASHTO specification and guidance.
- Engagement in policy development/rule making agencies are expected to carry out/perform.
- Defining congressional intent on program management.
- Creating a network of peers, subject matter experts and contractors.
- Develop pooled fund projects aimed at addressing regional issues/needs.
- Innovation program AASHTO Regional Associations cohesion with research.

Issues we should we be discussing as a Region

Partial list:

- Improvement of research implementation.
- How to adopt new innovations and share best practices.
- How best to coordinate with our University Transportation Centers (UTCs).
- Brainstorming In-kind support would allow us to explore and leverage our funds for greater outcomes.
- RAC 4 Exclusive Surveys.
- State Transportation Legislation.
- PI Support For Proposed Pooled Fund Projects.

Emerging themes of interest

- Development of a Western Transportation Research Consortium
- Funding Strategies
- Working with UTCs
- Technology Infrastructure
- RAC 4 Knowledge Sharing
- DEI
- Talent Management

QUESTIONS?

APPENDIX C. LTRC – SOUTHEAST TRANSPORTATION CONSORTIUM

Southeast Transportation Consortium

Tyson D. Rupnow, Ph.D., P.E.
Associate Director, Research

LOUISIANA DEPARTMENT OF TRANSPORTATION & DEVELOPMENT

LOUISIANA TRANSPORTATION RESEARCH CENTER

STC Background

- AASHTO RAC Region 2 Members
  - Originally created to share knowledge, best practices, and research collaboration
  - Funded through pooled fund process
  - Funded multiple projects of interest to RAC Region 2

STC – Phase II

- Members expressed desire to continue meeting for collaborative efforts
  - Statements to the effect of, "The STC Annual Meeting serves as a mini-peer exchange
- Led to exploration of using STD for multi-state peer exchanges
  - In conjunction with STC Annual Meeting
  - Location to rotate between states

STC – Phase II Objectives

- Plan and conduct meetings to establish research priorities, share findings, and exchange information in a peer exchange setting
- Discuss and screen research/synthesis projects
- Conduct projects
- Hold multi-state peer exchanges (3-states maximum) on a topic of their choosing
- Communicate and disseminate research results and innovative practices
- Communicate the impact of STC to national leaders

STC – Phase II Cost

- $15,000 per state per year
- Allows one traveling participant per meeting per state
- Host state may have others attend

STC – Phase II Logistics

- Piloted peer exchange (FL and LA) with results published within 4 weeks of completion
- Host states get to choose additional members (RAC Regions, SME's, etc.)
- First Meeting in March 2023 in Greenville, SC
- Second Meeting – May 2024 in Lexington, KY

Highlights

- STC is a proved model for Region 2
- Makes for a streamlined peer exchange process
  - "Standardized" peer exchange format for Region 2
  - Larger audience allows for a greater flow of information
  - Takes the majority of the effort out of single state sole planning by participating states
- Partner with hosting state LTAP group for hotel block, breakfast/lunch food and beverages
- GREAT networking opportunity for a young/new RAC Member

Questions

APPENDIX D. UTAH DOT – RESEARCH PROGRAM BEST PRACTICES: RESEARCH PRIORITIZATION

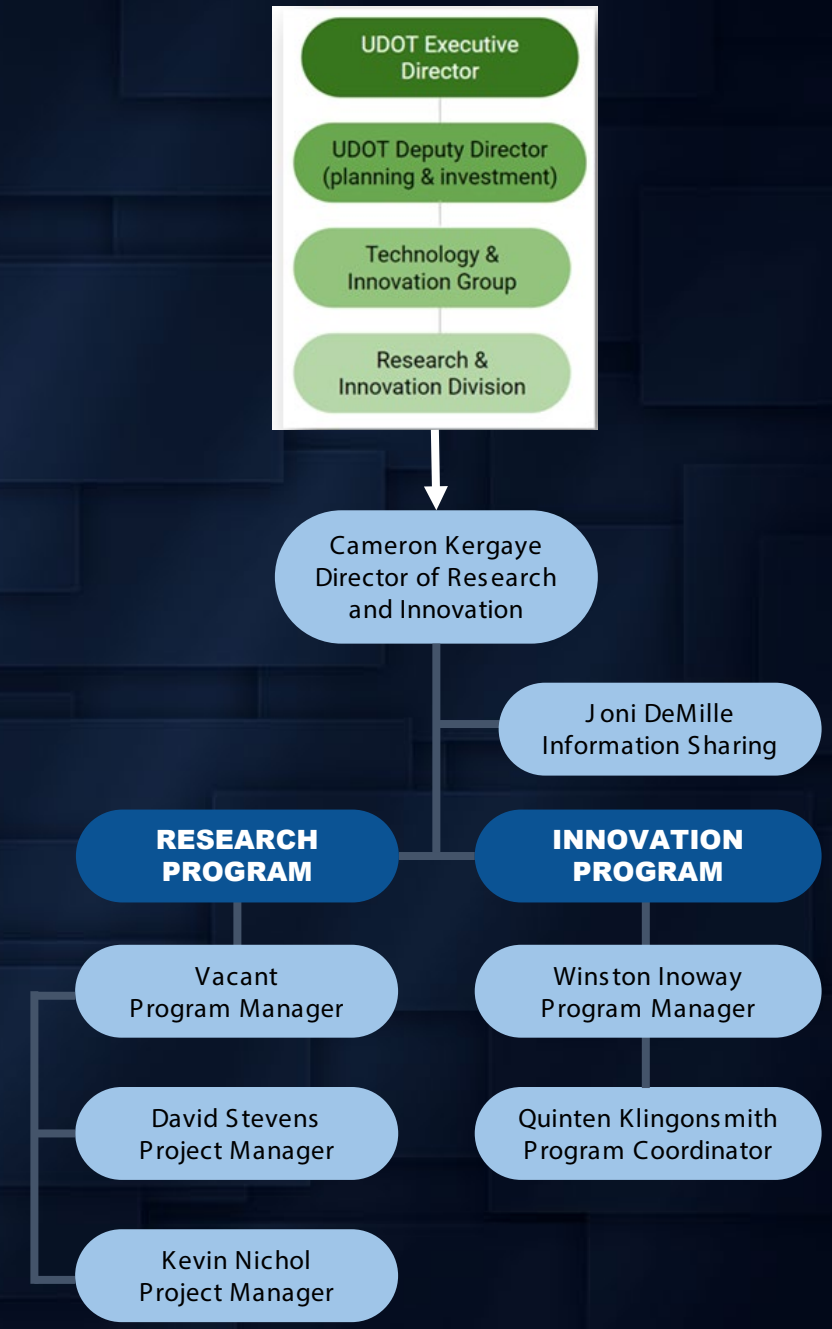
Research Program Best Practices: UDOT Research Prioritization

David Stevens, UDOT Research & Innovation

WTRC Peer Exchange, November 20, 2024

Overview of Program

- Research & Innovation Division: 7 people
  - Primarily SPR-B funded research projects
  - Share UDOT innovations
- Consultant support in both R & I
- Traditional research projects
  - 81 active projects
  - $1.2M per year for new projects
  - $20K to $100K per project
- Pooled fund studies
  - Leading 6
  - Contributing $160K per year to others



Highlighted Success: Research Prioritization

- Identify and prioritize the research needs of UDOT's **subject matter experts (SMEs)**
- Our process includes an annual Research Workshop, aka the "UTRAC" workshop
- Utah Transportation Research Advisory Council
  - Previously a group of UDOT senior leaders who reviewed and approved new research projects
- The prioritization workshop has been held approximately annually from 1993 to 2024
- Process changes were made every few years
- Utah Transit Authority staff also participate with $

UDOT Keeping Utah Moving

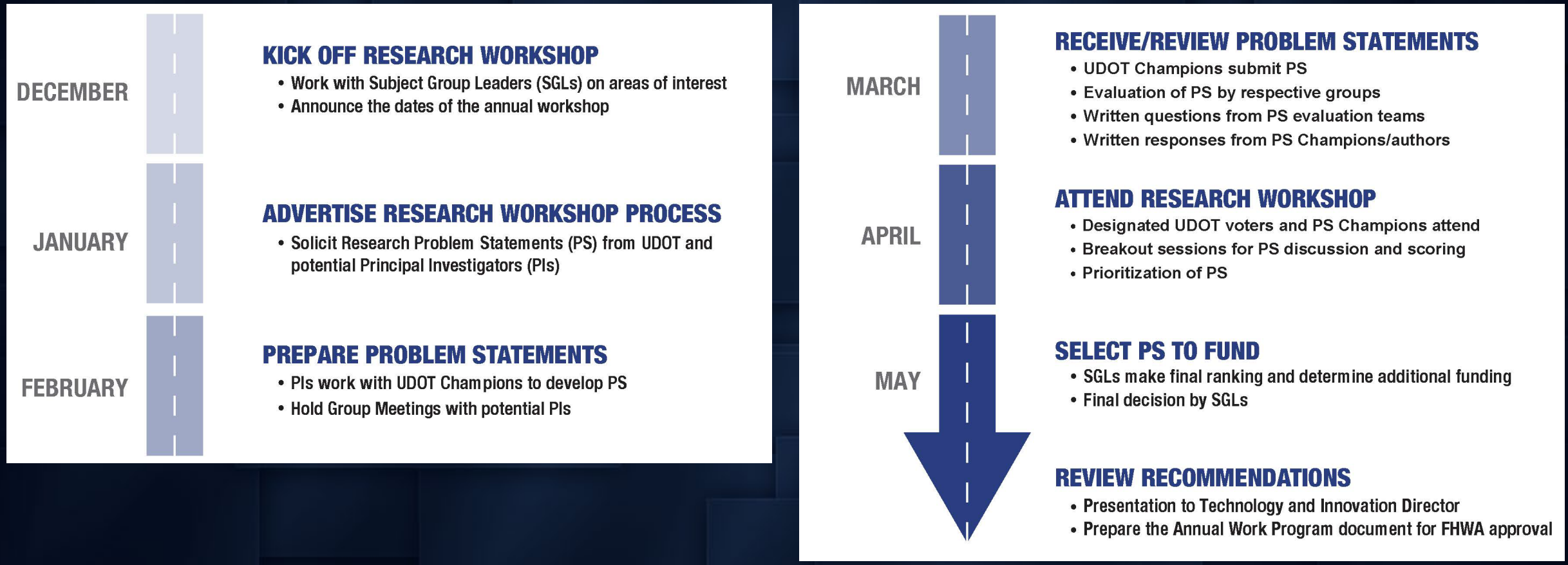
Past Obstacles and Adjustments (Years Ago)

- Potential researchers had too much influence on the process
  - Hold pre-workshop meetings to share UDOT's research needs
  - Only UDOT champions (SMEs) may submit problem statements
  - Researchers may still co-author problem statements
  - Only designated UDOT evaluation teams may vote
- A push to reduce cost or go virtual with the workshop, and make sessions non-concurrent
  - Considered using meeting rooms in UDOT buildings
  - The COVID-19 pandemic made a virtual workshop a necessity
  - Multiple-day virtual workshop with non-concurrent sessions

2024 Process Improvements

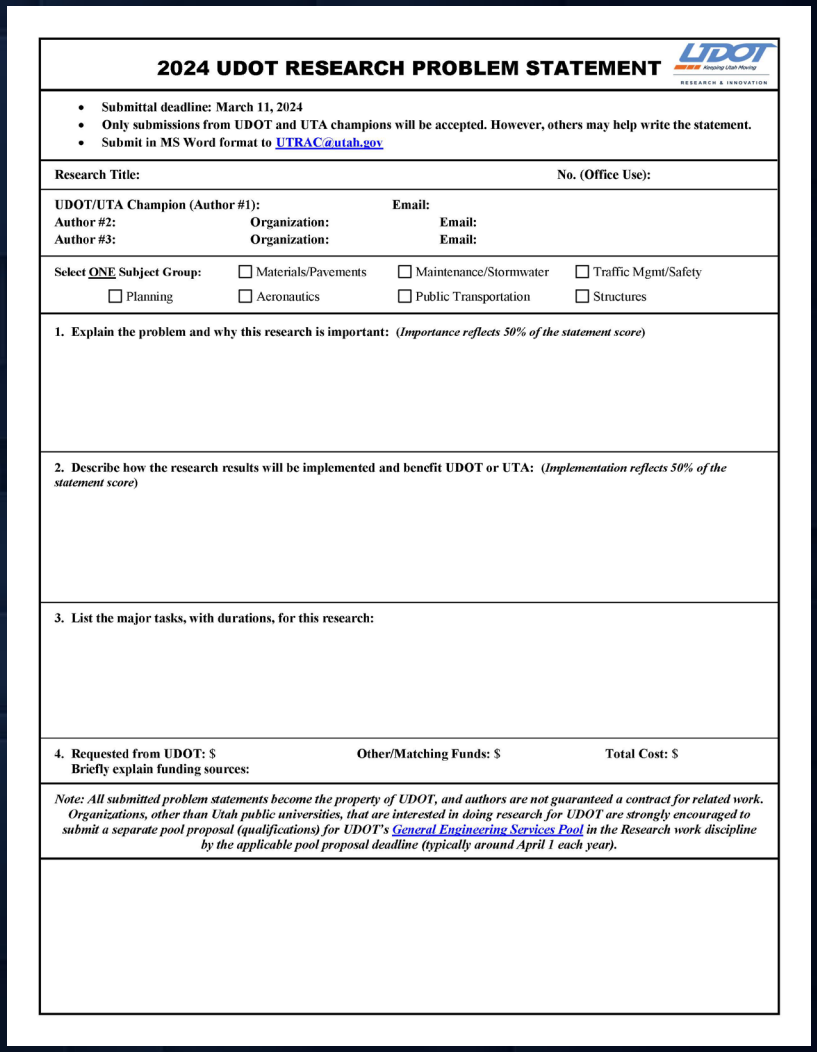
- Changes were made in response to requests for a reduced time burden on UDOT problem statement champions, researcher co-authors, and evaluation teams
  - Simplified problem statement form
  - No problem statement presentations (videos or live)
  - Evaluation teams and champions/co-authors participated in written Q&A prior to the workshop
  - Held the multiple-day workshop in person for only invited UDOT evaluation teams and champions to discuss and prioritize research needs

Current Process Timeline



Research Problem Statement Solicitation

- Research solicited in 7 subject groups
- Then held pre-workshop meetings with interested researchers to discuss UDOT research needs
- Information on the problem statement
  - UDOT champion and other authors
  - Explain problem and **importance**
  - Describe **potential implementation** and benefits
  - List tasks and durations
  - Requested funding amount



2024 UDOT RESEARCH PROBLEM STATEMENT

- **Submittal deadline: March 11, 2024**
- **Only submissions from UDOT and UTA champions will be accepted. However, others may help write the statement.**
- **Submit in MS Word format to UTRAC@utah.gov**

Research Title: **No. (Office Use):**

UDOT/UTA Champion (Author #1): **Email:**
Author #2: **Organization:** **Email:**
Author #3: **Organization:** **Email:**

Select ONE Subject Group: ☐ Materials/Pavements ☐ Maintenance/Stormwater ☐ Traffic Mgmt/Safety ☐ Planning ☐ Aeronautics ☐ Public Transportation ☐ Structures

1. Explain the problem and why this research is important: (*Importance reflects 50% of the statement score*)

2. Describe how the research results will be implemented and benefit UDOT or UTA: (*Implementation reflects 50% of the statement score*)

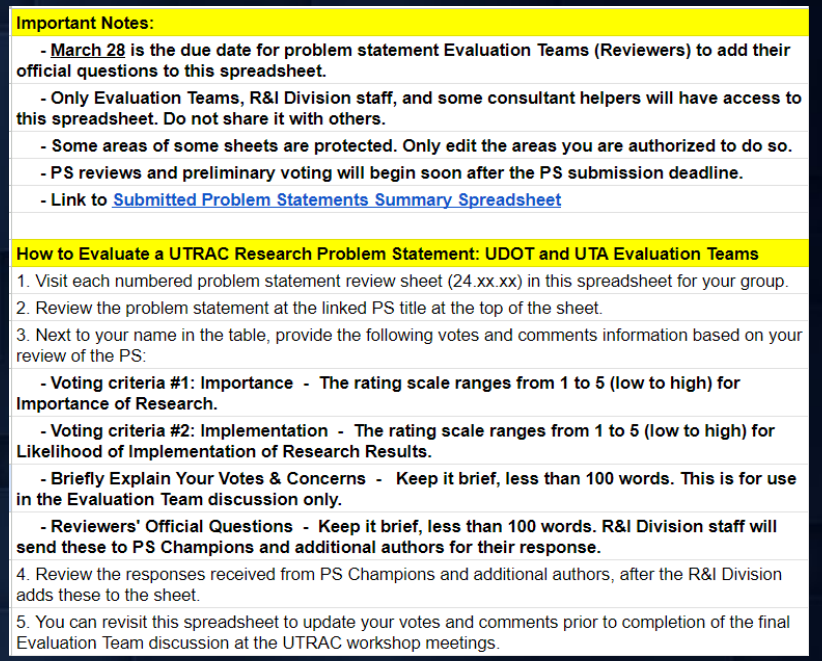
3. List the major tasks, with durations, for this research:

4. Requested from UDOT: $ **Other/Matching Funds: $** **Total Cost: $**
Briefly explain funding sources:

Note: All submitted problem statements become the property of UDOT, and authors are not guaranteed a contract for related work. Organizations, other than Utah public universities, that are interested in doing research for UDOT are strongly encouraged to submit a separate pool proposal (qualifications) for UDOT's General Engineering Services Pool in the Research work discipline by the applicable pool proposal deadline (typically around April 1 each year).

Problem Statement Evaluation Process

- Research staff organize the submitted problem statements
- Instructions are sent to designated UDOT evaluation teams
- Each subject group uses a separate shared spreadsheet to enter votes and comments
- Reviewers' official questions are shared with champions/co-authors, and their responses are shared with the reviewers
- Evaluation criteria (scale of 1-low to 5-high)
  - Importance of the research
  - Likelihood of implementation of research results



Important Notes:
- March 28 is the due date for problem statement Evaluation Teams (Reviewers) to add their official questions to this spreadsheet.
- Only Evaluation Teams, R&I Division staff, and some consultant helpers will have access to this spreadsheet. Do not share it with others.
- Some areas of some sheets are protected. Only edit the areas you are authorized to do so.
- PS reviews and preliminary voting will begin soon after the PS submission deadline.
- Link to Submitted Problem Statements Summary Spreadsheet
How to Evaluate a UTRAC Research Problem Statement: UDOT and UTA Evaluation Teams
1. Visit each numbered problem statement review sheet (24.xx.xx) in this spreadsheet for your group.
2. Review the problem statement at the linked PS title at the top of the sheet.
3. Next to your name in the table, provide the following votes and comments information based on your review of the PS:
- Voting criteria #1: Importance - The rating scale ranges from 1 to 5 (low to high) for Importance of Research.
- Voting criteria #2: Implementation - The rating scale ranges from 1 to 5 (low to high) for Likelihood of Implementation of Research Results.
- Briefly Explain Your Votes & Concerns - Keep it brief, less than 100 words. This is for use in the Evaluation Team discussion only.
- Reviewers' Official Questions - Keep it brief, less than 100 words. R&I Division staff will send these to PS Champions and additional authors for their response.
4. Review the responses received from PS Champions and additional authors, after the R&I Division adds these to the sheet.
5. You can revisit this spreadsheet to update your votes and comments prior to completion of the final Evaluation Team discussion at the UTRAC workshop meetings.

Workshop Sessions

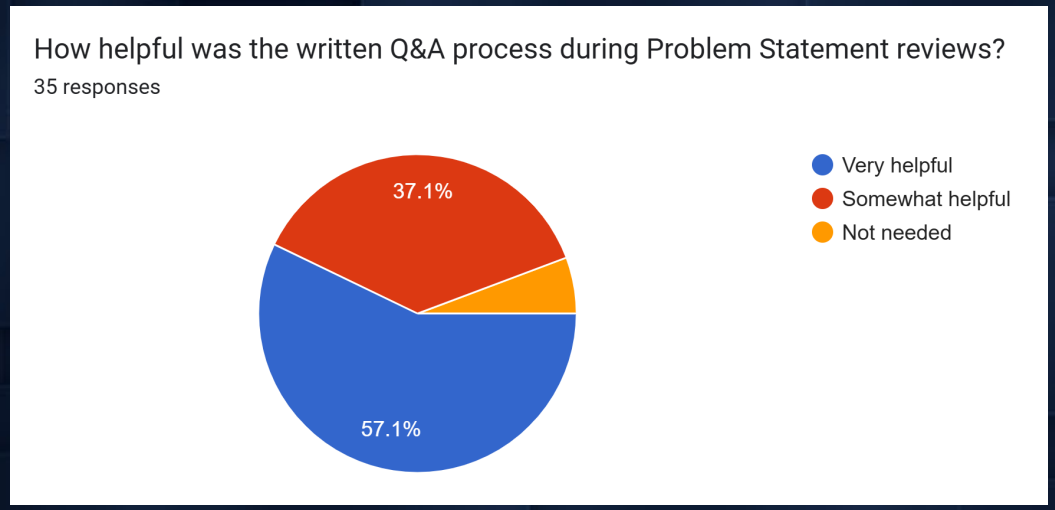
- About 2 are held per day for UDOT evaluation teams and champions, in person
- Subject group leader and Research staff guide the meeting
- Use the group's shared spreadsheet
  - Discuss the group's problem statements and finalize voting
  - View the voting results
  - Adjust priority if needed
  - Consider the designated available funding and other sources
  - Recommend a few priority projects for Research funding
- Research staff meet to discuss prioritization results and prepare new projects list for leader approval and the Annual Work Program

Results of the 2024 Workshop Process

- 50 submitted problem statements were considered
- 27 were prioritized and selected for UDOT R&I funding as new research projects
- Approx. $1.4M Research funds + $500K other funds (UDOT divisions, UTC, universities, UTA, NSF, DOE)
- Saved approx. 200 labor hours in the latest revised process

Feedback on the Revised Process

- Participants gave mostly positive feedback



- Several mentioned they miss the beneficial networking and collaboration opportunities of in-person meetings with UDOT subject group leaders, SMEs, and interested researchers
  (This could apply to pre-workshop meetings and the workshop itself)

Current Challenge

- Time for networking and discussion are not sufficient in the virtual pre-workshop meetings about UDOT's research needs
- How will we provide more meaningful (in-person) networking and collaboration opportunities for all participants in the research prioritization process?
- Options for in-person pre-workshop meetings
  - Lunch event for extended conversations
  - Speed networking event with various tables or rooms
- Consider holding a symposium later for research results and ideas

Q&A

- What do other state DOTs do to engage with SMEs and interested researchers about research ideas prior to developing research problem statements?

