

FY 2023 INDOT Research Program Summary of IMPACT

Taking INDOT to the Next Level



FY 2023 INDOT Research Program Summary of IMPACT

Impacting INDOT's Strategic Objectives: Safety, Mobility, Economic Competitiveness, Customer Service, Asset Sustainability, Organization & Workforce, and Innovation & Technology

Introduction: The INDOT/JTRP Research Program is an established and nationally recognized state DOT Research Program that has partnered with practitioners, academia, and industry since 1937 to address Indiana's transportation needs and challenges. Several state DOTs have modeled their state research programs after the Indiana program and the program has received national recognition for its impact on national transportation issues. Each year, the Indiana DOT provides two reports highlighting the quantitative and qualitative benefits delivered by the program. One report is the Return on Investment (ROI) that quantifies the cost savings to customers (user costs and safety) and to INDOT (agency savings) *INDOT Research Program Return on Investment*. The second report is the summary of IMPACT that highlights the qualitative benefits derived from the program. Together, these reports provide a comprehensive snapshot of the benefits, savings and impacts from the INDOT/JTRP Research Program. As research findings can significantly impact DOTs resulting in large returns on investment, it behooves researchers to quantify and qualify these benefits and savings to provide credibility to the program and in turn market this message to leadership. These ROI and IMPACT reports help to validate to stakeholders and others the value of a well run research program. A previous INDOT Commissioner noted that *a viable research program was essential for a DOT to remain competitive and to continue to advance when there is a climate of scarce resources*. Even when resources are not scarce, DOTs must position themselves as good stewards and forward thinking. A good DOT research program is one way to accomplish this end.

In 2019, INDOT unveiled its updated Strategic Plan. Strategic Objectives included: Safety, Mobility, Economic Competitiveness, Customer Service, Asset Sustainability, Organization & Workforce, and Innovation & Technology. The Research Program provides direct support to the Strategic Plan for INDOT to fulfill its Strategic Objectives outlined in the Strategic Plan.

In 2020 and 2021 the COVID19 pandemic challenged INDOT, the State of Indiana, the country, and the world. COVID 19 affected the INDOT Research Program as well, however, the Program adapted quickly with new practices and approaches to keep the Program functional, efficient, and effective. With the signage of Infrastructure Investment and Jobs Act (IIJA), the United States Department of Transportation (USDOT) and the Federal Highways Administration (FHWA) encourages research mitigating the adverse effects of climate change and promoting, resiliency, sustainability innovation, safety workforce development and diversity, equity, and inclusion in transportation.

This summary highlights projects completed in FY 2023. Additional accomplishments are also included such as awards, contributions from specialized testing programs, performance metrics, continuous improvement initiatives, and the relatively new forensic investigation program.

Following, is a listing of IMPACT areas and research projects and activities that resulted in qualifiable benefits to customers and stakeholders.

Strategic Plan Impact Areas

Safety & Mobility (page 4)

Asset Sustainability (page 6)

Innovation & Technology and Economic Competitiveness (page 8)

Customer Service and Organization & Workforce (page 9)



Other Program Impact Areas:

Every Day Counts, EDC (page11)

Enhancing Internal Services, Intentional Partnership, Engagement & Networking (page 13)

State and National Recognitions (page 15)

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Supporting INDOT's Strategic Objectives: Safety, Mobility, Economic Competitiveness, Customer Service, Asset Sustainability, Organization & Workforce, and Innovation & Technology

○ Strategic Plan Impact Areas

These are select examples of projects. Each individual project can be downloaded from <https://docs.lib.purdue.edu/jtrp/> for additional information.

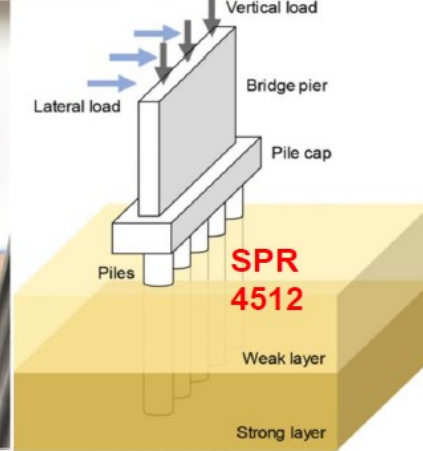
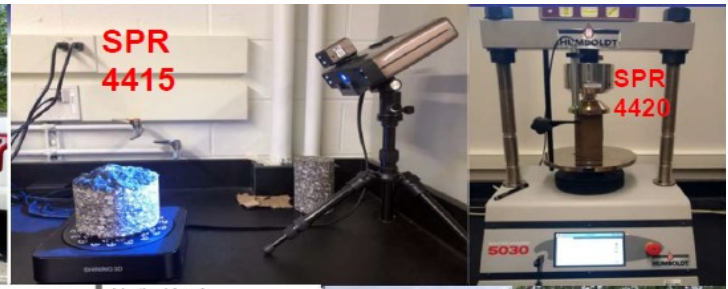
IMPACT on Safety & Mobility (select examples)

- **SPR-4439, Guidelines for Evaluating Safety Using Traffic Conflicts: Proactive Crash Estimation on Roadways with Conventional and Autonomous Vehicle Scenarios**
(<https://doi.org/10.5703/1288284317587>)
- **SPR-4442, Highway Lighting Test Bed on INDOT Facility**
(<https://doi.org/10.5703/1288284317384>)
- **SPR-4537, Speed Management on Freeways in Transition Zones between Rural & Urban** (<https://doi.org/10.5703/1288284317586>)
- **SPR-4541, Roadside Barrier End Treatments: Safety Evaluation of INDOT Inventory & Practices**
- **SPR-4600, Impacts to Traffic Behavior from Queue Warning Truck – Current Pilot Project** (<https://doi.org/10.5703/1288284317448>)
- **SPR-4637, Speed Enforcement in Work Zones and Synthesis on Cost-Benefit Assessment of Installing Speed Enforcement Cameras on INDOT Road Network**
(<https://doi.org/10.5703/1288284317639>)
- **SPR-4638, Integration of the Lane-specific Traffic Data Generated from Real-time CCTV Videos into INDOT's Traffic Management System**
(<https://doi.org/10.5703/1288284317400>)



IMPACT on Asset Sustainability (select examples)

- SPR-4320, Implementation of Epoxy Injection of Concrete Overlaid Bridge Decks (<https://doi.org/10.5703/1288284317588>)
- SPR-4325, Volumetric Acceptance & PWL Criteria for SMA (<https://doi.org/10.5703/1288284317580>)
- SPR-4415, Determining Asphalt Mixture Properties Using Imaging Techniques (<https://doi.org/10.5703/1288284317635>)
- SPR-4420, Estimating Strength from Stiffness for Chemically Treated Soils (<https://doi.org/10.5703/1288284317383>)
- SPR-4432, Culvert Inspection Frequency Guidelines (<https://doi.org/10.5703/1288284317578>)
- SPR-4452, Demonstration Project for Asphalt Performance Engineered Mixture Design Testing (<https://doi.org/10.5703/1288284317382>)
- SPR-4504, Development of INDOT Slab Jacking Program
- SPR-4512, Pile Stability Analysis in Soft Soils - Guidance on Foundation Design Assumptions with Respect to Loose/Soft Soil Effects on Pile Lateral Capacity and Stability (<https://doi.org/10.5703/1288284317387>)
- SPR-4520, Development of an MSE Wall Construction Manual & Training Course
- SPR-4526, Predictive Analytics for Quantifying the Long-Term Cost of Defects during Bridge Construction (<https://doi.org/10.5703/1288284317615>)
- SPR-4527 Shear & Bearing Capacity of Corroded Steel Beam Bridges & Effects on Load Rating. (<https://doi.org/10.5703/1288284317634>)
- SPR-4632, Steel Bridge Coating Evaluation and Rating Criteria (<https://doi.org/10.5703/1288284317386>)