- Any questions on the UDOT research prioritization process

APPENDIX E. NORTH DAKOTA – RESEARCH PROGRAM SUMMARY

Research program summary

WTRC - Peer Exchange 2024

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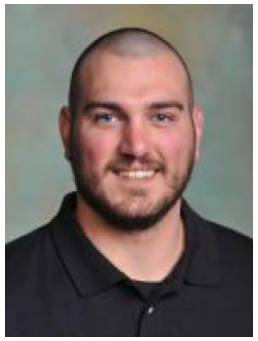
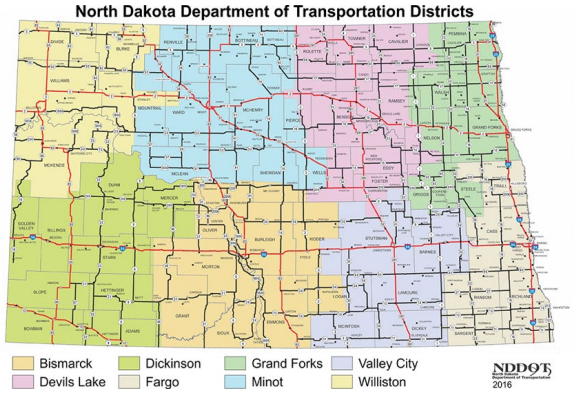
TJ Murphy, PE
Section Leader



Jon Stork, PE
Transportation Engineer

Research Program SnapShot



NDDOT Organization

- 982 Full Time Employees
- 8 Districts & Central Office

North Dakota Transportation Facts

- **8,613** Miles of Roadway
- **1,722** Bridges
- **1,159,000+** Registered Vehicles
- **350** Snowplows
- Average **39** events per year that require snow/ice treatment

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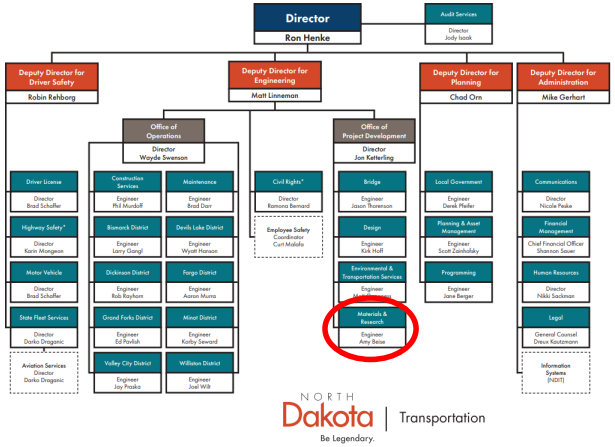


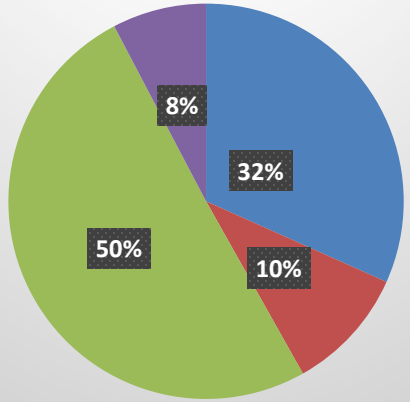
Research Program – Work Program

SUBMIT ANNUALLY DECEMBER 31ST

ANYTHING THAT USES SPR – B FUNDING

AMEND AS NEEDED

Research Funding Distribution



- Work Program ($1,500,000)
- Research (25-35%)
- Nondestructive Testing (20-25%)
- Culvert Inspection (10-15%)
- SME's (10-15%)
- QPL Management(20-25%)

THEME: Research and Innovation Program Best Practices

- Transportation Innovation Program (TRIP)
- DOT Staff Engagement
  - How do we get people involved through the whole research cycle
  - How do engage more “change champions”

Transportation Innovation Program (TRIP)

History

- Typical University Research and Internal efforts were being under utilized and viewed as slow to implement under the fear of failure.
- Internal processes of reviewing and piloting new innovative methods or products also had this stigma.
- Collaboration between DOT executive's and local UTCs the TRIP program was created.
- Goal was to Move Road Ready Innovation into practice rapidly.

Transportation Innovation Program (TRIP) (2)

Obstacles

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Transportation Innovation Program (TRIP) (3)

Next Steps −

The TRIP Review Team will review all submittals. The Review Team may request that a submitter provide a presentation to the TRIP Review Team. Presentations will allow the Review Team to ask questions of the submitter to clarify any details before the Team makes its recommendation.

The TRIP Coordinator will contact submitters after the NDDOT Executive Team have made final decisions on implementation of submitted concepts. Before making its final determination, the Executive Team may ask for additional information from the Review Team or the idea submitter.

Eligibility −

All transportation based contractors, consultants, suppliers, colleges and universities, associations, tribes, local jurisdictions and NDDOT staff are eligible to submit an innovation idea.

Guidelines −

1. Ideas should address a specific transportation issue, component, process or service. This program may not result in funding projects that are already in a jurisdiction's CIP (Capital Improvement Plan) or the STIP (State Transportation Improvement Plan). However, innovation ideas that could be implemented and funded as part of an add-on to existing CIP or STIP projects are eligible.
2. The selection committee may reject ideas that do not satisfy the eligibility, guidelines and selection criteria.

Selection Criteria −

Idea submittals will be evaluated based upon the previously mentioned guidelines and the following criteria:

1. Innovative: Does the submittal clearly address the benefits of the proposed idea? For example; does the idea provide time or cost savings, durability improvement (longer life) or improved safety or service?
2. Readiness Level: Is it in development or implementation stage?
3. Implementable: Is the idea realistic, thoughtful, data-driven and in accordance with state laws? For example; design build statutory constraints or legislative limits for IT projects.
4. Additional considerations:
    1. Does the idea include any matching funds or supplying of materials, machinery or labor?
    2. What is the potential for economic benefit? Note that TRIP is anticipated to be an ongoing program. Unsuccessful submittals may be reconsidered in future rounds of the solicitation and review process.

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TRIP - Transportation Innovation Program (4)

TRIP is a program to identify and implement innovative ideas for transportation projects, processes and products. Transportation Innovation Ideas are to address transportation areas overseen by the North Dakota Department of Transportation (NDDOT) including but not limited to: bridges and structures, construction, operations and maintenance, roadway surfacing, planning, environmental, safety, service delivery, transit, multi-modal, innovative training or training on topics where little or no training currently exists, and innovative research.

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Recent / Active TRIP Projects

- July 2021
  Tubular Steel Dowel Alternative
  Fiber Reinforced Polymer (FRP) Dowels
- July 2021
  HawkScan – Oversized Vehicle (Early Warning) Scanning System –$532,500 50/50 (Sep 5, 2023)
- January 2022
  RasterMaster Mower (hydraulic and manual)
  Bismarck and Dickinson District
- March 2023
  RDO - 3D Scanning and Modeling and Automated Machine Guidance (AMG) Technologies (M&R)
- February 2024
  UND (Dr. I-Hsuan-Ho) Improved Quality Control of Compaction Test (DCP), assigned to TTRI & to be expanded

Transportation Innovation Program (TRIP)

We moved toward Technology Readiness and steered away from Research submissions. The Technology Readiness Levels (TRLs) range from Level 1 (basic research) to Level 9 (implementation). To achieve a specific TRL, the technology must meet all the requirements within that level and prior levels. Each level indicates a different measure of maturity and contains different requirements to determine the level of technical maturity.

The goal is to have a prototype or proven system (TRL 6 or higher).

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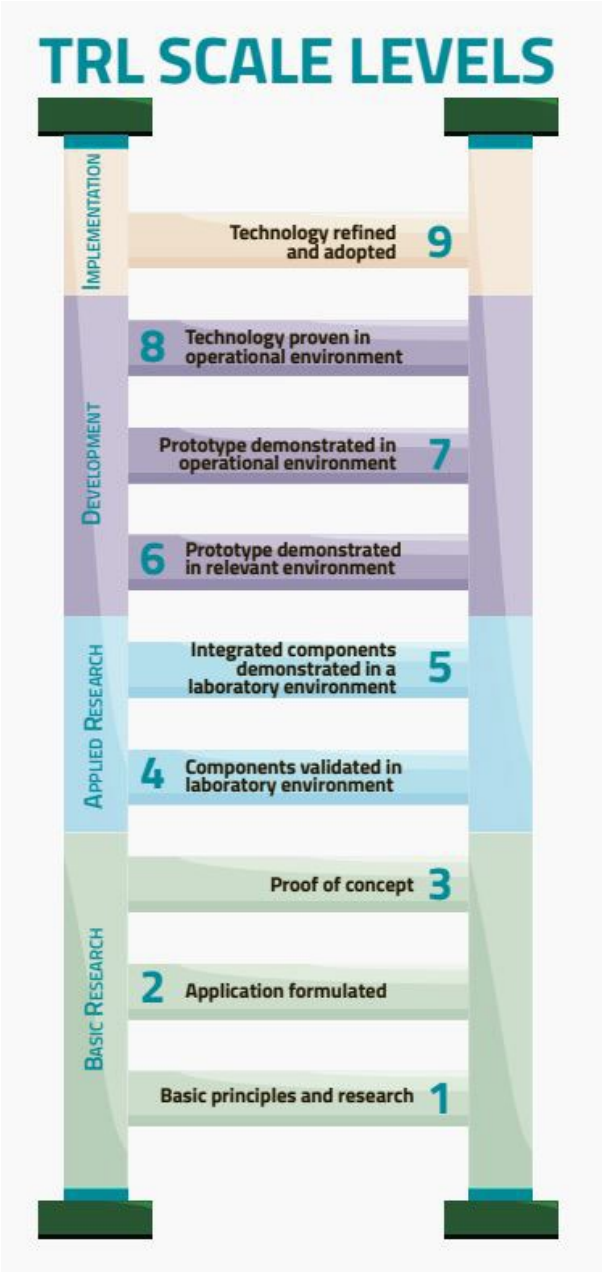

Technology Readiness Levels

Transportation Innovations Program Submissions

How to Submit an Idea

Please upload your idea using the TRIP Program idea submission form. Submission deadline is December 31. Early submissions are encouraged and appreciated. We are only accepting applications that are Transportation Readiness Level (TRL) of 6 or greater (6-9).

Idea submittals must include:

- One-page Idea Executive Summary*
- Problem Statement and Proposed Innovation*
- The Transportation Readiness Level (TRL) of your project (please explain)*
- Implementation Approach and Estimated Completion Date*
- Contact person for additional information, including daytime phone, email and address*
- Estimated cost to implement or amount of funding requested (if known)
- Appendix of Supporting Materials (optional)

** Required information*

TRIP SUBMISSION FORM

Click here to submit your idea. Please make sure to include all required information as outlined on this page.

The entire submittal, including appendices but excluding front and back covers if included, should not exceed 15 pages. Photos or illustrations are encouraged to enhance the review team's ability to evaluate the merits of the idea.

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Innovation Spotlights

https://youtu.be/rSKCBJ2ud1U	Pipe Crawler
https://youtu.be/qlxKHI_jHI0	CDL Testing
https://youtu.be/JnmGiwlS9O8	Test Sections
https://youtu.be/F_SZYzB0xow	Rumble Strips
https://youtu.be/copdvtRGRrU	iCone
https://youtu.be/mZS6KKtIT08	Cone Pickup
https://youtu.be/lbG1oMepges	Cone Placer
https://youtu.be/6tx3ArCX3VI	Autonomous Rolling

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Empower people
Improve lives
Inspire success
NORTH
Dakota
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Thank You

TJ Murphy, PE
Research Engineer
tjmurphy@nd.gov

APPENDIX F. NEVADA DOT – RESEARCH AND INNOVATION PROGRAM BEST PRACTICES

WTRC/Peer Exchange Theme 2

Research and Innovation Program Best Practices

November 11, 2024

Program Snapshot: NDOT Research

- Research Scope
  - Problem Statement collection
  - Research Proposal solicitation
  - Coordinate SME reviews
  - Negotiate agreement terms
  - Administrative management of projects
  - Budget building and tracking
  - State and federal reporting
  - Focus on applied/implementable research topics
  - Do not track or participate in implementation
  - Water the plants
- Research Staff
  - Research Chief – Lucy Koury
  - Research Coordinator – Mitch Ison
  - Research Analyst – Melissa DeMattei
- Research Budget
  - $2,300,000
  - Funds Research and TPF Projects, Product Eval Program, salaries
- Programs w/in Research Section
  - Product Evaluation Program
  - Research Library
  - LTAP

NEVADA DOT SAFE AND CONNECTED

Research Program Success: What and How

- Program Success
  - Strong relationships with our Champions
- How did we get here?
  - Built confidence in our processes
  - Followed through
  - Followed up
  - Told lots of jokes
- Obstacles Identified
  - Internal outreach had grown stagnant
  - Long-time Research Coordinator moved on leaving knowledge gaps
- Obstacles Overcome
  - Gave a department-wide presentation on the Research Program
  - Encouraged participation through one-on-one conversations
  - Started attending events/conferences
  - Worked closely with active Champions to get up to speed on their projects
  - Touched bases with them frequently and often off-line
  - Admitted specific knowledge gaps and worked to fill them
  - Actively worked to be a reliable, friendly, resource

NEVADA DOT SAFE AND CONNECTED

Research Program Best Practice: What and How

- Program Best Practice
  - Encouraging researchers to get insight on the topic directly from the Champion(s)
- How did we get here?
  - Revamped our Problem Statement, solicitation, and proposal review processes
  - Removed potential for conflicts of interest
- Obstacles Identified
  - Strict Nevada law governing communication between evaluation committees and anyone not on the evaluation committee (especially potential proposers)
- Obstacles Overcome
  - Champion is not on the evaluation committee (Expert Task Group) to review proposals on their project(s)
  - Champion is not provided committee scores/comments until after a proposal is selected and approved by the RMC

NEVADA DOT SAFE AND CONNECTED

Significant Challenge in Search of Significant Solutions

- Challenge: Receiving consistent and high-quality research ideas
  - We are in need of research ideas to keep up with our spending requirements
  - Not just ideas, but high-quality topics
  - Spreading topics out over time, “it never rains but it pours”
- Solutions: We’re at the beginning
  - Outreach, outreach, outreach
  - Updating internal and external websites
  - Making the processes more transparent and easily accessible
  - Factsheets in development

“[Nevada] has railroads in it, and telegraphs, and stars, and suspension-bridges, and other romantic fictions foreign to sand and sage-brush.”
- Mark Twain

Nevada DOT: Safe and Connected

APPENDIX G. COLORADO DOT – BEST PRACTICES

Best Practices: Colorado

WTRC Peer Exchange

20 November 2024

COLORADO
Department of Transportation

Stephen A. Cohn
Assistant Director for Research
Division of Transportation Development
Colorado Department of Transportation
steve.cohn@state.co.us

Best Practices: Colorado Overview

WTRC Peer Exchange

20 November 2024

CDOT's Applied Research and Innovation Branch is now the

Office of Applied Research (OAR)

COLORADO

Department of Transportation

Stephen A. Cohn

Assistant Director for Research

Division of Transportation Development

Colorado Department of Transportation

steve.cohn@state.co.us

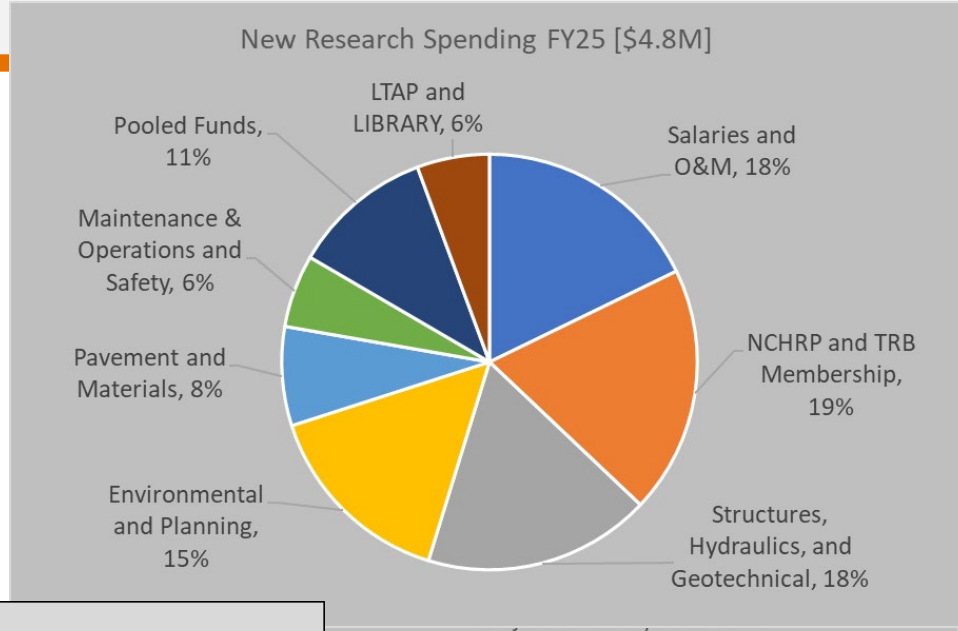
Research Program Overview

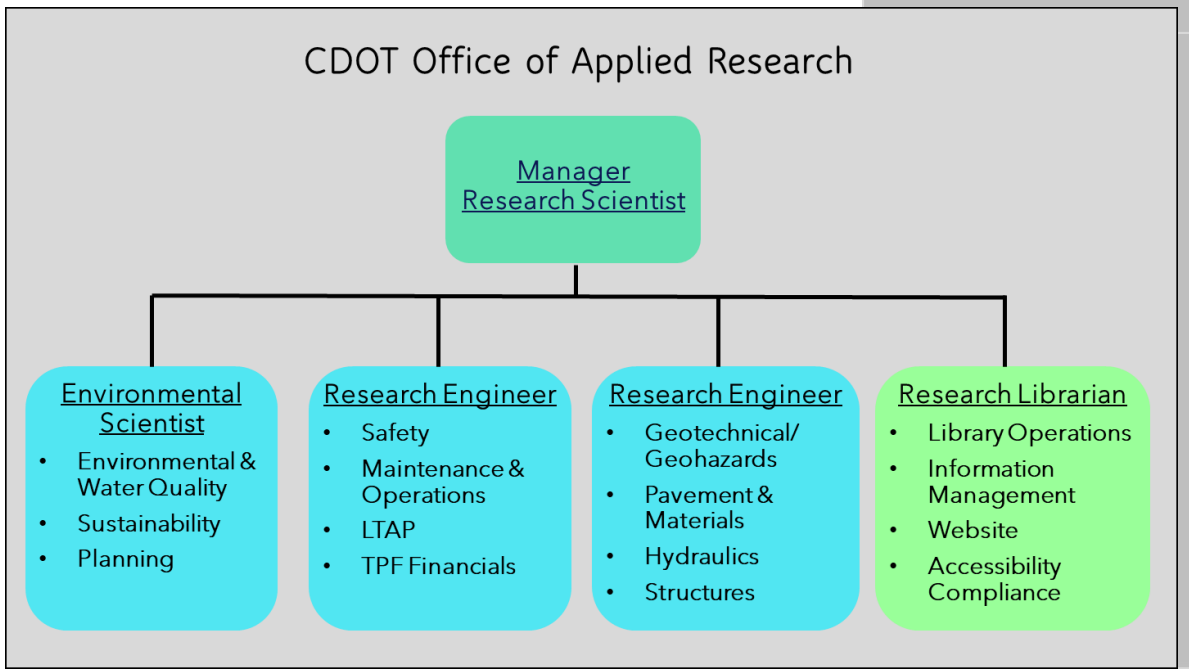
General (FY25)