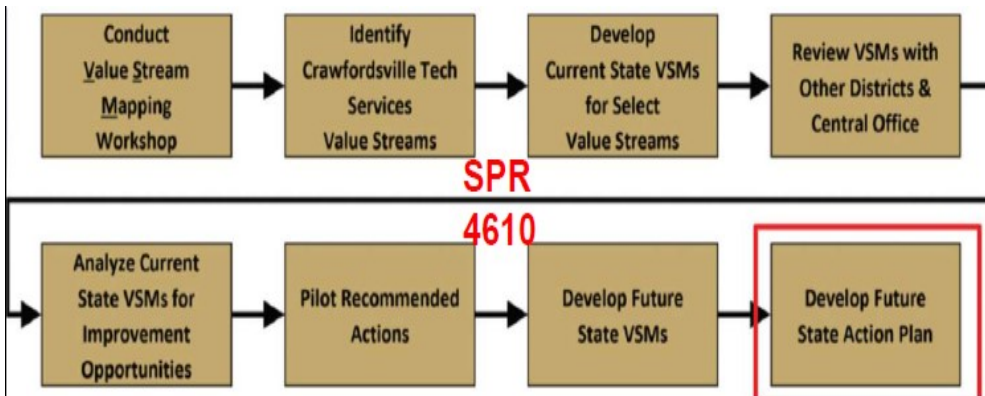
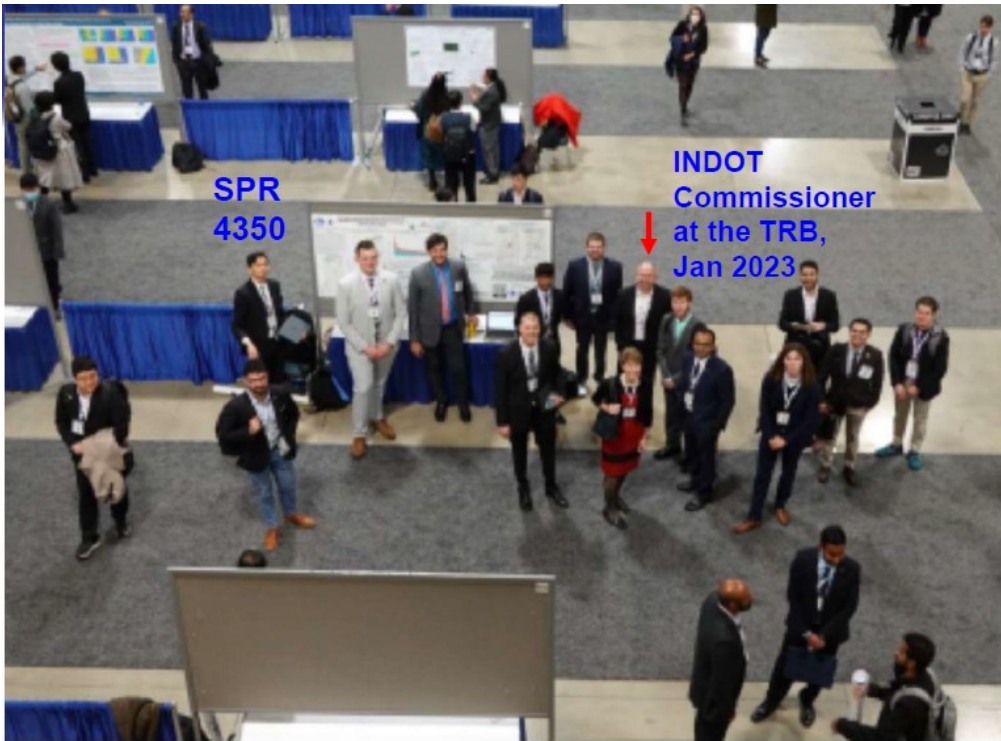
Impact on Innovation & Technology and Economic Competiveness (select examples)