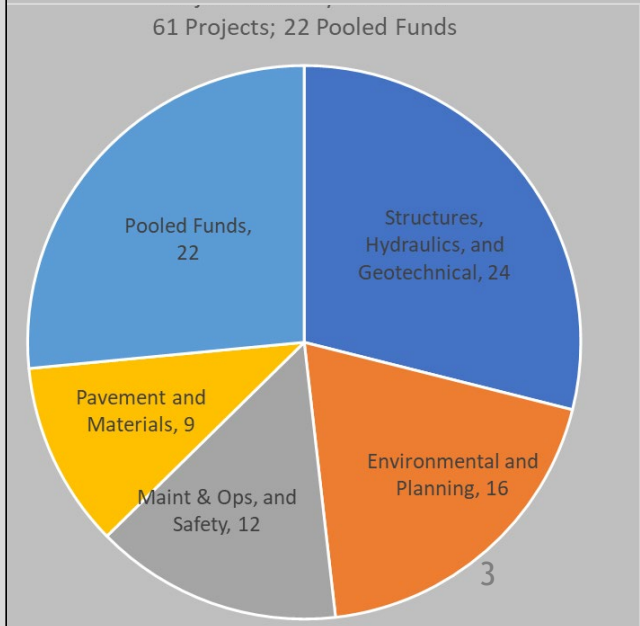
- Research sits in CDOT's **Div of Transportation Development**
- Budget: **~$4.4M/yr** (SPR-B)
- Staff: **5 FTE**, including Library professional
- Project count: **61 projects, and 22 TPF** (lead 4)

Responsibilities

- Research projects
- Pooled Funds
- National view (TRB, NCHRP)
- Research Library
- LTAP, T2 & STIC
- **NOT** Innovation







Best Practices #1

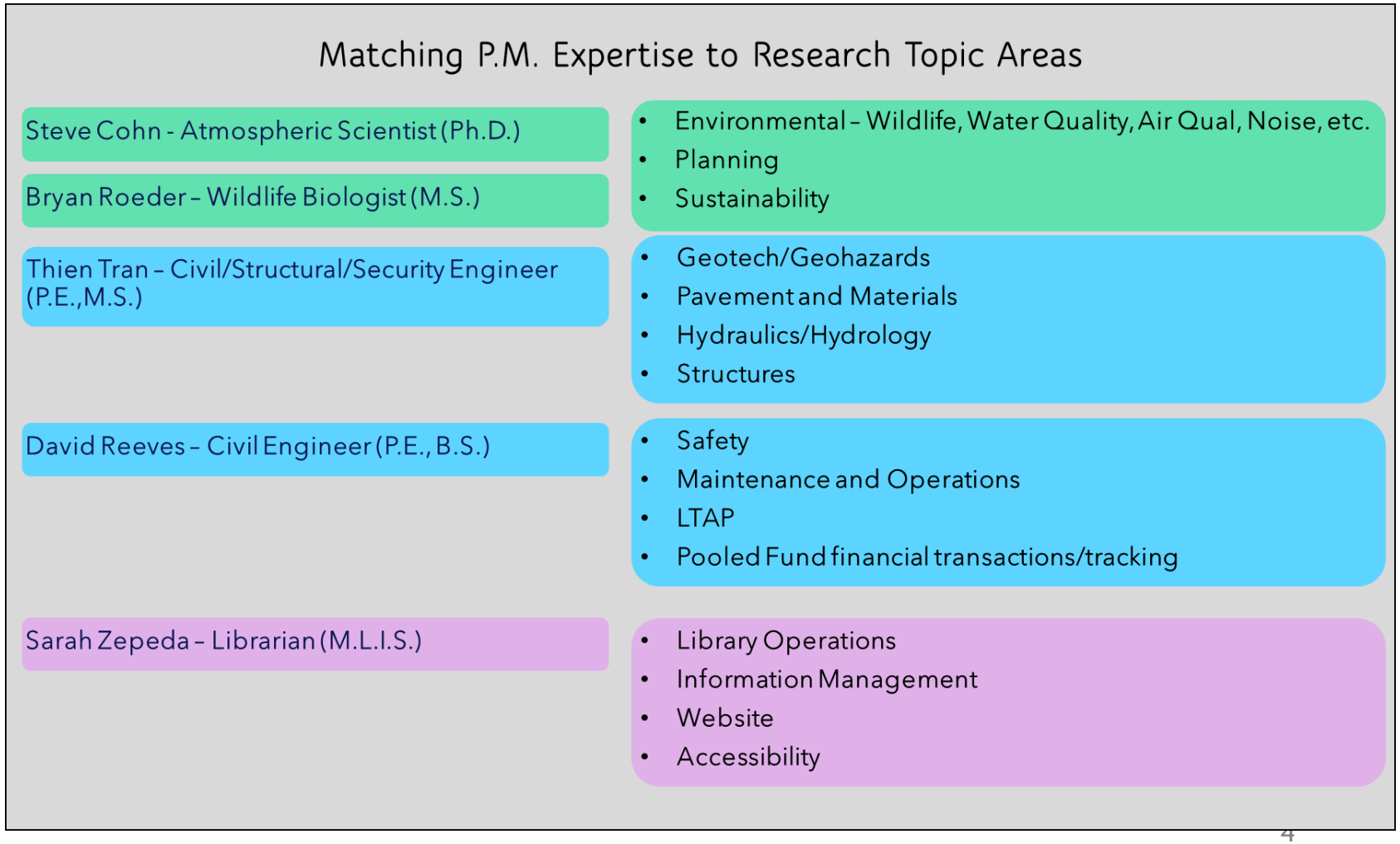
Research Managers are Technical Experts

Pros

- Excellent technical support of projects
- Good communication with SMEs
- Mission/Portfolio focus to emphasize impact

Cons

- Large fraction of time on procurement and project management, not primary technical skillset
- Some technical areas are uncovered
- Not as efficient and organized as e.g., PMPs for some tasks.



Best Practices #2

Areas of Emphasis

AoE are topics/areas of special interest to CDOT, where:

- Focused research can result in substantial near-term and long-term benefits to Colorado.
- Easy to answer, “Why is Colorado leading this research rather than other states?” E.g., due to natural features (terrain, climate, built environment), public sentiment, strong local research programs at universities, consulting firms, or national laboratories.

Three Current Areas of Emphasis

Mitigating Wildlife Vehicle Collisions and Improving Safe Wildlife Passage

Construction and Operations & Maintenance impacts on Air Quality

Post-Wildfire Debris Flow

Best Practices #2

Areas of Emphasis

How did we get there?

- Concept in 2020 to address FHWA/Denver concern
- Candidate ideas selected by OAR and RIC (advisory group)
- Limited number; probably 3-4 is our limit
- Topics are emphasized in Problem Statement solicitation and other venues

Obstacles?

- Attracting new rather than “relabeled” ideas
- How to decide when to sunset an AoE, and when to begin a new one.
- We will need to be more formal in our processes, someday.

Best Practices #3

Focus on the Future and New Technologies

Greater emphasis in past 4 years. Examples:

- Machine Learning and AI for research: since 2022, 9 of our research projects use ML/DL, or AI.
  E.g.: Bridge management, pavement condition, wildlife image detection, slope monitoring/rockfall, LLM in traffic operations.
- Cybersecurity
  E.g.: for Electric vehicle charging station security; aftermarket ODB-II devices such as ELDs.
- Radar as a tool for wildlife detection on the roadway
- Evaluation of commercial lidar at intersections
- Properties of graphene-modified asphalt

Intersection view by the Lidar (Photo Source: https://velodynelidar.com/)

How did we get there?

- Being accepting of incoming higher risk, longer outlook ideas
- Pushing some ideas that we think have potential
- Expanding our relationships with researchers

Obstacles?

- (Lots has already been said about AI/ML)
- Gaining interest/acceptance in change on the front lines
- TRL is not always what we need
- Time needed for meeting with companies pitching capabilities

Best Practices #4

Research Library

Resources

- Library Catalog - includes books, eBooks, audiobooks, manuals, digitized reports (Research & NEPA), training resources
- Journal & Database Subscriptions - TRID, AASHTO & ASTM Standards, Denver Post, New York Times, Washington Post
- LibGuides – Subject guides

Services

- Literature Searches and Literature Reviews
- Article and Book Requests

Programs

- Quarterly Book and Speaker Series
- Outreach – Bike-to-Work Month, Team Presentations

Library Board

Contribute to advancing the library's mission, influencing policies, and overseeing the budget. Your voice can make a significant impact on the CDOT community's access to valuable resources and services.

Sarah Zepeda, MLIS
Sarah.Zepeda@state.co.us

Significant Challenges

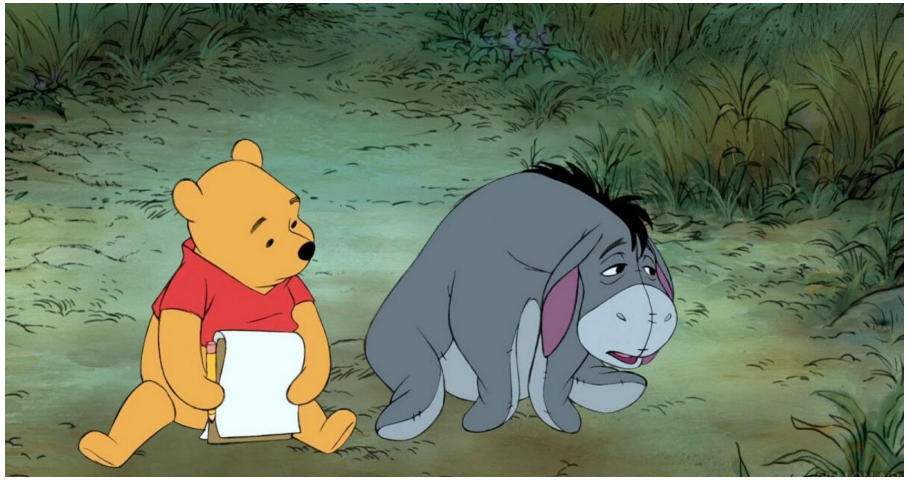
We have no shortage of challenges. **Some are also opportunities.**

Challenges

- Procurement timeline, effort, and complexity
- Tracking and quantifying implementation
- Champion turnover and uneven interest
- Formalizing processes
- Information management
- Corporate change (WCAG compliance stance; Office consolidation; …)

Opportunities to get better

- Structured Procurement interactions
- Follow formalized implementation tracking process
- Outreach for new champions; top-down support
- Formalize processes
- Information management intern developing systems
- Smile through the pain: Corporate change



Best Practices: Colorado

WTRC Peer Exchange

20 November 2024

COLORADO
Department of Transportation

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APPENDIX H. IDAHO TD – RESEARCH AND INNOVATION PROGRAMS

ITD Research and Innovation Programs

Overview and Best Practices

Western Transportation Research Consortium & Peer Exchange
11/20/2024

Amanda Laib

Your Safety • Your Mobility • Your Economic Opportunity

Research Program Snapshot

Mission: Support research, development, and technology transfer activities addressing the Department's strategic goals and initiatives.

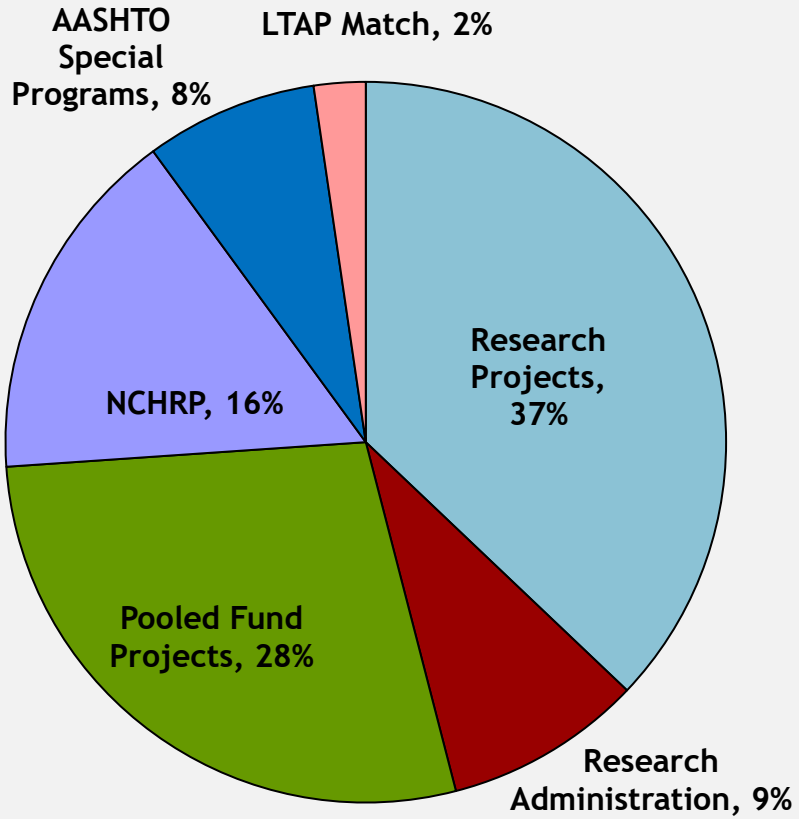
Responsibilities

- Identifying ITD research needs and priorities.
- Administering SPR funds.
- Overseeing ITD-funded research performed by universities and consultants.
- Coordinating ITD involvement in multi-state pooled fund projects.
- Coordinating ITD involvement in national and regional transportation research with TRB, AASHTO, the PacTrans (regional UTC), etc.
- Helping staff locate transportation research information.

2 FTEs

21 New and active research projects

Total FY2025 Budget = $2.59 million



Successes

- Successfully completed FHWA Program Review
  - FHWA found ITD has well-documented research management process
  - Also noted that the department has a robust process for final reports and meeting Section 508 requirements for report accessibility
- Implemented RFP process for researcher selection
  - Developed in-house process for developing and advertising RFPs and selecting researchers
  - Have received between three and fourteen proposals for advertised projects
- Implemented pre-project surveys to better understanding expectations and needs
- Recent Project Successes
  - Two projects selected for AASHTO High Value Research
  - Two projects collaboratively led by private-public partnerships between researchers

Challenges

- Determining “top down” priorities of research
  - Meet with ITD strategic goal teams annually
  - However, most ideas generated “bottom-up”
- Lack of dedicated research project managers
  - Rely on SMEs in areas requesting research projects to serve as project managers
  - Adds to their work responsibilities

- Competitively bidding research projects
  - Requires time from Research Program staff and project requestors
  - Templates help streamline
- Moving research into practice
  - Build implementation support (training, draft specifications, etc.) into project tasks and deliverables
  - Rely on project sponsors to champion implementation

Innovate ITD! Snapshot

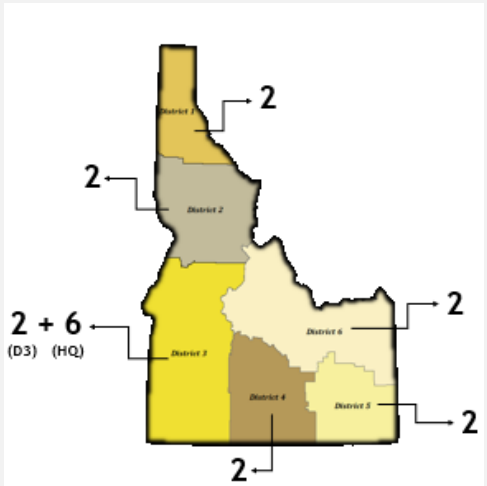
Mission: Empowering our coworkers to discover their value through thinking, doing, and leading.

- Innovate ITD is a broad-based program that seeks to engage staff from across the organization

- Led by the Innovative Business Practices (IBP) team, a group of leaders and SMEs:
  - Executive Sponsors
  - Senior Leaders from Districts and HQ
  - Staff from Communications and IT
  - Research Program Manager
- Staff Roles
  - Chief Innovation Experience Officer
  - Office of Continuous Improvement – 3 FTEs

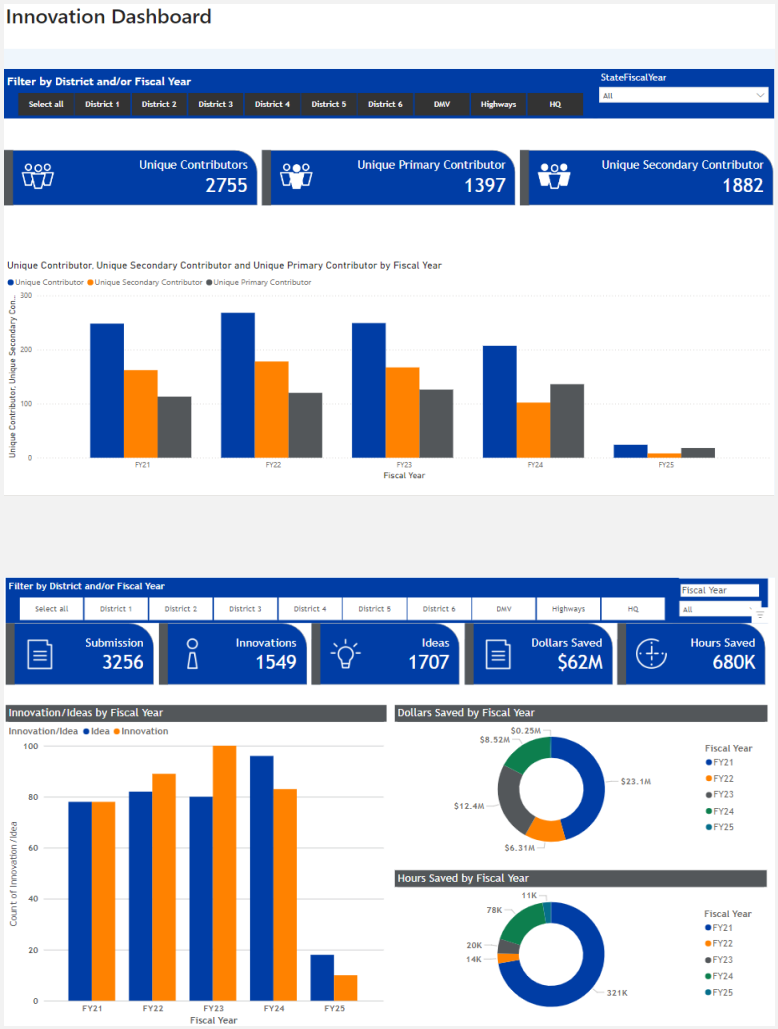
Innovation Stewards

- Responsibilities:
  - Encouraging and assisting staff with idea submissions
  - Supporting staff efforts to implement innovations
  - Recognizing employee efforts
  - Collaborating to facilitate statewide implementation of innovations
- 1-2 in Every Division & District
- Devote 5-10 percent of their work time to Steward duties
- Interested staff can volunteer to serve as a steward and are selected by their division/district leaders



Successes

- Fostering a culture of innovation within ITD
- Since Innovate ITD was initiated in 2014:
  - 2,755 unique individuals have contributed to the program
  - 1,549 innovations big and small have been implemented
  - Estimated savings:
    - $62 million
    - 680,000 hours
- Our innovation initiative is celebrating its 10th year
- Invited to Participate in NCHRP Domestic Scan 23-04: *Developing and Maintaining a Culture of Innovation within DOTs*



Challenges

- Spreading homegrown innovations across the department.
  - “Times 7” used to convey this concept (HQ + 6 Districts)

Best of the Best

Innovation Stewards
Helping Ideas Flourish

- Engagement and incentivization
  - New “Innovation Olympics” reward system coming soon!
- These have been areas of focus for the Innovation Stewards

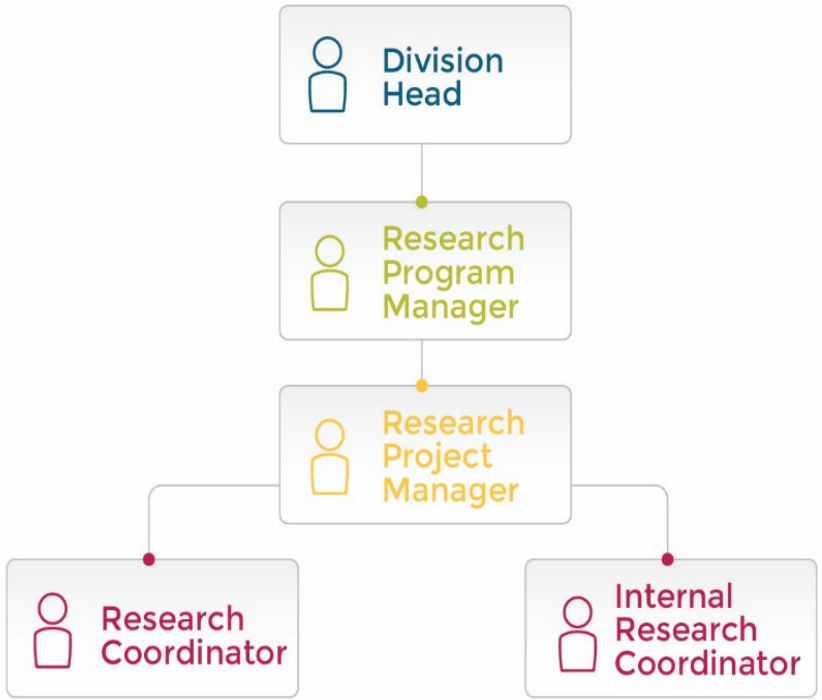
Questions?

Your Safety • Your Mobility • Your Economic Opportunity

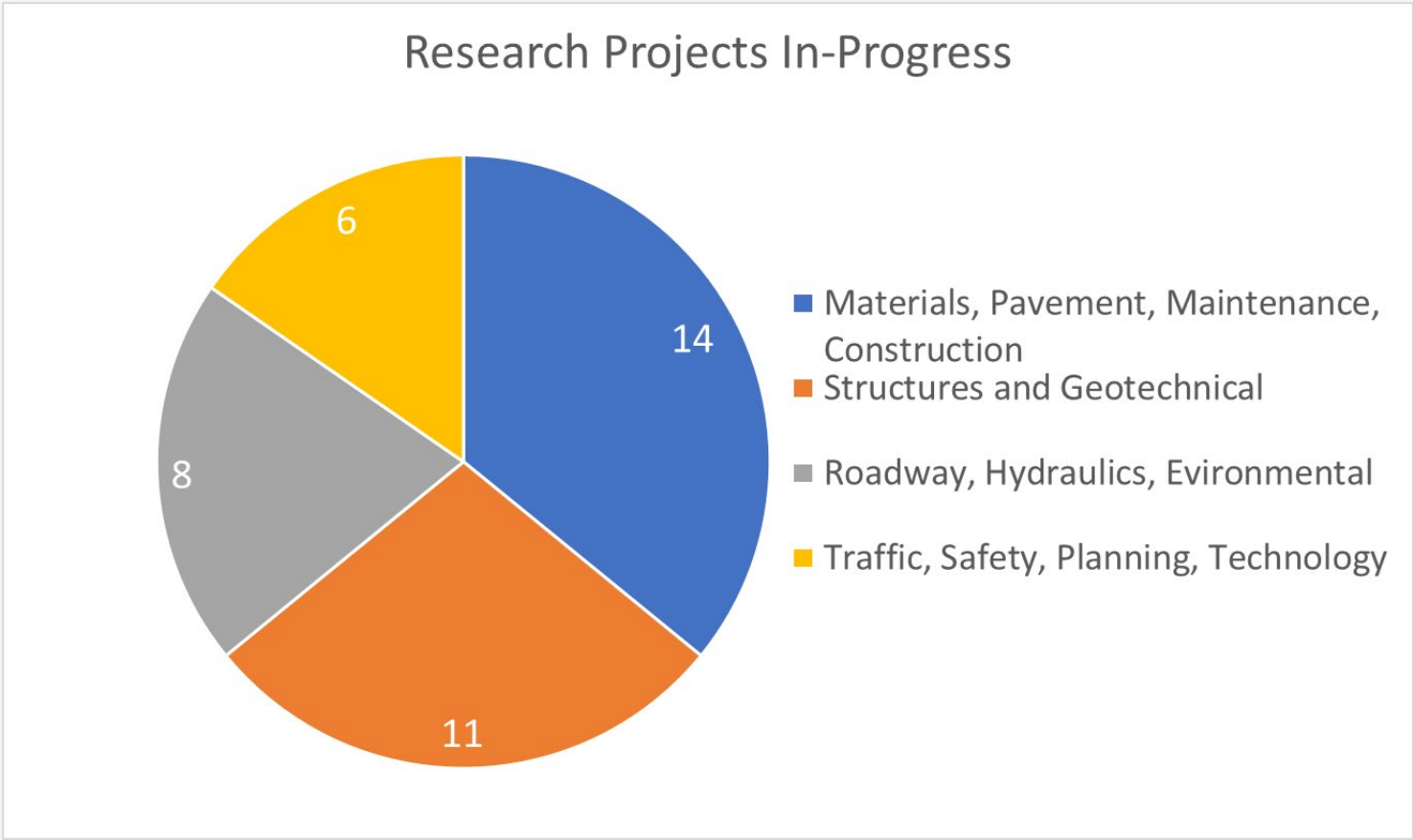
APPENDIX I. NEBRASKA DOT – RESEARCH AND INNOVATION PROGRAM BEST PRACTICES


NEBRASKA RESEARCH
AND INNOVATION
PROGRAM
BEST PRACTICES
Mark Fischer
NEBRASKA
Good Life. Great Journey.
DEPARTMENT OF TRANSPORTATION

• Nebraska DOT RESEARCH SECTION



- 3 full time staff members
- $2.0 M State Planning & Research (SPR) annual budget
- Program goal is to find, develop, and implement practical solutions to transportation related issues
- About 40 active projects with 10-15 new projects each year
- Run the Midwest Roadside Safety Program Pooled Fund



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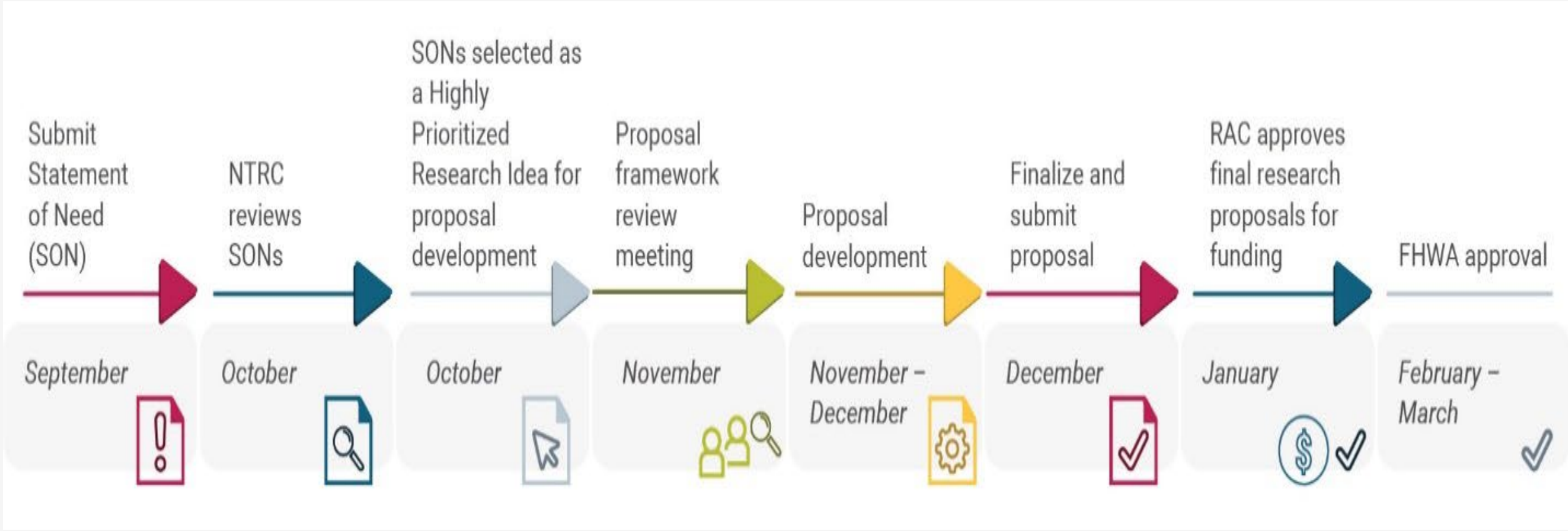
Develop an annual program Cycle



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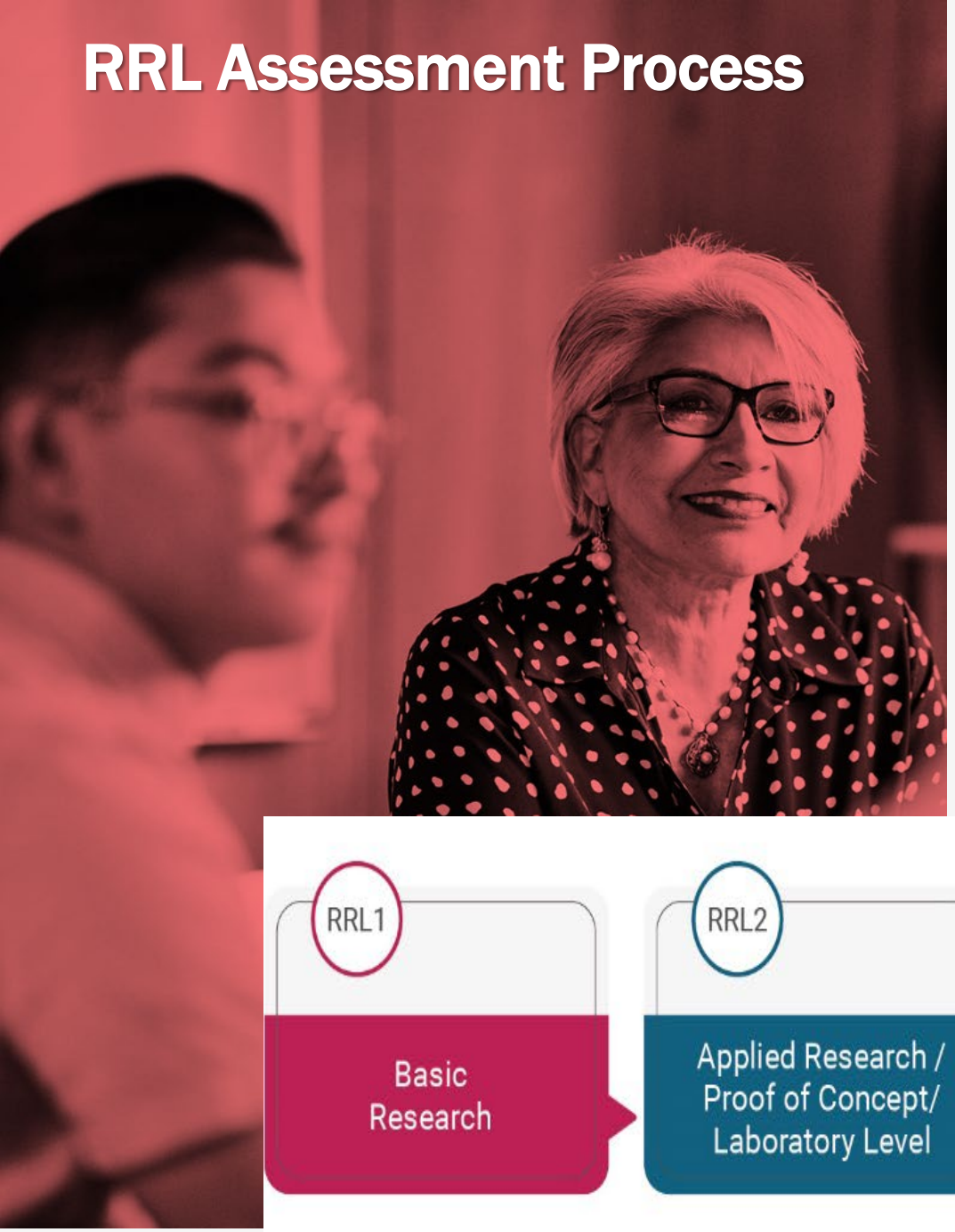
Completed Research Implementation

Research Readiness Level (RRL) Assessment

Research Readiness Level (RRL) Assessment identifies the immediate next steps for Implementation follow up.

The RRL concept is based on the FHWA Technology Readiness Level Guide and was adapted to meet NDOT's specific needs.

RRL Assessment Process



- The Research Project Manager prepares a summary report of the area or problem studied, research findings, interpretation of results and recommendations for how NDOT or other organizations should use the research and monitor their expected benefits.

- Assessment provides the means to identify and document the resources, processes and requirements necessary to progress research from basic research to implementation in standard practice.

- The assessment is designed to be linear process; however, some research may skip levels based on the depth of research performed.

This concept is based of FHWA's Technology Readiness Levels (TRLs).
Modified by the Nebraska Department of Transportation Research Section July 2020

Level	RRL	Description	RRL Assessment Process
Basic Research Develop/Improve tools for design, data collection, etc.	1	**Concept**	▪ Are system/model/method performance metrics at least partly described? ▪ Do preliminary analyses or experiments confirm that the application might meet the user need? ▪ Is system/model/method feasibility fully investigated? ▪ Do experiments or modeling and simulation validate performance predictions of system capability? ▪ Does the research address or introduce an improved system/model/method for the Department?
Applied Research/ Proof of Concept/ Lab-level	2	**Research validated and demonstrated in a laboratory/system/model/ method environment**	▪ Are end user requirements described or at least partly documented? ▪ Does a plausible draft integration plan exist and is component compatibility demonstrated? ▪ Were individual components successfully tested in a ***laboratory environment*** (a fully controlled test environment where a limited number of critical functions are tested)? ▪ Are external and internal system interfaces documented? ▪ Are target and minimum operational requirements developed? ▪ Is component integration demonstrated in a laboratory environment (*i.e.* fully controlled setting)?
Development/ Field-level	3	**Research demonstrated** **Technology proven in operational environment**	▪ Is the operational environment fully known (*i.e.* user community, physical environment, and input data characteristics as appropriate)? ▪ Does the research satisfy all operational requirements when confronted with realistic problems? ▪ Are available components representative of production components? ▪ Is the fully integrated research demonstrated in an ***operational environment*** (*i.e.* real-world conditions, including the Departments' environment)? ▪ Are all interfaces tested individually under stressed and anomalous conditions? ▪ Are all system components form, fit, and function compatible with each other and with the operational environment? ▪ Is the technology proven in an operational environment (*i.e.* meet target performance measures)? ▪ Was a rigorous test and evaluation process completed successfully? ▪ Does the technology meet its stated purpose and functionality as designed?
Implementation Evaluated the benefits of the implementation- Time period	4	**Research/Technology refined and adopted**	▪ Is the technology deployed in its intended operational environment? ▪ Is information about the technology disseminated to the user community/Department? ▪ Is the technology adopted by the Departments' environment?
Standard Practice/Fully Understood	5	**Research Adopted no evaluation is required**	▪ Research demonstrated and integrated without the need to evaluate the benefits.

Completed Research Readiness Level (RRL) Assessment

Executive Summary, Research Readiness Level Assessment and Technology Transfer

Supporting Bridge Management with Advanced Analysis and Machine Learning

Research Objectives

The primary objective of this research was to investigate and demonstrate the validity and usefulness of ANNs as a supplementary tool for bridge load rating and bridge management decision-making, substantiated through validation with diagnostic bridge tests. This research calibrated and/or refined an existing, preliminary ANN model to better serve the needs of NDOT, by expanding the ANN training data with Nebraska bridges and integrating reliability into the ANN predictions consistently with AASHTO LRFD/R.

Research Benefits

Bridges are commonly designed and evaluated with an appreciable degree of conservativism, beyond that strictly required to satisfy safety according to codes. Unneeded conservativism can be reduced, allowing bridges to remain in service and/or to carry higher loads, when justified by rational analysis and/or load testing.

The primary functional deliverable for this project was an Excel workbook, allowing load rating engineers to quickly estimate the potential benefits of refined analysis and/or load testing. Bridge owners are able to rationally substantiate decisions to defer maintenance or replacement for bridges in the inventory.

Alternatively, bridge owners can potentially raise or remove load restrictions for bridges. The benefit to any particular bridge is difficult to assess without a significant amount of time and effort.

The primary benefits of the proposed research provided easy and rapid access to knowledge of the degree to which any individual bridge represented by the ANN training offers these benefits.

Background

This project provided easy access to an approximation of advanced structural analysis, allowing practicing engineers to more accurately calculate bridge load ratings without needing to perform rigorous analyses themselves. Advanced analysis provided insight into whether or not bridge management intervention is necessary. Rigorous modeling can sometimes reveal unacknowledged capacity overlooked in traditional simplified models. This existing but unacknowledged capacity can potentially be sufficient to justify removal of load posting and deferral of bridge maintenance or replacement. Effectively managing the bridge inventory serves several strategic goals identified by the Nebraska Department of Transportation, particularly by balancing safety and fiscal responsibility.

Conclusion

The study included detailed FEA for 174 simple span, steel girder bridges with concrete decks. Subsets of 163 and 161 bridges within these available cases comprised the ANN design and training datasets for critical moment and shear live load effects, respectively. The reliability calibration found that the ANN live load effect prediction error with mean absolute independent testing error of 3.65% could be safely accommodated by increasing the live load factor by less than 0.05. The study also demonstrates application of the neural network model validated with a diagnostic field test, including discussion of potential adjustments to account for noncomposite bridge capacity and Load Factor Rating instead of Load and Resistance Factor Rating.

Principal Investigators

Joshua Steelman (P.I.)
University of Nebraska

Lead TAC Member

Fouad Jaber, PE, Assistant State Bridge Engineer

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DEPARTMENT OF TRANSPORTATION

Nebraska Department of Transportation
Project SPR-P1 (19) M088
May 2020

Executive Summary, Research Readiness Level Assessment and Technology Transfer

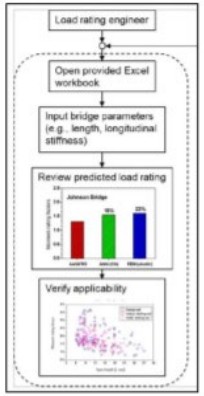
Interested in finding out more?

Final report is available at:
NDOT Research Website

NDOT Recommendations Based Off of Research Project

Bridge Division will use this research as screening method of potential load rating which required field measurements. Bridge Load Rating Section will validate the concept through production, using the spreadsheet developed as "Tool in the Box" to map the load rating which fits the research criteria.

The proposed validation of concept is summarized in the flowchart below under Load Rating Engineer.



The Load Rating Bridge Engineer will performed the followings:

- The provided user interface in Excel, input bridge characteristics required for ANN predictions (e.g., length as a value from 20 to 89 ft, girder spacing, longitudinal stiffness, cross frames, number of girders, skew angle, barrier edge distance, Deck thickness, Compressive strength and steel yield stress.
- Review the output load rating prediction (load rating value predicted by the CN from background calculations).
- Verify that the predicted load rating versus the input parameters lies within the space of design set points in the scatterplots.

The primary functional deliverable (readily accessible to practitioners) for this project will be an Excel workbook, allowing load rating engineers to quickly estimate (and directly use, at their discretion) the potential benefits of refined analysis and/or load testing. Bridge owners will be able to rationally substantiate decisions to defer maintenance or replacement for bridges in the inventory. Alternatively, bridge owners can potentially raise or remove load restrictions for bridges.

- *As provided by Fouad Jaber, Lead TAC Member*

Research Readiness Level (RRL) Assessment

RRL 4

Level 4: (Implementation with Follow up)

- Research/Technology refined and adopted by the Department. Benefits of the implementation will be evaluated for a time frame of 5 years.

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Nebraska Department of Transportation
Project SPR-P1 (19) M088
May 2020

Executive Summary, Research Readiness Level Assessment and Technology Transfer

Technology Transfer

Transportation Research Board Annual Meeting Lectern Presentations/Sessions

- Garcia, F., Garfias, J. P. P., Sofi, F., and Steelman, J., "Integration of Artificial Neural Networks in Bridge Load Rating and Case Study Application," Lectern Session 1304: Bridge Load Rating Washington, D. C., January 13, 2020.
- Sofi, F., Lin, X., Steelman, J. S. and Garcia, F., "Supporting Bridge Management with Advanced Analysis and Machine Learning," Poster Session 1565: Application of Machine Learning Methods for Operation and Maintenance of Transportation Systems (Part 1), Washington, D. C., January 15, 2019.
- Sofi, F., Lin, X., Steelman, J. S. and Garcia, F., "Supporting Bridge Management with Advanced Analysis and Machine Learning," Panel Session 1652: Application of Machine Learning Methods for Operation and Maintenance of Transportation Systems (Part 2), Washington, D. C., January 15, 2019.
- Steelman, J. S., and Sofi, F., "Supporting Bridge Management With Refined Load Ratings Estimated Using Machine Learning" AHD30: Structures Maintenance Committee Meeting, Washington, D. C., January 9, 2018.

ASCE/SEI Structures Congress 2018, Fort Worth, Texas, April 19-21, 2018

- Sofi, F., and Steelman, J. S., "Structural Evaluation Augmented with Artificial Neural Networks with a Demonstration for Bridge Management,"

This brief summarizes Project SPR-P1 (19) M088
"Supporting Bridge Management with Advanced Analysis and Machine Learning"
Nebraska Department of Transportation Research Program

Research on Weather Conditions and Their Relationship to Crashes

Principal Investigator: Mark Andersen-UNL
Co-Principal Investigator: Aemal Khattak-UNL
NDOT Lead TAC Members: Don Butler-Traffic Division
Matthew Baker-Operations Division

Traffic/Operations

Research Readiness Level Assessment (RRL) - Level 3
Research/Technology developed in an operational environment.
(will be followed up in real-world situation).

NDOT Recommendations Based on Completed Research

This research provided the Department the key finding that most winter weather related vehicular crashes analyzed in this study were associated with relatively minimal winter weather conditions. The reported crashes typically occurred either with low snowfall amounts or with residual snowfall on the ground even though it was no longer precipitating. This highlights the need for winter maintenance operations activities to continue well after a storm has left the region and the need for continued messaging of hazardous winter weather road conditions even on seemingly clear roads.

The findings highlighted the need for safety improvements to reduce the severity of crashes on icy pavement. NDOT plans to continue targeted application of High Friction Surface Treatment, removal of objects near the roadway, and add cable median barrier on I-80 where traffic is heavier, and the median is the narrower. Cable median barrier reduces the severity of vehicle crossover crashes due to icy conditions on roadways with divided medians. The barriers are designed to absorb the impact and stop out-of-control vehicles from entering oncoming traffic.

Research outcomes justify using intelligent transportation system (ITS) devices related to adverse road conditions. This implementation allows a process by which appropriate speeds can be determined and posted on Variable Speed Limit (VSL) signs when lower speed limits are warranted by weather, accidents, or other extraneous situations. The Department will fund deployment of VSL signs with Federal grant. Research follow up will compare crash data before and after the devices are deployed. Evaluation of the I-80 corridor will take about 4 years. This effort will have a decision support system using weather and traffic information by maintenance decision support system (MDSS) could prove to be an effective means of providing timely, accurate, and consistent messaging and posted speeds for the traveling public.