- SPR-4225, INDOT Research Program Benefit Cost Analysis – Return on Investment (<https://doi.org/10.5703/1288284317723>)
- SPR-4336, Improvement of Scaling Resistance of Concrete Pavement Using Nano-additives (<https://doi.org/10.5703/1288284317583>)
- SPR-4407, Road Ditch Line Mapping with Mobile LiDAR (<https://doi.org/10.5703/1288284317354>)
- SPR-4513, Concrete Strength Monitoring Using Wireless Sensing (<https://doi.org/10.5703/1288284317613>)
- SPR-4616, GIS based Geotechnical Database (<https://doi.org/10.5703/1288284317637>)



IMPACT on Customer Service and Organization & Workforce (select examples)

- **SPR-4350, Transportation Research Board (TRB) Annual Meeting Activities**
- **SPR-4406, Frontline Employee Training Using Virtual Reality Simulation of Field Conditions**
- **SPR-4523, Applied Ergonomics (<https://doi.org/10.5703/1288284317636>)**
- **SPR-4610, Crawfordsville Technical Services Asset Management Workflow Improvement Project (<https://doi.org/10.5703/1288284317581>)**
- **SPR-4651, Synthesis Study on Employing Snowplow Driving Simulators in Training (<https://doi.org/10.5703/1288284317614>)**
- **SPR-4652, Synthesis Study on Best Practices of Cleaning Tools & Paving Equipment (<https://doi.org/10.5703/1288284317381>)**
- **SPR 3411, INDOT's Damage Wise program Implementation experienced a record-breaking fiscal year.**
- **SPR 4549, Salt Monitoring and Reporting Technology (SMART): Implementation for Salt Calibration**
- **INDOT staff serving as business owners/SAC with faculty, practitioners, other DOT staff (INDOT staff indicates positive professional development from SAC engagement)**





Other Program Impact Areas

Every Day Counts, EDC, (National IMPACT select examples)

- Partnership with FHWA in EDC Initiatives
- Participated in EDC 7 Virtual Summit and submitted 6 innovations for Indiana collaborating with Innovation Division (Summit was on February 16, 2023)
- Facilitating the 7 Innovations in EDC 7 (Listed Below)
- Participated in National STIC Meetings.
- \$830K STIC Incentives leveraging 11 INDOT studies.
- Participated in National Pooled Fund Studies, PFS.

Innovation Spotlight

[Crowdsourcing for Advancing Operations]

The Indiana Department of Transportation (INDOT) has found an effective combination by merging data from third-party vehicle probe data providers with agency field devices. By doing so, the agency can effectively process vehicle speed data, estimate travel times between major cities, and pass that information along to traveler information systems.

INDOT also developed a number of traffic operations dashboards in conjunction with Purdue University. The Traffic Ticker is a web-based dashboard that aids with monitoring Interstate conditions in real-time, continually evaluating crowdsourced probe vehicle data. The Traffic Ticker provides roadway miles under a specified vehicle speed on Interstate segments that can be visualized for current and historical context. Filters allow users to designate a target speed threshold, date range, roadway segment, and DOT district. The output is a series of easily understood charts and graphs that depict speeds.

Delta Speed is another dashboard that is used by law enforcement and Traffic Management Center staff to identify changes in average speed that may indicate a roadway incident. The mapping feature of the dashboard is accompanied by tables that reflects differential speeds among roadway segments, an indicator of queue formation and other traffic anomalies in real-time. INDOT is developing an updated Delta Speed tool based on a newer crowdsourced dataset.

Finally, INDOT estimates that crowdsourcing data helped save about 116,000 hours of arterial travel time on one busy corridor alone, because they were able to use the data to retune traffic signals along that route. The savings are estimated at \$2.7 million dollars for road users.

See the [INDOT case study](#) for more information on their use of crowdsourced data to advance transportation operations.

Speed (mph) along 60-mile detour for 37-mile I-65 route

Legend: 55 - 65, 45 - 54, 35 - 44, 25 - 34, 15 - 24, 0 - 14

Days: Day 1, Day 2, Day 3, Day 4

Time: 12 AM, 12 PM, 12 AM, 12 PM, 12 AM, 12 PM

Number of Miles: 0, 5, 10, 15, 20, 25

I-65 bridge closure and detour route speed visualization from Indiana Department of Transportation's Traffic Ticker tool.