As provided by Don Butler and Matthew Baker, TAC Members Leaders

Interested in finding out more?
Final report is available at:
NDOT Research Website

Nebraska Rail Crossing Safety Research

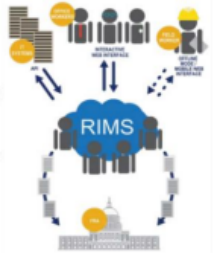
Principal Investigator: Aemal Khattak-UNL
NDOT Lead TAC Members: Jodi Gibson-Local Project Division

Safety

Research Readiness Level Assessment - Level 3
Research/Technology developed in an operational environment.
(will be followed up in real-world situation).

NDOT Recommendations Based on Completed Research

The research provided a better understanding of what the Department and Nebraska Counties need to update on the statewide Highway Railway Grade Crossings (HRGC) inventory. The research provided a model based on a Poisson regression model with scaled parameters as the Nebraska HRGC Crash Prediction Model. This model will need to be validated after the Department updates the HRGC inventory system for Nebraska's eight Districts, 593 Cities and 93 counties by adding missing values and removing errors in the existing database. This will be a collaboration effort between NDOT, Cities and Counties to complete a developed inventory checklist via field visits, NDOT pathweb (video log browser) and Google Earth when applicable. The validation of the new crash prediction model for rail crossing safety to assess the safety of rail crossings and for resource allocation among competing rail crossings will be useful for public agencies in Nebraska.



- *As provided by Jody Gibson, Lead TAC Member*

Interested in finding out more?
Final report is available at:
NDOT Research Website

RRL Assessment Provides

Level 1 and Level 2 RRL can be able to provide Ideas for Future Research/ Statement of Need

COMPLETED RESEARCH READINESS LEVEL (RRL) ASSESSMENT

- Research Readiness Level (RRL) Assessment identifies the immediate next steps for a research or technology development project by assigning an RRL number indicating how close to acceptance as standard practice the project is.
- The RRL Assessment provides a systematic method for identifying how NDOT can best support the development of research at various stages in the process.
- The RRL concept is based on the FHWA Technology Readiness Level Guide and was adapted to meet NDOT's specific needs.

RRL 1

Basic Research

- Materials, Pavements, Maintenance and Construction
- Roadway, Hydraulics and Environmental
- Structures and Geotechnical
- Traffic, Safety, & Planning Technology

RRL 2

Applied Research/ Proof of Concept/ Laboratory Level

- Materials, Pavements, Maintenance and Construction
- Roadway, Hydraulics and Environmental
- Structures and Geotechnical
- Traffic, Safety, & Planning Technology

RRL 3

Development Field Standard Practice Level

- Materials, Pavements, Maintenance and Construction
- Roadway, Hydraulics and Environmental
- Structures and Geotechnical
- Traffic, Safety, & Planning Technology

RRL 4

Implementation with Follow-up

- Materials, Pavements, Maintenance and Construction
- Roadway, Hydraulics and Environmental
- Structures and Geotechnical
- Traffic, Safety, & Planning Technology

RRL 5

Standard Practice/ Fully Understood

- Materials, Pavements, Maintenance and Construction
- Roadway, Hydraulics and Environmental
- Structures and Geotechnical
- Traffic, Safety, & Planning Technology

ALL RRL Documents

View All RRL Documents in Searchable Table Here

What obstacles did Nebraska overcome and how ?

Research section prepares a write up based on Discussion with Lead TAC Member	>
Request Technology Transfer from PI	>
Prepare draft for TAC Lead Member to review	>
Published based on RRL assessment	>
Upload project on NDOT SharePoint for future follow-up	>

SharePoint Site

Global view of project timelines w/automatic follow-up scheduling

Simple Access to Project Information - Searchable

Document Storage

Ability to upload documentation

Require assigning meta-data to each uploaded document

- USERS
  - NDOT Technical Lead when the project was completed,
  - NDOT Project Manager

NEBRASKA
Good Life. Great Journey.
DEPARTMENT OF TRANSPORTATION

M&R Research Readiness

Home
Search
Projects
Documents
Recent
testTask2
RRL Admin
RRL SharePoint Notes
UNL Digital Commons
NDOT Research
EDIT LINKS

Research Readiness Level

Projects Filtered by RRL

In-House Research

Projects Filtered to In-House Research

Funded Research

Projects Filtered to Federally Funded Research

Phased Projects

Links to Projects with Multiple Phases


THANK
YOU

APPENDIX J. OKLAHOMA DOT – RESEARCH AND INNOVATION PROGRAM BEST PRACTICES

OKLAHOMA Transportation

ODOT Research

Research and Innovation Program Best Practices

NOVEMBER 20, 2024

GARY HOOK

Organizational placement – Location in the agency, reporting to what level of management, etc.

Secretary/Director Transportation-Tim Gatz

V

Chief Innovation Officer-Joni Seymour

V

Office of Innovation-Tara Brown

V

Research and Implementation Team

Research & Implementation Team

OKLAHOMA Transportation

Engineering Services Branch

Ron F. Curb, PE, CPM, EM2

Gary Hook, PE, EM1

Wayne Rice, TM1

Sheree Black,

Program mission

SPR and other funds to provide transportation research for Oklahoma Transportation

- Research and implementation support to ODOT and transportation community
- Value toward safety, economics, time and environment

Program responsibilities

With direction from the Oklahoma Transportation (OT)'s Executive Staff and the Research Steering Committee,
ORI (Research and Implementation):

- Establishes and facilitates the process to identify, select, program, manage, and implement research
- Meets all federal-aid program requirements, including the preparation and maintenance of OT's Annual State Planning and Research (SP&R) Part 2 Annual Work Program (AWP) and an Annual SPR2 Performance & Expenditure Report (APER), host periodic Research Peer Exchange, and update OT's Research Guidance documents. OT will also coordinate implementation of STIC, EDC and AID projects.

Continued>

Program responsibilities II

Continued>

ORI:

- Establishes the research agenda based on the involvement and participation of its customers
- Develops and performs applied transportation research for all modes of transportation
  - Provides technical assistance to its customers to implement transportation research products
- Engages in both short-term and long-term research
  - Allocates funding for the research that includes leveraging national research funding from other transportation organizations and pooled funding opportunities

By the numbers: Size, research projects, budget, staff, etc.

Office Size- Authorizations, Four Assigned:

- 3 Project Managers and 1 Administrative Staff
- Oversight by Chief Innovation Officer and Deputy Chief Innovation Officer

SPR Part B (2) Budget FFY25- $5,489,467

- General Annual Items-7
- Continuing Research & Implementation Projects-7
- Continuing Pooled Fund Projects-14
- Oklahoma's Lead Pooled Fund Projects-2
- Active and Paid Pooled Fund Projects-7
- New Research & Implementation Projects-4

Recent Successes

2024 Oklahoma Transportation Research Day

Research Project Flowchart

Research Project “HIGHLIGHTER”

Oklahoma Transportation Library

Research Steering Committee

Biggest Challenges

- Sponsor Engagement
- PI Meeting Deadlines for Interim and Final Report Submissions
- Meeting Internal Target Dates for Annual Activities Timeline
- Agency-wide Standard Operating Procedure for non-SPR Funded Projects

URLs : Home page and Summaries

OOI / ORI (Office of Innovation / Research & Implementation)

https://oklahoma.gov/odot/programs-and-projects/programs/office-of-research-and-implementation.html

ODOT Research Highlighters

https://oklahoma.gov/odot/programs-and-projects/programs/office-of-research-and-implementation/implementation-highlighters.html

ODOT IMPLEMENTATION Highlighters

https://oklahoma.gov/odot/programs-and-projects/programs/office-of-research-and-implementation/highlighters.html

Questions

Ron Curb
Email: rcurb@odot.org, Phone 405-414-7740
Gary Hook
Email: ghook@odot.org, Phone 405-209-4352
Wayne Rice
Email: jrice@odot.org
Sheree Black
Email: sblack@odot.org, Phone 405-522-8971

OKLAHOMA Transportation Turnpike Authority Aeronautics

APPENDIX K. WYOMING DOT – WESTERN TRANSPORTATION RESEARCH CONSORTIUM

WESTERN TRANSPORTATION RESEARCH CONSORTIUM

WYOMING

Enid White, Research Manager
Wyoming Department of Transportation

Wyoming DOT

MISSION AND VISION OF RESEARCH CENTER

To ensure that the Research Center performs in an effective and efficient manner, and ensure all research activities are aligned with the WYDOT Purpose, Mission, Vision and Values.

Wyoming DOT - Overview

- STAFF: Research Manager
- SUPERVISOR: Assistant Materials Engineer
- LOCATION: Materials Department
- FUNDING: 100 percent SPR-B FUNDS

  (Approx: $1.6 Million a year)

  (80 percent Federal/20 percent State)
- Research projects and Pooled Funds

Wyoming DOT – FAST Act

Funding

The FAST Act further requires "not less than 25 percent of [the 2 percent]… be expended by the State for research, development, and technology transfer activities…" [23 U.S.C. 505(b)(1)] and that the federal share for SP&R shall be 80 percent. [23 U.S.C. 505(d)]

Wyoming DOT - RAC

Governing Body – Research Advisory Committee

- Permanent positions include the Research Engineer, State Research Manager, and FHWA representative.
  - The State Research Manager is a non-voting member of the RAC and acts as the chairperson of the RAC.
  - The Research Engineer is a non-voting member of the RAC. This individual acts as the chairperson of the RAC in the absence of the Research Manager.
  - The FHWA representative is a non-voting member of the RAC. This individual is invited to attend the meetings by virtue of his/her office or position, and acts as a liaison between WYDOT and FHWA

Wyoming DOT – RAC (cont'd)

Governing Body – Research Advisory Committee

- Rotating voting members include:
  - State Bridge Engineer
  - Geographic Information System (GIS)/Intelligent Transportation System (ITS) Program Manager
  - State Construction Engineer/State Maintenance Engineer
  - State Highway Development Engineer
  - State Highway Safety Engineer
  - State Materials Engineer
  - State Planning Engineer
  - State Traffic Engineer
  - Chief Engineering Geologist
  - Environmental Services Manager
  - District Engineers (5 total)

Wyoming DOT - Website

Website

- Links to Federal and State Libraries and Databases
- Information regarding the RAC makeup
- Current Research Projects
- Guidelines and Evaluations
- Wyoming Technology Transfer Center
- Work Flow and Work Program
- Final Research Projects
- Call for Research Proposals

Wyoming DOT - Authority

Authority

- WYDOT'S Operating Policies
- Section 450 of Title 23 of the Code of Federal Regulations, Planning Assistance and Standards, Statewide Transportation Planning, which guides statewide transportation planning and programming
- Section 420 of Title 23 of the Code of Federal Regulations, Planning and Research Program Administration, which grants DOTs the authority to administer State Planning and Research (SP&R) funds
- Section 200 of Title 2 of the Code of Federal Regulations, OMB Guidance for Federal Financial Assistance, which establishes uniform administrative requirement, cost principles, and audit requirements for Federal awards to non-Federal entities.

Wyoming DOT – Challenges

Challenges overcome

- Getting buy in from others at WYDOT.
- Lack of information on what the program duties are.
- Training on research centers.

Wyoming DOT - Successes

Success and Best Practices

- Staying ahead of the curve on state and local statutes, standards, best practices, trends
- Offering training on intellectual property, Section 508, artificial intelligence, 2 CFR 200
- Evaluating the program every 3-4 years
- Collecting performance measures for the program
- Drafting manuals for the program so that information will be available for the future

Wyoming DOT – Data Collection

Data Collected on all Projects

- Purpose and goals of the project
- Principal Investigator
- Sponsor/Contractor
- Project area/WYDOT department
- Funds
- Strategic Intent
- Project Type
- Outcome Measures
- Efficiency
- Inputs
- Timeliness
- Funding Extensions

Wyoming DOT - Contact

Enid White

Research Manager

WYDOT

Enid.white1@wyo.gov

307-421-7859

APPENDIX L. UTAH DOT – HOW TO BEST SHARE RESEARCH ACTIVITIES WITH DOT LEADERSHIP

How Best To Share Research Activities With DOT Leadership

Cameron Kergaye, UDOT Research & Innovation

WTRC Peer Exchange, November 20, 2024

UDOT Keeping Utah Moving

UDOT Leadership Structure

Leadership Meetings and Communication

- Semi Annual Meetings
- Annual Research Program Approval
- Post TRB Annual Meeting Follow up
- Email and Newsletter Articles
- Annual Innovation Awards Luncheon
- On Call for Requests

Information Shared

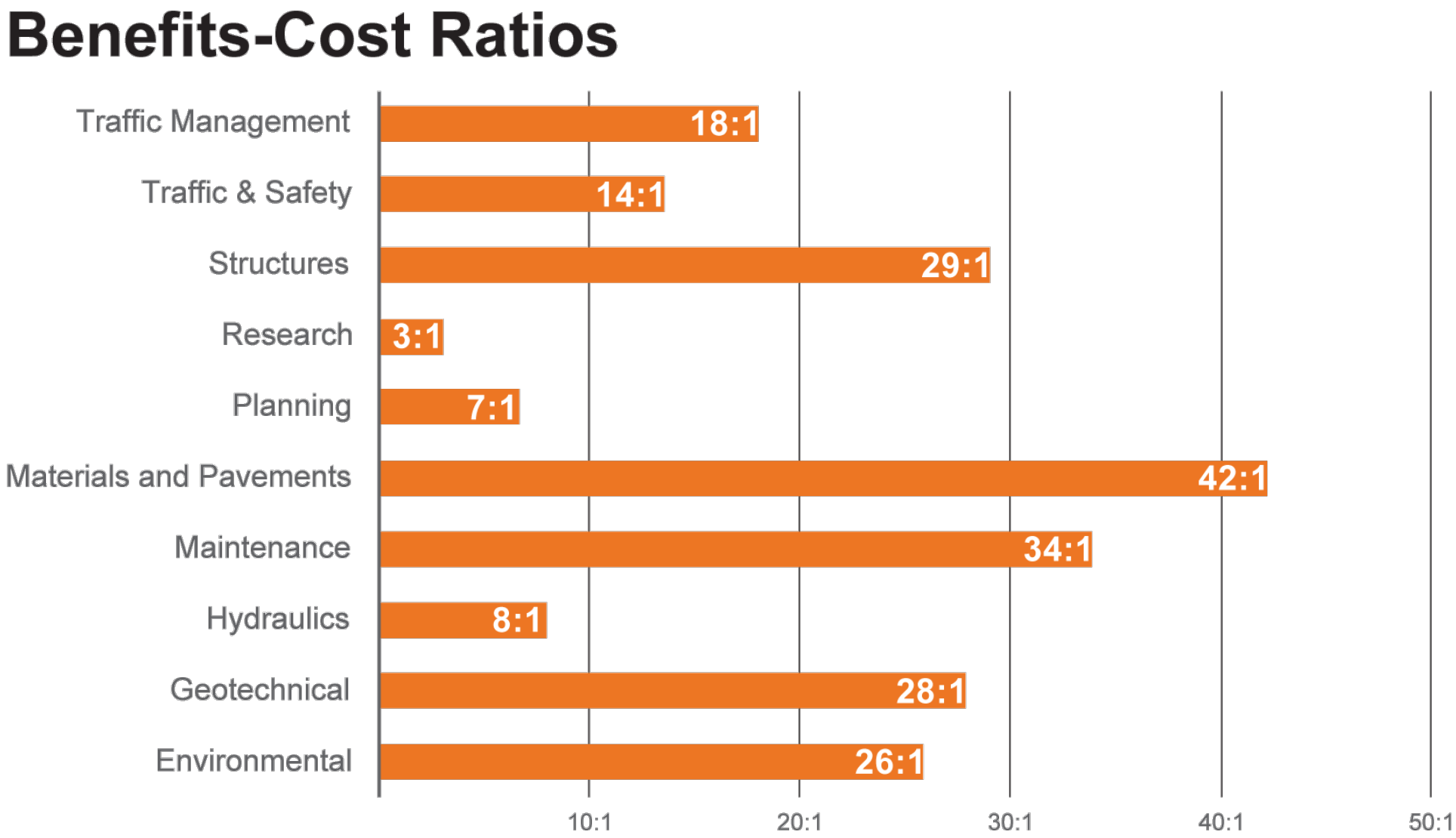
- Active Research Projects
- Research Projects and Results
- Project Implementation Status
- Special Research for Leadership
- Innovation Stories
- Innovation Metrics
- Program Requests
- TRB Implementations
- National Committee Participation

Active Research Projects

Research Projects and Results

- Repairing Delaminated Partial-Depth Precast Bridge Deck Panels
  - Objective: Address delamination that can form in some decks between the cast-in-place concrete section and underlying partial-depth precast deck panels; avoid blow-throughs
  - Results: Epoxy injection performed as well as combined epoxy and mechanical anchors for low deflections

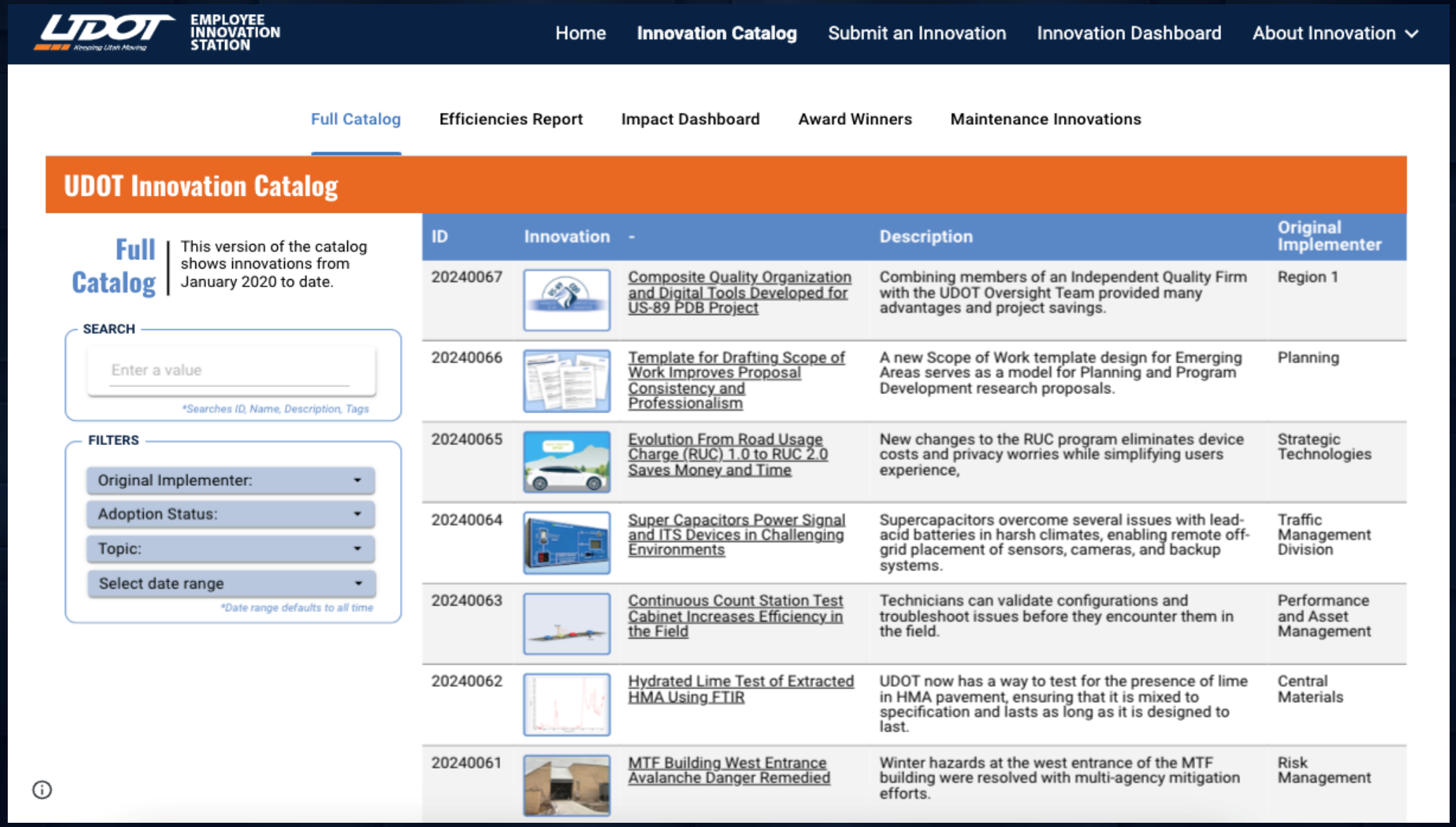
Project Implementation status



Special Research for Leadership

- Survey of e-bike policies and practices
- Litter research and recommendations
- ROW and homelessness
- Utility relocation costs
- Drone registration

Innovation Stories



Innovation Stories II

YEAR IN REVIEW

In many ways, 2023 was a historic year for UDOT. Amidst the challenges posed by record-breaking snowfall, significant spring flooding, and the growing and evolving transportation needs across the state, employees went above and beyond to keep Utah moving. Our drive to go the extra mile is rooted in our culture of innovation—a deep and resounding need to push the boundaries of what's possible. We innovate not for the sake of new ideas or solutions, but rather, to empower the many dreams and opportunities we share with the communities we serve.

NOV 2022 – APRIL 2023
Avalanche Control
Crews worked tirelessly to mitigate avalanche danger and keep travelers safe.
Little Cottonwood Canyon
- 98 avalanches onto the roadway
- 63 D3 and greater in size
- 1,072 artillery rounds fired
- 6 helicopter missions

NOV 2022 – APRIL 2023
Winter Operations
Crews worked around the clock to Keep Utah Moving during nearly 35 major storms.
2022-2023 Stats
- 567 snow plows
- 5,365,234 miles plowed (60% more than previous year)
- 500,000 cubic yards of salt used (300,000 more than the year before)

JAN 8 – 12, 2023
UDOT employees attend the **National Transportation Research Board (TRB) Annual Meeting**

NOV 2022 – APRIL 2023
Utah's Record-Breaking Snowpack
- Average snow water equivalent (SWE) 15.8 inches
- 2023 snowpack provided 30 inches SWE
- Alta recorded 903 inches of snow by April 30
That's 75 feet of snow, 155 inches more than the previous record and 403 inches more than normal.

APRIL 2023 – JUNE 2023
Major Flooding Averted
"High snowpack meant some flooding occurred. However, improvements to infrastructure, a slow melting period and emergency preparedness actions by citizens and state officials minimized damage."

2023
The Challenge of Growth
Utah's population growth and strong economy is driving transportation demand like never before.
Growth Stats
- Utah jumps from 34th to 30th most populous state, now a midsize state
- 61% growth from migration
- Job growth consistently best in the nation
- 34 billion vehicle miles traveled in 2022 projected to increase to 51 billion by 2040

AUG 14, 2023
New Lane Striping technology announced

JUL 1, 2023
New Trails and Transit Division launched

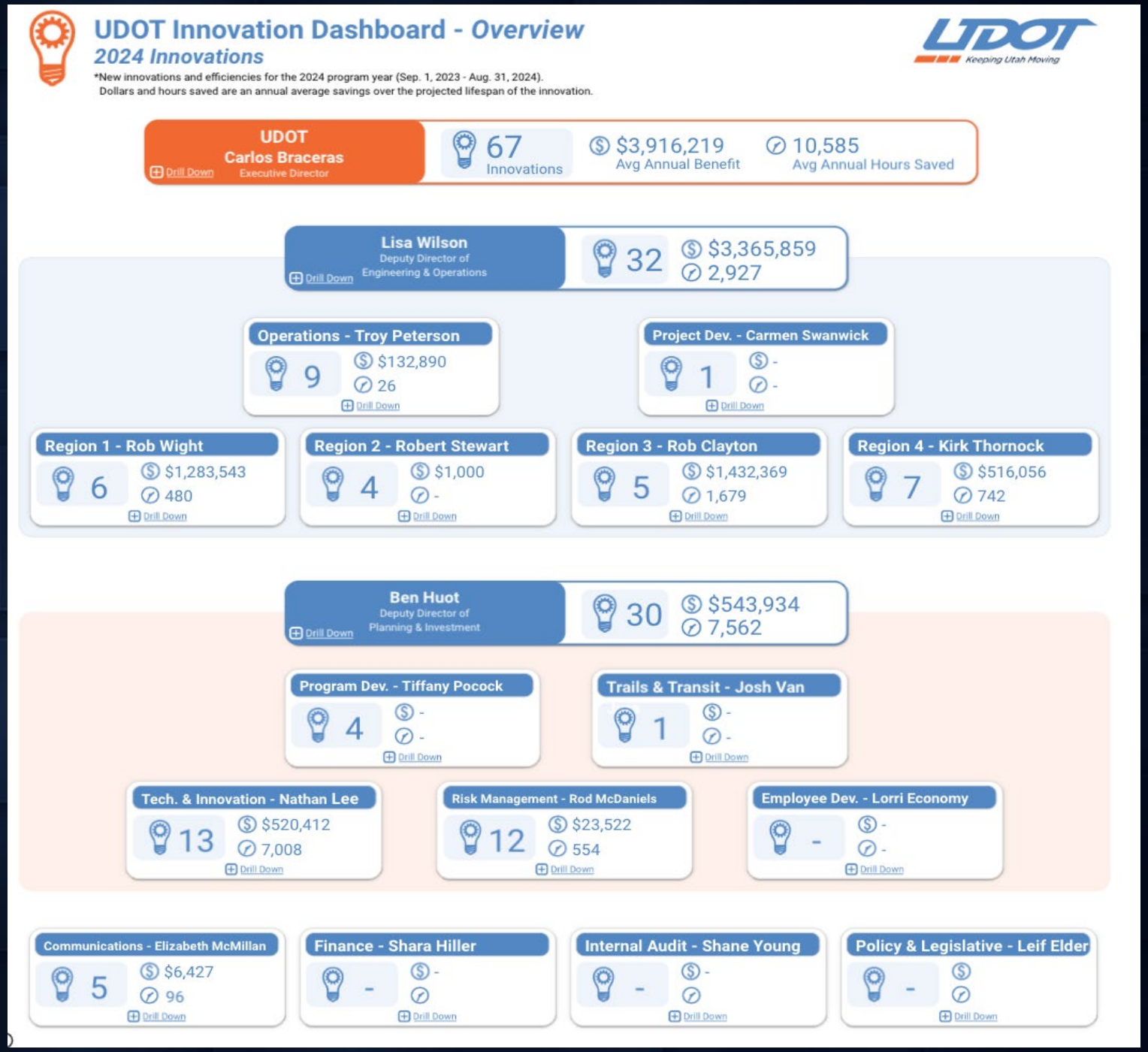
MAY 23, 2023
New Web-Based Innovation Catalog and Efficiencies Report

2022 NOVEMBER DECEMBER JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUS

UDOT Keeping Utah Moving

Innovation Metrics

- Number of collected innovations stories: 67
- Reported Quantifiable benefits: 29
- Annual Benefit: $3,916,219
- Hours Saved: 10,585
- Significant Impacts: 16
- Project Innovations: 10
- Collaboration outside UDOT: 26



Program Requests

- Monetary prizes to reward efforts and drive participation
  - Quarterly prizes ($50, 3 innovations: Dec, Mar, Jun, Sep)
  - Prizes for Finalists ($50 each/$500)
  - Prizes for Winners ($100 each/$1000) + team/unit ($1000)
- Maximum Cost: $22,000

TRB Implementations

- 2025: Sending 22 people to annual meeting
- 2024 : Sent 17 people. 12 people collected and reported ideas; 19 ideas collected; 12 ideas Implemented.
- 2003 - 2024: Sent 319 attendees, 135 unique employees, average 15 per year
  - Total number of ideas recorded: 527
  - Total number of implemented projects: 236
  - Total estimated savings: $200,879,500
- Considering using estimated savings and benefits

National Committee Participation

- TRB
  - # of committees/panels: 58 (15 committees/43 project panels)
  - # of unique individuals on TRB committees/panels: 37
  - # of committee/panel chairs: 12
  - # of committee/panel chairs: 10 unique employees
  - # of employees serving on at least 2 TRB committees/panels: 13
- AASHTO
  - # of committees and subcommittees: about 235
  - # of unique individuals on AASHTO committees: 91
  - # of chairs/co-chairs: 9 unique employees / 14 total
  - # of vice chairs: 7 unique VCs / 11 total
  - # of employees serving on at least 2 AASHTO committees: 56

National Committee Participation - Survey

What are your committee's objectives?

- AASHTO manuals
- Electronic engineering standards
- Eliminating traffic fatalities & serious injuries
- Application of research findings
- Cost-effective evaluation of materials / products / devices
- State of the art / state of the practice
- Quality assurance
- National resilience & security

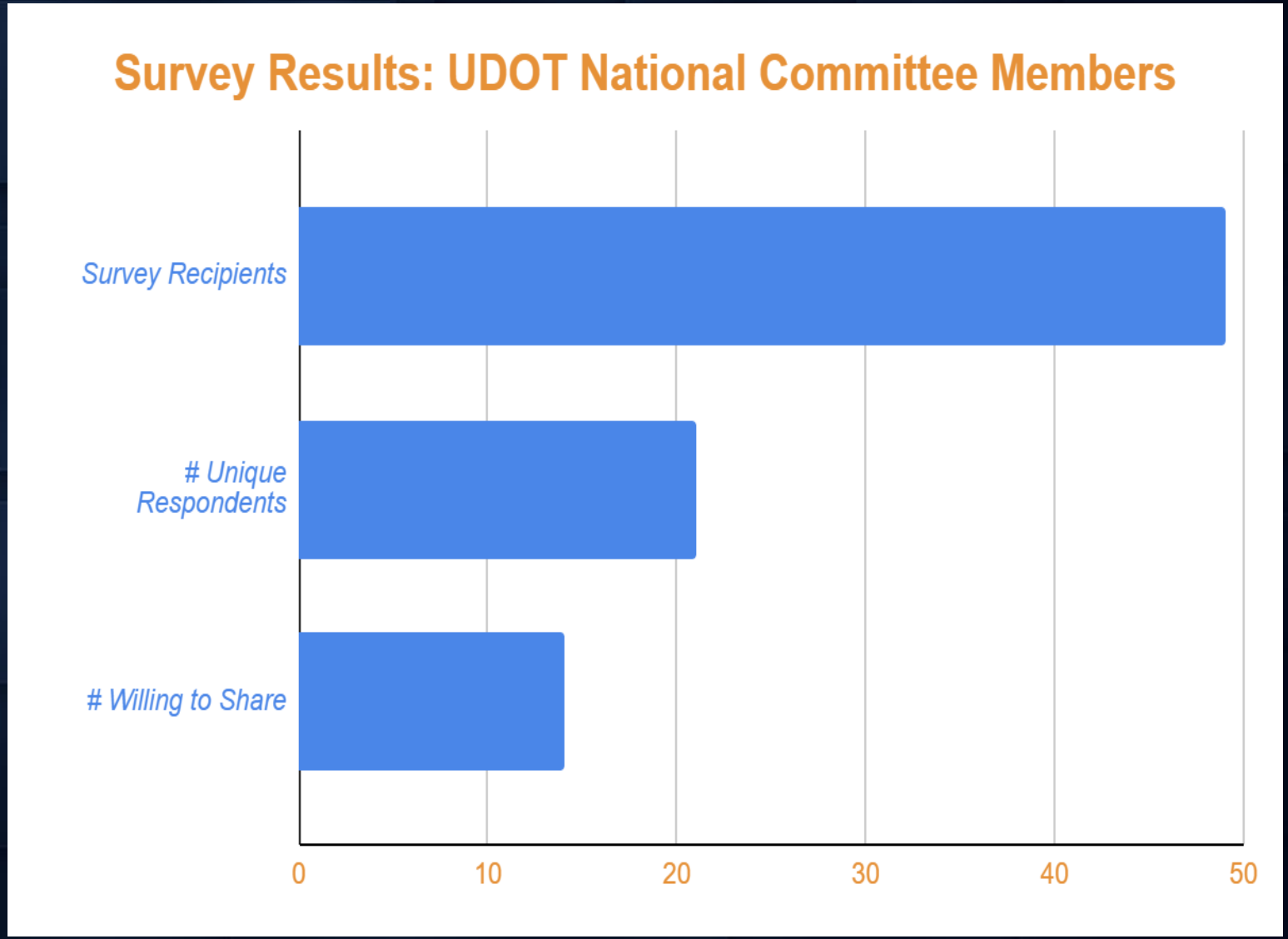
How does your participation help UDOT?

- Q&A email forum
- Networking
- Pooled fund studies
- Meeting federal performance requirements / improving program funding
- Gained perspective
- Advanced UDOT's standards
- State of the practice info

National Committee Participation – Survey II

Would you share a newsletter article on how your committee involvement helps UDOT?

- 14 of 21 individuals (67%) are willing to share
- 71% of AASHTO committee members said “yes”
- 25% of TRB members said “yes”



National Committee Questions

- Is UDOT supporting the right committee?
- Do we have the right person on each committee?
- What are their contributions or achievements?
- How is committee information or opportunities shared?
- Is there more we should be doing with committees?

APPENDIX M. NORTH DAKOTA DOT – HOW TO BEST SHARE RESEARCH ACTIVITIES WITH DOT LEADERSHIP

How To Best Research Activities with Leadership

WTRC - Peer Exchange 2024

NORTH Dakota
Be Legendary.™

Leadership Engagement Snapshot

- Attend annual RAC meeting.
- Annual Review of the SPR Work Program.
- Attend TRB and stay involved in the NCHRP research cycle.
- TRIP Submission Approval.
- Engage directly as needs arise communication lines are always open.

Leadership History

- NDDOT is Small Connected Organization
- University Research is Highlighted at the annual RAC meeting and in the work program
- Research One Pagers
- Involvement in the TRIP program
- Innovation Spotlights.

Challenges.

- Staffing
  - Minimal Internal Research Staff and SME across the department.
- Funding
  - Basic Funding levels primary focused on funding core activities and pooled funds.


Empower people
Improve lives
Inspire success
NORTH
Dakota
Be Legendary.

Thank You

TJ Murphy, PE
Research Engineer
tjmurphy@nd.gov

APPENDIX N. NEVADA DOT – HOW TO BEST SHARE RESEARCH ACTIVITIES WITH DOT LEADERSHIP

WTRC/Peer Exchange Theme 3

How Best to Share Research Activities with DOT Leadership

November 11, 2024

Leadership Involvement Snapshot

- Research Management Committee/DOT Leadership
  - Director x1
  - Deputy Directors x3
  - Assistant Directors x5
- Work Program Review/Approval
  - Including amendments
- Research Proposal selection approval
  - With minimal review
- Adds up to ~ twice-yearly check-ins
- Very hands off
  - Good and bad

Activity Sharing Success: What and How

- Communication Success
  - Held our first in-person RMC meeting since 2018
- How did we get here?
  - Respectfully mentioned meeting in-person at every appropriate opportunity
  - Buy-in from direct management
- Obstacles Identified
  - Complacency/lack of enthusiasm
  - Communication gaps
  - Availability
- Obstacles Overcome
  - Change in leadership
  - Started at the beginning: who we are/what we do
  - Highlighted meeting as an opportunity for training
  - Offered shortest time possible for maximum attendance
  - Conveyed enthusiasm and gratefulness for their time

NEVADA DOT SAFE AND CONNECTED

Activity Sharing Best Practice: What and How

- Best Practice
  - We have some good practices but I'm not sure that they're best practices
- How did we get here?
  - We're not there yet
  - We're at the beginning of rebuilding open communication and a relationship with NDOT leadership
- Obstacles Identified
  - Lack of enthusiasm for research
  - Leadership availability
  - Growing pains
- Obstacles Overcome
  - Seeking additional buy-in from higher leadership/direct chain of command

Significant Challenge in Search of Significant Solutions

- Challenge: Imparting the importance of Research
  - Getting in the same room as the RMC and sharing information that's pertinent to them
  - How to avoid getting too deep in the weeds?
  - How to get active participation?
- Solutions: We're at the beginning
  - Had our first in-person RMC meeting since 2018!
  - Trying to build enthusiasm for research
  - Approaching our new Assistant Director and explaining the importance of meeting in-person at least twice a year
  - Trying to breakdown the "gate keeper" mentality between the RMC and the Research Program

NEVADA DOT SAFE AND CONNECTED

Photo credit: Nadeen Flynn

“Blame it or praise it, there is no denying the wild horse in us.”
- Virginia Woolf

Nevada DOT: Safe and Connected

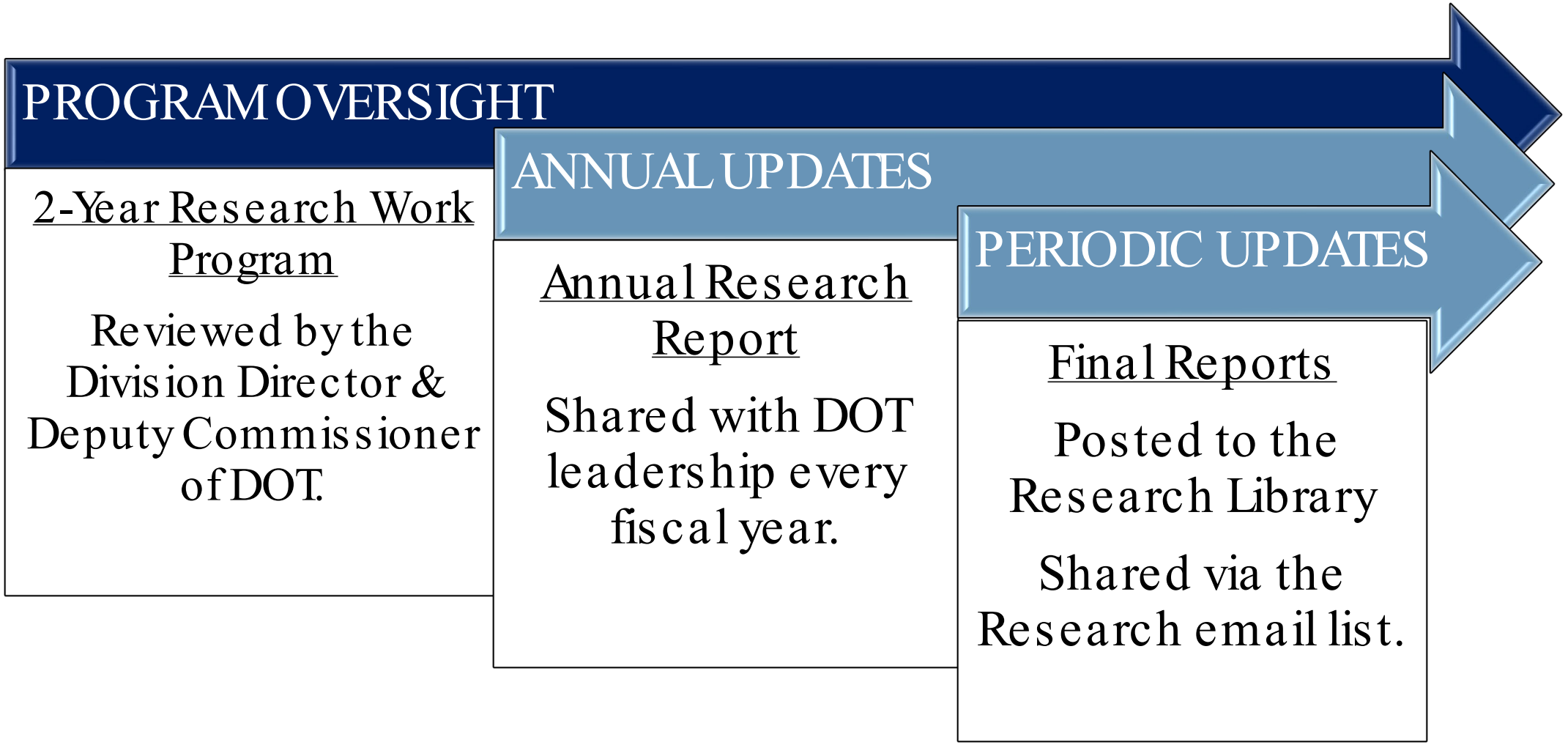
APPENDIX O. ALASKA DOT&PF – SHARING RESEARCH ACTIVITIES WITH DOT LEADERSHIP

Alaska Department of Transportation and Public Facilities

Sharing Research Activities

With DOT Leadership

Sharing Research Activities



Sharing Research Activities II

Best Method for Sharing Research Activities

Final Presentations

In person or virtual presentation

Principal Investigator discusses project overview and findings

- Turn out varies depending on the topic and which departments are the primary audience.
- There is a larger attendance for general construction practices verses bridge design, for example.
- Not quite webinars
  More sporadic

Sharing Research Activities III

Best Method for Sharing Research Activities

Annual Research Report

Summary of the entire Research Program

Overview of all active research projects and activities

- Best for those who don't have time for highly technical presentations or reports
- Required by FHWA
  No extra work to produce
- Doesn't discuss final results or implementation

Sharing Research Activities IV

Developing an efficient strategy for reporting and tracking progress and outcomes	Additional Staff!
Producing a quarterly update Newsletter, webinar, report, etc.	✓ I should have two full time staff in the coming year.

Sharing Research Activities V

Questions

APPENDIX P. CALTRANS – STRATEGIES FOR COMMUNICATING RESEARCH ACTIVITIES TO LEADERSHIP

DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Strategies for Communicating Research Activities to Leadership

How Does Caltrans Leadership Typically Interact with the Research Program?

- Governance
  - DP-0081-R1 established the Research and Deployment Advisory Committee (RDAC)
    - Approval of the annual research portfolio
- Leadership participates in various events
  - Vendor Day
  - Directors Innovation Awards
- DRISI regularly updates the Executive Board
- DRISI prioritizes Executive research requests through a contingency process

What are Caltrans Research Program's Greatest Successes?

- Repurposing of resources to address research and innovation needs
  - Implementation Program
  - Innovation Team (iTeam)

- Focusing on pursuing and executing new, innovative communication strategies to share the research program with leadership, stakeholders, and the rest of Caltrans.

What are Caltrans Research Program's Most Significant Challenges

- Communication from leadership on their most pressing challenges and how DRISI can best assist
- Directing the research focus toward research needs 20+ years out
- Establishing a more nimble research selection process
- Research project closeout and remediation
- Contracting with out-of-state universities
- Identifying gaps in research
- Developing research roadmaps
- Research cost inconsistencies

RESEARCH COMMUNICATION DOCUMENTS

- Research Notes

https://dot.ca.gov/programs/research-innovation-system-information/research-notes

- Research Results

https://dot.ca.gov/programs/research-innovation-system-information/research-results

- Research Final Reports

https://dot.ca.gov/programs/research-innovation-system-information/research-final-reports


DRISI
CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Notes

Caltrans Field Trials of the Intelligent Truck-Mounted Attenuator (ITMA)

To evaluate the effectiveness of ITMA in actual Caltrans operating conditions and identify any problems which arise during the on-road field trials.

Maintenance

MAY 2024

Project Title:
Caltrans Field Trials of the Intelligent Truck-Mounted Attenuator (ITMA)

Task Number: 4159

Start Date: January 2, 2023

Completion Date: December 31, 2024

Task Manager:
Hamid Ikram
Transportation Engineer (Electrical)
hamid.ikram@dot.ca.gov

WHAT IS THE NEED?

Caltrans highway maintenance and repair activities often require a shadow (trailing) truck equipped with a Truck-Mounted Attenuator (TMA) to provide impact protection for workers from errant vehicles. The nature of shadow trucks, or TMA trucks, dictates that they will be hit by errant vehicles, so while the TMA truck increases safety for the workers, each collision still compromises the safety and well-being of the shadow truck driver. There is a need to remove Caltrans' shadow truck drivers from the risks associated with errant vehicle impacts. This is expected to reduce operator injuries due to public vehicle impacts with the TMA vehicles in highway work zones.

The ITMA, which achieves this, was successfully evaluated on closed test sites in previous research, including testing on a closed segment of State Route 905 (SR905). To proceed towards deployment of the ITMA for regular Caltrans operations, controlled field trials on public roads with and without an ITMA safety operator are essential.

WHAT ARE WE DOING?

This research project plans to perform monitored field trials of the Intelligent Truck-Mounted Attenuator (ITMA) system on California public roads, to demonstrate its feasibility. During normal operations of the ITMA system, the lead vehicle (LV) lays down electronic breadcrumbs (E-crumb) utilizing Global Positioning System (GPS) technology. The steering, engine throttle, and braking of the follower vehicle (FV) are controlled by the Kratos system to follow the E-crumb path of the LV and maintain a user-defined distance.

The contractor from Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center at UC Davis will work with Kratos on any system modifications that

DRISI provides solutions and knowledge that improves California's transportation system

ADA Notice: Users with accessibility issues may contact the California Department of Transportation, Division of Research, Innovation and System Information. For TTY assistance, call the California Relay Service at 711, email pm2.communications@dot.ca.gov or write Caltrans, DRISI – MS-83, P.O. Box 942873 Sacramento, CA 94273-0001


DRISI
CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Results

Roadside Safety Performance Measures for Specific Countermeasures to Protect Workers

This project developed draft engineering memos for specific safety recommendations.

Design

AUGUST 2024

Project Title:
Roadside Safety Performance Measures for Specific Countermeasures to Protect Workers

Task Number: 4163

Start Date: July 20, 2022

Completion Date: December 31, 2023

Task Manager:
Hamid Ikram
Transportation Engineer, Electrical
hamid.ikram@dot.ca.gov

WHAT WAS THE NEED?

The previously completed research project (Task ID 2761) developed a number of recommendations related to roadside features such as hardscape, which if implemented, are expected to enhance worker safety. There was a need to prioritize the list of recommendations and create draft guidance documents (such as draft engineering memos) that would provide templates for Caltrans Divisions of Maintenance and Design to use to update their Maintenance and Highway Design Manuals, and thus realize these safety benefits.

WHAT WAS OUR GOAL?

The goal of this project was to develop draft engineering memos for key safety recommendations and help Caltrans incorporate the selected safety recommendations into appropriate manuals, with the goal of enhancing worker safety.

WHAT DID WE DO?

In this project, researchers from the Advanced Highway Maintenance and Construction Technology (AHMCT) Research Center, UC Davis revisited the list of safety recommendations identified in the previous research (Task ID 2761 "Performance Measures for Roadside Features") and developed an updated list of potential safety recommendations. This list was presented to the Caltrans project panel, and further input was solicited. Researchers worked with the project panel and developed a prioritized list. The AHMCT researchers discussed each topic with the panel to develop a clearer understanding of the issues, developed survey questions and conducted surveys of Caltrans

DRISI provides solutions and knowledge that improves California's transportation system

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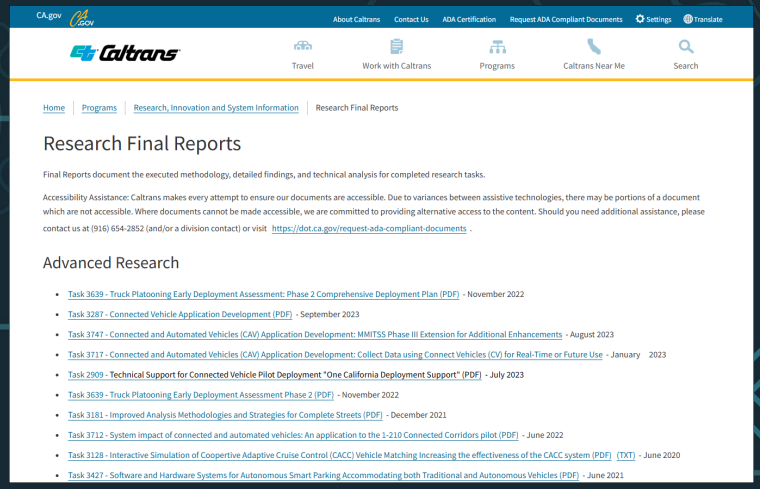
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Caltrans

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Home | Programs | Research, Innovation and System Information | Research Final Reports

Research Final Reports

Final Reports document the executed methodology, detailed findings, and technical analysis for completed research tasks.

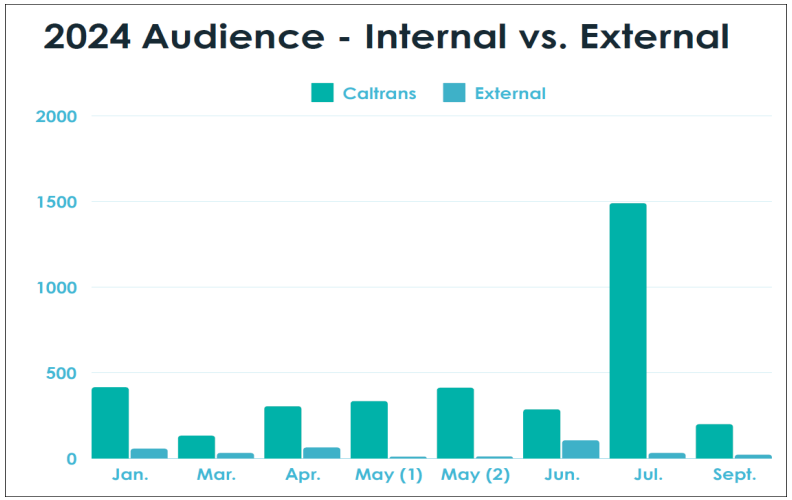
Accessibility Assistance: Caltrans makes every attempt to ensure our documents are accessible. Due to variances between assistive technologies, there may be portions of a document which are not accessible. Where documents cannot be made accessible, we are committed to providing alternative access to the content. Should you need additional assistance, please contact us at (916) 654-2852 (and/or a division contact) or visit https://dot.ca.gov/request-ada-compliant-documents .

Advanced Research

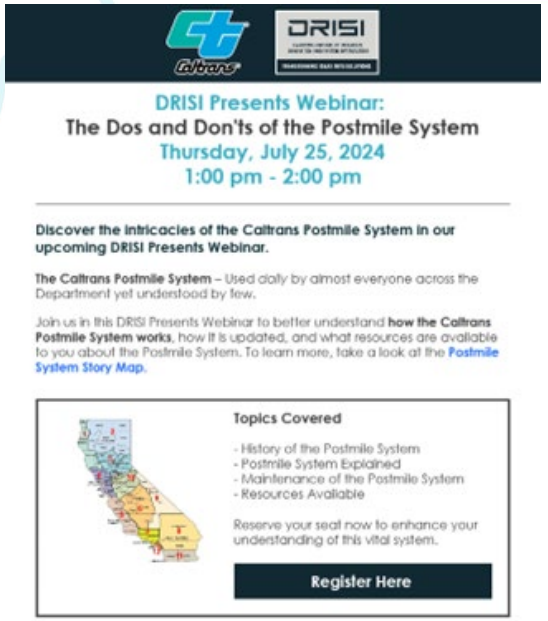
- Task 3639 - Truck Platooning Early Deployment Assessment: Phase 2 Comprehensive Deployment Plan (PDF) - November 2022
- Task 3287 - Connected Vehicle Application Development (PDF) - September 2023
- Task 3747 - Connected and Automated Vehicles (CAV) Application Development: MMITSS Phase III Extension for Additional Enhancements - August 2023
- Task 3717 - Connected and Automated Vehicles (CAV) Application Development: Collect Data using Connect Vehicles (CV) for Real-Time or Future Use - January 2023
- Task 2909 - Technical Support for Connected Vehicle Pilot Deployment "One California Deployment Support" (PDF) - July 2023
- Task 3639 - Truck Platooning Early Deployment Assessment Phase 2 (PDF) - November 2022
- Task 3181 - Improved Analysis Methodologies and Strategies for Complete Streets (PDF) - December 2021
- Task 3712 - System impact of connected and automated vehicles: An application to the 1-210 Connected Corridors pilot (PDF) - June 2022
- Task 3128 - Interactive Simulation of Coopertive Adaptive Cruise Control (CACC) Vehicle Matching Increasing the effectiveness of the CACC system (PDF) (TXT) - June 2020
- Task 3427 - Software and Hardware Systems for Autonomous Smart Parking Accommodating both Traditional and Autonomous Vehicles (PDF) - June 2021

WEBINARS

- Research Connections
  - https://www.youtube.com/playlist?list=PL2wehjQAfiNFcYBIWQC7xhRplerqYijGh
- DRISI Presents
  - https://www.youtube.com/playlist?list=PL2wehjQAfiNENvfA7ZYt6B6Slq2D1_8LD

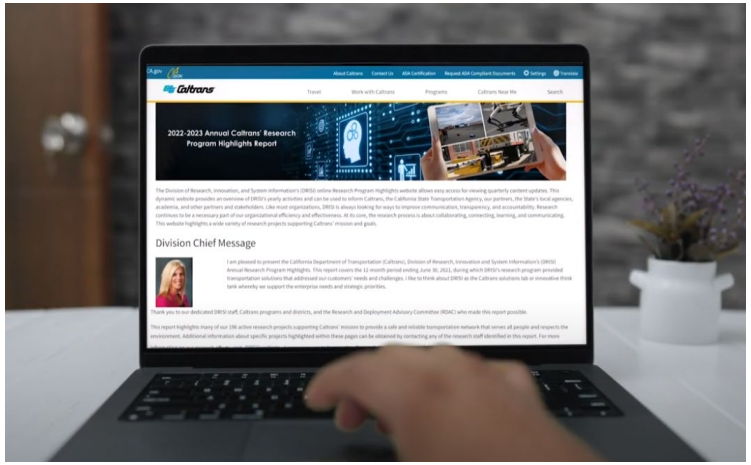


Average number of Caltrans & External attendees in 2024



VIDEOS

- Mower Demo
- Annual Caltrans Research Program Report Highlights
- DRISI Research Program



REPORTS

- Transportation Research Board (TRB) Annual Meeting Report
- Caltrans Transportation Pooled Fund (TPF) Reports
- Caltrans Fact Booklet
  - 2024 Caltrans Facts (PDF)
- DRISI Accomplishments Annual Report

FACT SHEETS

Research Program Steering Committees Fact Sheets

Division of Research, Innovation and System Information | Fact Sheet 01

Fact Sheet: Equipment

This fact sheet provides an overview of equipment research projects that advance transportation and contribute to a safe, sustainable transportation network for all.

Current and Upcoming Research

Task 4288: Evaluation of Mobile Robot Teams for Security at the California Department of Transportation (Caltrans) Equipment Yards and Maintenance Stations

The purpose of the project is to evaluate the usefulness of a mobile robot security guard to deter theft and also capture critical information on intruders similar to Task 4153. The system being evaluated is the Boston Dynamics robot dog "Spot", which has been outfitted by Asylon Robotics for security purposes. The robots regularly patrol a given yard after business hours and log security events such as intruders, suspicious vehicles, open and broken gates, etc. The project aims to save the state money by reducing theft at equipment yards.

Photo 1: Robot Security dogs for equipment yards

Division of Research, Innovation and System Information | Fact Sheet 01

Fact Sheet: Modal

This fact sheet provides an overview of multimodal research projects that advance transportation and contribute to a safe, sustainable transportation network for all system users.

Current and Upcoming Research

Task 4326: Equity in Payments for Transit and Congestion Charging

The proposed research will develop a data-driven and stakeholder-reviewed framework for improving users' equitable access to, and experience of, payment across all modes of transportation.

This framework will incorporate proposed shared standards to make it easier for all users to pay for and use the transportation system, increase the efficiency of transactions, and enable cross-modal payments and incentives to encourage mode shift to increase.

Photo 1: Wilshire/Vermont metro station in Los Angeles

Division of Research, Innovation and System Information | Fact Sheet 01

Fact Sheet: Advanced Research

This fact sheet provides an overview of advanced research projects that advance transportation and contribute to a safe, sustainable transportation network for all.

Task 3900: Congestion Impacts Reduction via Connected and Automated Vehicles-in-the-loop Lagrangian Energy Smoothing

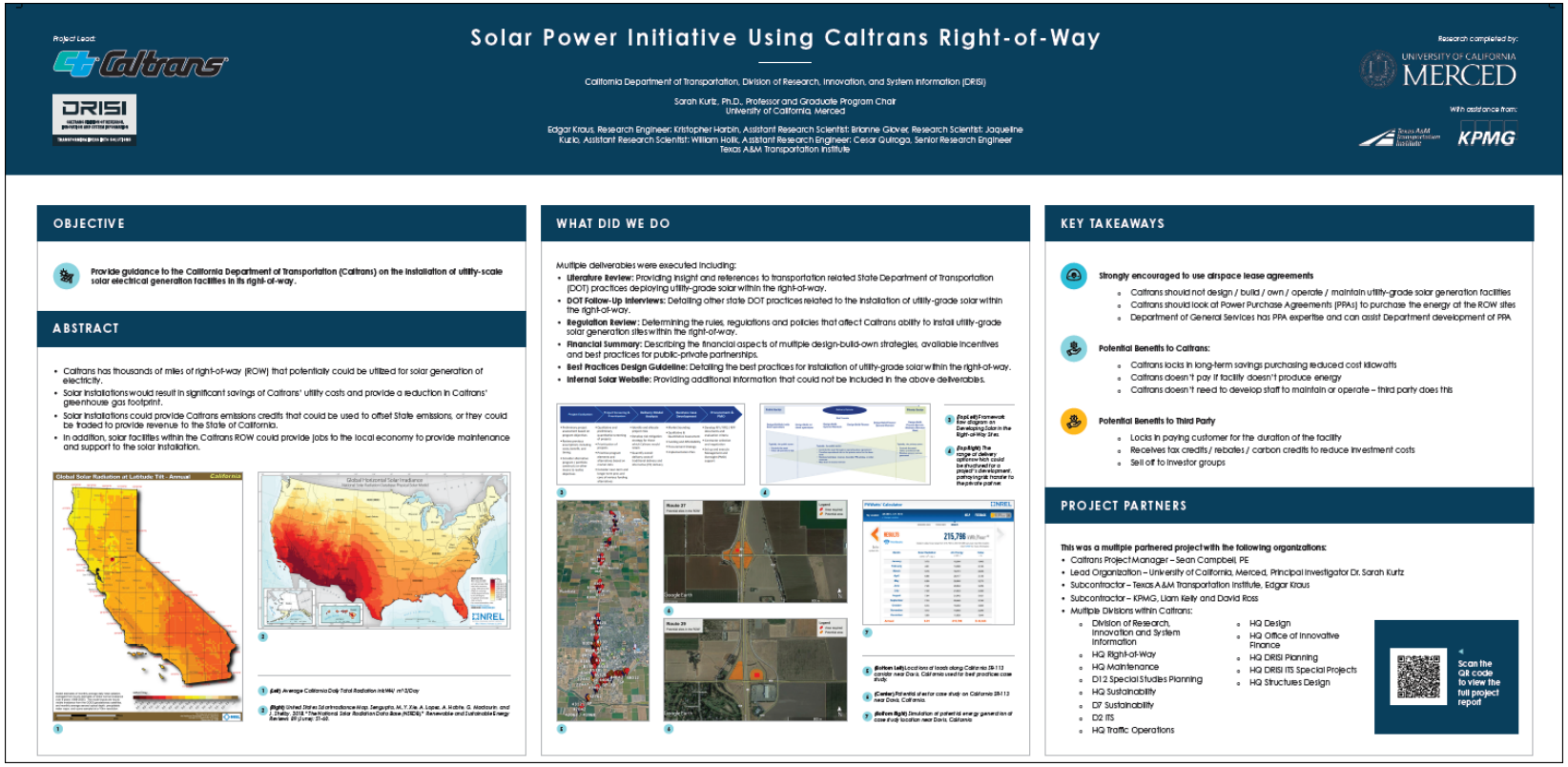
The project aims to reduce instabilities in traffic flow, called "phantom jams" that cause congestion and wasted energy. If you have ever encountered a temporary traffic jam for no apparent reason, this might have been a phantom jam that occurred naturally because of human driving behavior.

The project is significant because it shows a single vehicle using adaptive cruise control to reduce shockwaves can also reduce fuel consumption in that vehicle by 10%-20%.

Photo 1: Advanced Research on traffic Jams

POSTER

American Association of State Highway and Transportation Officials (AASHTO) Poster



Solar Power Initiative Using Caltrans Right-of-Way

California Department of Transportation, Division of Research, Innovation, and System Information (DRISI)

Sarah Kurtz, Ph.D., Professor and Graduate Program Chair
University of California, Merced

Edgar Kraus, Research Engineer; Kristopher Harbin, Assistant Research Scientist; Brianne Glover, Research Scientist; Jaqueline Kurtz, Assistant Research Scientist; William Holik, Assistant Research Engineer; Cesar Quiroga, Senior Research Engineer
Texas A&M Transportation Institute

OBJECTIVE

Provide guidance to the California Department of Transportation (Caltrans) on the installation of utility-scale solar electrical generation facilities in its right-of-way.

ABSTRACT

- Caltrans has thousands of miles of right-of-way (ROW) that potentially could be utilized for solar generation of electricity.
- Solar installations would result in significant savings of Caltrans' utility costs and provide a reduction in Caltrans' greenhouse gas footprint.
- Solar installations could provide Caltrans emissions credits that could be used to offset State emissions, or they could be traded to provide revenue to the State of California.
- In addition, solar facilities within the Caltrans ROW could provide jobs to the local economy to provide maintenance and support to the solar installation.

WHAT DID WE DO

Multiple deliverables were executed including:

- **Literature Review:** Providing insight and references to transportation related State Department of Transportation (DOT) practices deploying utility-grade solar within the right-of-way.
- **DOT Follow-Up Interviews:** Detailing other state DOT practices related to the installation of utility-grade solar within the right-of-way.
- **Regulation Review:** Determining the rules, regulations and policies that affect Caltrans ability to install utility-grade solar generation sites within the right-of-way.
- **Financial Summary:** Describing the financial aspects of multiple design-build-own strategies, available incentives and best practices for public-private partnerships.
- **Best Practices Design Guideline:** Detailing the best practices for installation of utility-grade solar within the right-of-way.
- **Internal Solar Website:** Providing additional information that could not be included in the above deliverables.

KEY TAKEAWAYS

Strongly encouraged to use airspace lease agreements

- Caltrans should not design / build / own / operate / maintain utility-grade solar generation facilities
- Caltrans should look at Power Purchase Agreements (PPAs) to purchase the energy at the ROW sites
- Department of General Services has PPA expertise and can assist Department development of PPA

Potential Benefits to Caltrans:

- Caltrans locks in long-term savings purchasing reduced cost kilowatts
- Caltrans doesn't pay if facility doesn't produce energy
- Caltrans doesn't need to develop staff to maintain or operate – third party does this

Potential Benefits to Third Party

- Locks in paying customer for the duration of the facility
- Receives tax credits / rebates / carbon credits to reduce investment costs
- Sell off to investor groups

PROJECT PARTNERS

This was a multiple partnered project with the following organizations:

- Caltrans Project Manager – Sean Campbell, PE
- Lead Organization – University of California, Merced, Principal Investigator Dr. Sarah Kurtz
- Subcontractor – Texas A&M Transportation Institute, Edgar Kraus
- Subcontractor – KPMG, Liam Kelly and David Ross
- Multiple Divisions within Caltrans:
  - Division of Research, Innovation and System Information
  - HQ Right-of-Way
  - HQ Maintenance
  - D12 Special Studies Planning
  - HQ Sustainability
  - D7 Sustainability
  - D2 ITS
  - HQ Traffic Operations
  - HQ Design
  - HQ Office of Innovative Finance
  - HQ DRISI Planning
  - HQ DRISI ITS Special Projects
  - HQ Structures Design

Scan the QR code to view the full project report

QUESTIONS?

APPENDIX Q. MONTANA DOT – MONTANA RESEARCH

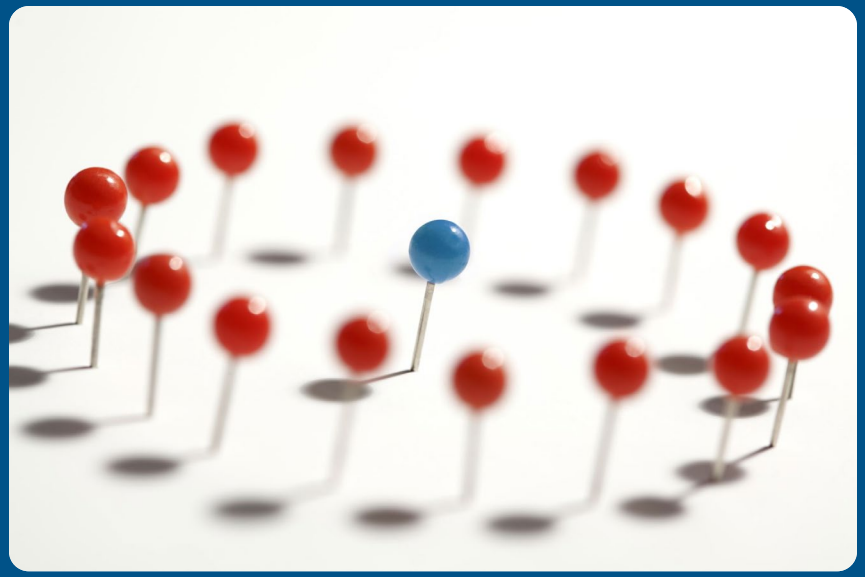
Montana Research

Rebecca Ridenour
Section Supervisor

MONTANA
Department of Transportation

Leadership Interaction with Research

- Quarterly Research Review Committee (RRC) meetings
  - Annual work plan approved in June
- Ad-hoc meetings
- Open Door Policy
- Email requests



Sharing Research Activities

- Posters – started posting around building
  IDEA: Scavenger hunt - gift card prize

- All 2024 HVR projects posted on website
  High Value Research (HVR)

- **New Director** – new take on Innovation and Research

Obstacle: Employee Awareness of the Research Program

Tools to emerge:

- Branding
- Marketing
  - Lunch & Learns
  - Bi-weekly announcements
  - Reaching out to specific work units
  - Posters

Rebecca Ridenour
Research Section Supervisor
Montana Department of Transportation
406-444-7203 | rridenour@mt.gov
mdt.mt.gov

Follow Us:

APPENDIX R. NEW MEXICO DOT – NMDOT…TAKE ME TO YOUR LEADERS

New Mexico DEPARTMENT OF TRANSPORTATION
MOBILITY FOR EVERYONE

NMDOT…
TAKE ME TO YOUR LEADERS!

New Mexico DEPARTMENT OF TRANSPORTATION
MOBILITY FOR EVERYONE

New Mexico DEPARTMENT OF TRANSPORTATION
MOBILITY FOR EVERYONE

TAKE ME TO YOUR LEADERS!

NMDOT Research and Climate Bureau Snapshot

- Budget of $2.7m

- Bureau of 10 positions – including 3 in the climate space managing CMAQ, Carbon Reduction Program and PROTECT funding

  Myself, 2 Managers, 2 Project Managers, 2 Program Coordinators, 2 project assistants and 1 open position to be determined

TAKE ME TO YOUR LEADERS!

We may not have access to our leaders, but we have access to those who do have access. And we hope to serve those people, our champions, customers and peers within the DOT by being proactive.

we see our leaders as the lead engineers, district engineers, design regions engineers and others that can let others know if we are accessible, available and capable.

our greatest success has been through the presentation at the front end.

New Mexico DEPARTMENT OF TRANSPORTATION
MOBILITY FOR EVERYONE

TAKE ME TO YOUR LEADERS!

How do DOTs present their offerings?

NMDOT's greatest success has been through the presentation at the front end. Our example is from our climate side, but is to be adopted by our research side going forward.

This involves having a webinar on the funding. The webinar beforehand has the information on what the resources can be used for, prior to a call for applications and problem statements.

TAKE ME TO YOUR LEADERS!

When we offered a webinar, we got strong participation from the districts, design centers and other divisions.

They asked thoughtful questions and had better understanding of the purposes of the funding and how they need to meet those purposes to be considered eligible for funding.

NMDOT RESEARCH AND CLIMATE BUREAU

edward.halbig@dot.nm.gov

APPENDIX S. TEXAS DOT – WTRC MEETING AND PEER EXCHANGES – HOW TO BEST SHARE RESEARCH

WTRC Meeting and Peer Exchange

Kevin Pete, TxDOT-RTI Division Director

Texas Department of Transportation

February 21, 2025

Leadership Interactions With The Research Program

- *Periodic updates, requests and opportunities for communication*
  - NCHRP Problem Statements.
  - Quick response needs request. (Legislative Session)
  - Quarterly Dashboard (Dir Strategy & Innovation)
  - Biweekly 1x1 – (Dir Strategy & Innovation)
  - Biannual - Senior Leadership Meetings
  - Published News Articles (Occasional)

- *Program Oversight/Review/Approval*
  - Research Oversight Committee – Dist. Engr. & Div. Dir.
  - Research Executive Committee – Chief Engineer & Dir S & I.

HOW BEST TO SHARE RESEARCH ACTIVITIES WITH DOT LEADERSHIP

- **Senior Leadership Meetings**
  - Focus on one/two hot topics/projects or areas of interest
  - Sharing Program Benefit and Impacts
  - Outstanding Technical Lead awards

- **Challenge**
  - Getting added to agenda
  - Engaging organizer
  - Persistence and support from Dir. of Strategy & Innovation.

HOW BEST TO SHARE RESEARCH ACTIVITIES WITH DOT LEADERSHIP

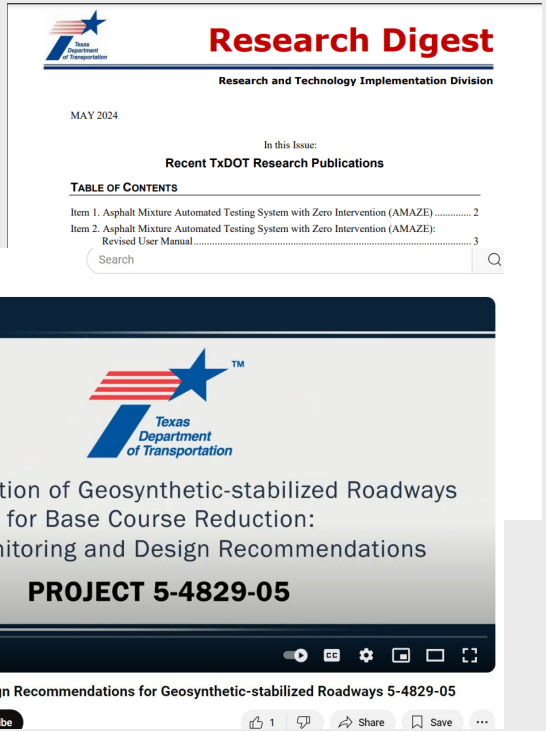
- **Quarterly Dashboard with Dir. Strategy & Innovation**
  - Opportunity to share research program & division activities
  - Engages with staff, staff reports on work activities i.e. LTAP, STIC, Grants, internal initiatives, program health and budget and expense projection.
  - Provides upper management with insight into the Program.
  - Active/Closing Project Highlights

Challenge - Increasing Awareness of the Research Program

Who, How & When To Tell

…Any and Every Way You Can!!

- ❑ Newsletters
- ✓ Webinars
- ✓ Videos
- ✓ Various TxDOT Division Meetings
- ✓ Readers Digest –
- ❑ Social Media
- ✓ TxDOT Conference Presentations



Questions

APPENDIX T. WASHINGTON STATE DOT – WESTERN TRANSPORTATION RESEARCH CONSORTIUM – HOW TO BEST SHARE RESEARCH ACTIVITIES WITH DOT LEADERSHIP

Western Transportation Research Consortium – How to Best Share Research Activities with DOT Leadership

Jon Peterson, Research Manager

Nov. 19-20, 2024

Roger Millar, Secretary of Transportation

Mike Gribner, Deputy Secretary of Transportation

2025-27 State Planning & Research – Applied Research Projects

Doug Brodin & Jon Peterson
October 14, 2024

Roger Millar, Secretary of Transportation

Research for 2025-27 for $2.5 million

- **Applied**
  - $1,200k for 2025-27, max. project amount $200k
  - This research addresses WSDOT's high priority research needs and typically uses a consultant or university to perform research in conjunction with a WSDOT Subject Matter Expert (SME) and/or Technical Advisory Committee (TAC).
- **Innovative**
  - $600k for 2025-27, max. project amount $100k. This category explores more creative approaches, opportunistic or emergent research ideas and innovations that address department needs. These ideas may have a higher risk but promise a significant return on investment or would bring about transformational or systemic change, if successfully deployed.
- **Quick Response**
  - $700k for 2025-27, max. project amount $50k
  - This category addresses high priority, opportunistic or emergent research needs as they arise outside of the normal research selection schedule. Projects approved by RSL Administrator.

Applied Research Project Selection

- Research & Library Services received 12 research problem statements for $2.3 million and our volunteer Advisory Group (TAG) rated and ranked the top 6 for selection for funding.
- The TAG members are Celeste Gilman, Todd Lamphere, Dongho Chang, Charlene Kay, Mike Fleming, Alvina Mao & John Milton.

Advisory Group Recommended Top 6 for Funding

1. Speed Reduction in Transition Zones - $200,000
2. Pavement Design Guidance for Climate Change Resilience - $199,460
3. Seismic Collapse Prevention for WSDOT Bridges - $200,000
4. Shore Power Partnerships for eMobility Options at Terminals - $200,000
5. Enhancing Active Transportation User Safety through I2X Tech- $200,000
6. Low Impact Development Best Mgmt. Practices to Reduce Stormwater Runoff - $187,700

Total = $1,187,160

7. Predictive Availability for Truck Parking - $200,000
8. Cybersecurity Resilience - $200,000

Speed Reduction Treatments in Transition Zones - $200,000

- The study focus area is in urban to suburban and rural to suburban transition zones where there are a high number of deaths and serious crashes reported.
- The study team will evaluate speed reduction treatments that support Complete Streets goals at different locations across the state.

Subject Matter Expert: Pamela Vasudeva, Dina Swires, John Milton, Alex Liaw

Research Manager: Jon Peterson

Researcher: Michigan State Univ.

Pavement Design Guidance for Climate Change Resilience - $199,460

- This research will first assess WSDOT's current pavement design practices and determine how robust they are relative to the current temperatures and flooding events.
- The second phase of the research consists of identifying thresholds to help develop design guidance based on expected climate change models most applicable to Washington to enhance the resiliency of WSDOT's pavement network.

Subject Matter Expert: WSDOT Pavement Office & Materials

Research Manager: Mustafa Mohamedali

Researcher: Wash. State Univ.

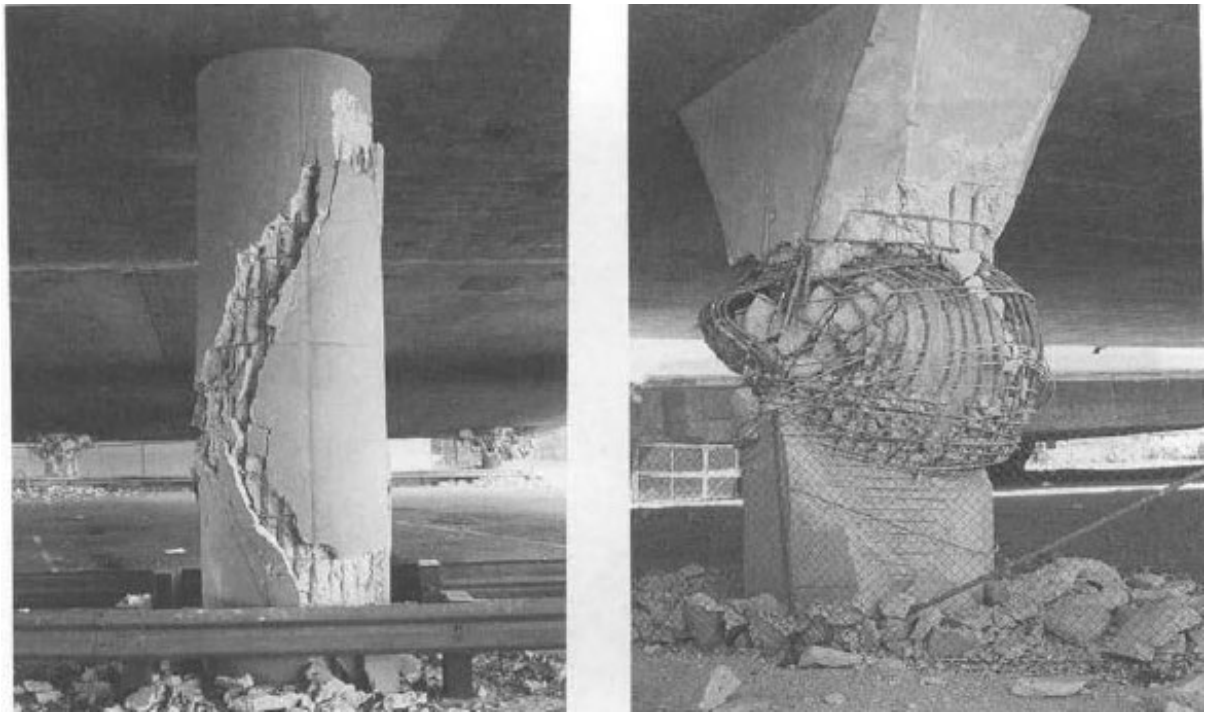
Seismic Collapse Prevention for WSDOT Bridges - $200,000

- The goal of this research will be to develop the tools necessary for WSDOT to identify and remedy bridges and bridge columns that are the most likely to fail in shear during an earthquake.

Subject Matter Expert: Amy Leland & Geoff Swett

Research Manager: Mustafa Mohamedali

Researcher: Univ. of Washington



How do we define technology transfer @ WSDOT?

***Research* Technology Transfer is defined as sharing results of WSDOT-funded research with WSDOT staff, our primary audience.**

From time to time, we also share results of in-house research not funded by us, and innovations developed by our staff that might not be broadly disseminated within the department, otherwise.

Additionally, we share results of transportation research conducted by other organizations with our staff in various ways, but that is not our main focus.

How we do T2

Internally

Educate staff about research program

- Alignment with agency strategic goals
- “Research delivers results!”
- Establish and maintain relationships with Subject Matter Experts interested in research

Publicize projects, outcomes, benefits

- Provide access to project findings
- Communicate to management
- Webinar Wednesday series

Externally

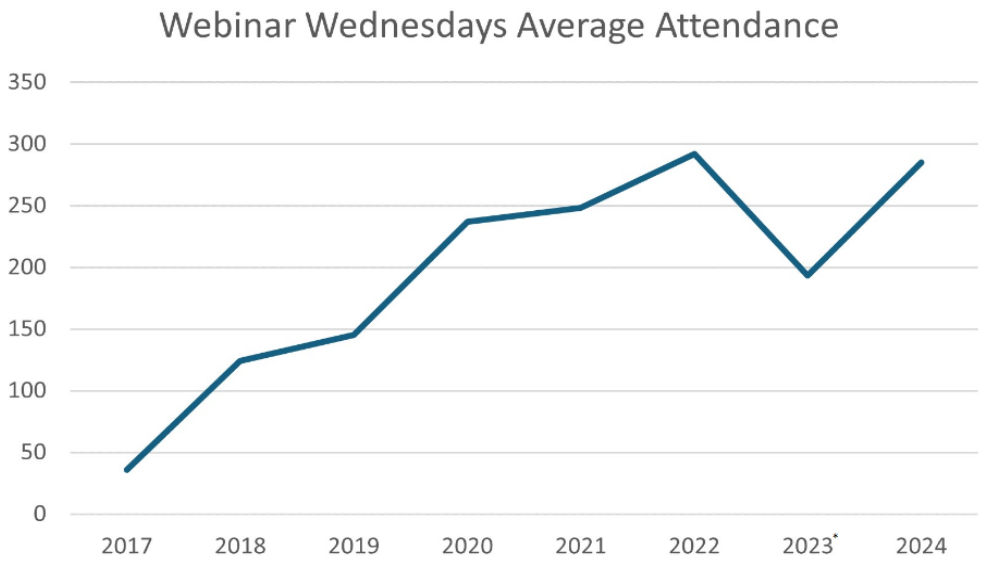
- Webinar Wednesday series
- Research report distribution
- Presentations at conferences
- TRAC eNews
- Via FHWA Division Office
- Take advantage of national opportunities: STIC Innovation Showcase, ICOP, AASHTO RAC High Value Research, etc.

Webinar Wednesdays

Series began in 2017 with intent to share research findings to encourage tech transfer and implementation of research results and, perhaps, inspire further innovation.

Environmental DNA

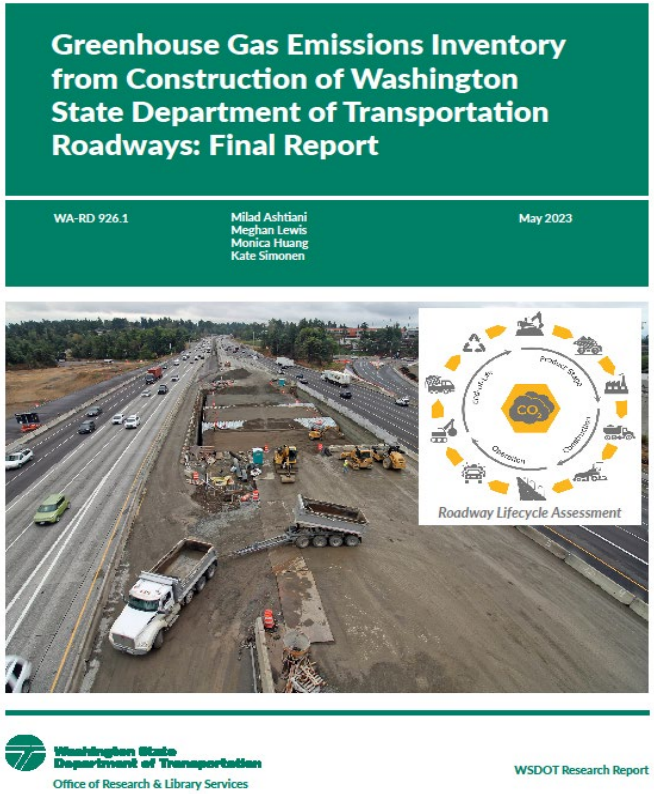
Effects of Mega Earthquakes on Bridges



*Only three webinars produced in 2023.

Total attendance 2017- June 2024: 6,806 at 37 webinars.

Final Research Reports



SPR-B requirement to distribute to select national (digital) repositories:

USDOT/National Transportation Library

TRB/TRID database, etc.

As a state agency publication, statutory requirement to submit to Washington State Library for eventual placement in state ePubs collection/digital archives.

To find out how to search for and access reports, visit our webpage:

[Research reports | WSDOT (wa.gov)]

Partnering for Tech Transfer

TRAC is a cooperative, interdisciplinary transportation agency, formed in 1983 by WSDOT, University of Washington and Washington State University.

August 2024

TRAC e-News: Delivering Research Results!

The Washington State Transportation Center (*TRAC*), conducts transportation research through collaborative partnerships among WSDOT, the University of Washington (UW), and Washington State University (WSU).

In this issue

- Developing high early strength concrete for rapid bridge deck overlays
- Assessing post-earthquake bridge functionality in Washington state
- Integrating real-time truck parking information
- Monitoring snow avalanches with smart sensors
- Using maintenance performance measures to predict highway asset performance
- Improving the use of multimodal performance measures in WSDOT projects
- Recent WSDOT Webinar Wednesday presentation

TRAC eNews

Research newsletter includes WSDOT information

Many of WSDOT's Research reports are published on TRAC website

TRAC publicizes projects in which any of the partners are involved

Final thoughts . . .

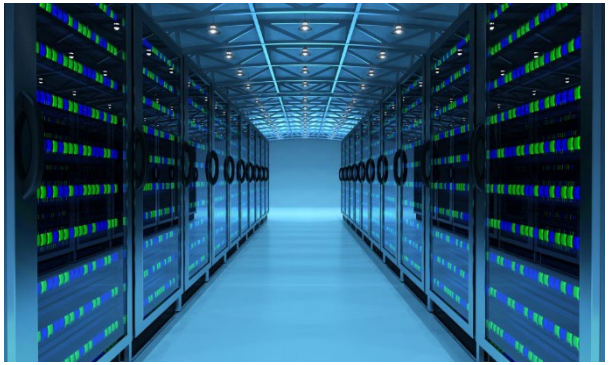
- **Successes**
  - *Webinar Wednesday* series
    - Direct and interactive communication between research teams and targeted audiences
  - Good relationships with SMEs, PIs, agency research participants and management
    - They are our research champions!

- **Challenges**
  - Measuring effectiveness of how we communicate research deliverables
  - Determining impact of research results beyond the project team
  - Working within agency constraints around website content and social media usage to communicate research deliverables

There's more work to be done.

How to Best Share Research Activities with DOT Leadership

- **How does DOT leadership interact with your program?** We have WSDOT leadership review our recommended list of research projects and approve. We utilize all the T2 items previously discussed to keep our agency and partners informed of our progress.
- **Describe one or more of your successes and best practices for sharing research activities.** We started our Webinar Wednesday series in 2017, and it has grown and grown, and we have shared it with other states.
- **What obstacles have you overcome and how?** Our research webpage is very small because of bandwidth. We aren't allowed to use You Tube or X and use Go To Webinar for our webinars. Partnering with others (TRAC eNews, etc.) has helped us share our research.
- **Name one of your program's most significant challenges and how you are trying to overcome it.** Data, data, data.. Where to put it all? We discuss with the PI before a project begins. It is more of a concern if we want to implement something down the road that has lots of data. To be continued….



— THE END —
THANK YOU!

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WSDOT Research Reports - https://wsdot.wa.gov/about/library-research-reports/research-reports