Every Day Counts • EDC-6 Final Report

EDC-7 Innovation	INDOT SME	FHWA Counterpart	Baseline Status (submitted 4/21/23)	Goal Status (to be attained by 2025)
Nighttime Visibility for Safety	Dan McCoy, Dave Boruff, Mike Holowaty	Eryn Fletcher; eryl.fletcher@dot.gov	Assessment	Institutionalized
Next Generation TIM: Technology for Saving Lives	Ed Cox, Hillary Lowther	Karen Stippich; karen.stippich@dot.gov	Development	Demonstration
Integrating GHG Assessment and Reduction Targets in Transportation Planning	Alison Shaner, Roy Nunnally, Frank Baukert	Patrick Carpenter (patrick.carpenter@dot.gov); Kari Carmany-George (k.carmanygeorge@dot.gov)	Development	Demonstration
Enhancing Performance with Internally Cured Concrete (EPIC2)	Matt Beeson, Mike Nelson	Tom Duncan; thomas.l.duncan@dot.gov	Assesment	Assesment
EPDs for Sustainable Project Delivery	Matt Beeson, Elena Cruz	Tom Duncan; thomas.l.duncan@dot.gov	Development	Demonstration
Rethinking DBE for Design-Build	Derrick Casson, Libby Crawford	Kenneth Woodruff; kenneth.woodruff@dot.gov	Institutionalized	Institutionalized
Strategic Workforce Development	Libby Crawford	Kenneth Woodruff; kenneth.woodruff@dot.gov	Institutionalized	Institutionalized

Fiscal Year	STIC Incentive Project	Funds Allocated
2023	Host Midwest Regional Innovation Peer Exchanges	\$50,000
2022	Apply origin-destination data patterns in Freeway Weaving Areas	\$100,000
2021	Upgrade web-based Winter Operations Dashboard using enhanced probe data	\$100,000
2020	1. Implement Enhanced Probe Data for Tactical Work Zone Operations (\$41,000) 2. Expand project bundling with machine learning for local agencies (\$35,000) 3. Expand current Virtual Public Involvement (VPI) efforts (\$24,000)	\$100,000
2019	Develop Mobile Mapping System Manual of Operations.	\$100,000
2018	Implementation of Intelligent Snowplow System	\$100,000
2017	Implementation of Connected Vehicle Corridor Deployment and Performance Measures for Assessment	\$100,000
2016	Implementation of LiDAR-Based Mobile Mapping System for Lane Width Evaluation and Reporting in Work Zones for INDOT Traffic Management	\$100,000
2014	Development of Intelligent Compaction standard specification for soil embankment and subgrade compaction	\$80,000

Enhancing Internal Services, Intentional Partnership and Engagement & Networking (select examples)

- **Road School 2023**
- **West African Engineers Go the Distance to Learn from INDOT (Inside INDOT, May 2023)**
- **Meeting with the Commissioner and Executive Staff to solicit their research needs and present the research needs and ideas received from INDOT Staff, Academia, and Industry (February 3, 2023)**
- **Participating in the staff meeting of INDOT People Services Led by DC Angela Roosa to strengthen their engagement in the Research Program (February 15, 2023).**
- **Organizing the annual research fair and presenting the prioritized research needs & ideas to the executive staff for their approval to proceed (February 21, 2023)**
- **INDOT executive staff visit to INDOT R&D and Purdue (February 24, 2023)**
- **Budget Staff Visit to INDOT R&D (July 6, 2023)**
- **Organizing for All Indiana Universities All Faculty Meeting (September 12, 2023)**
- **Poster presentation and show and tell of our pavement testing equipment, Indiana Fairground (September 20, 2023).**
- **Show and tell of the 3D Laser and 3D GPR, in Greenfield Fairground (September 28, 2023)**
- **Organizing a Site Visit by DC Roland Fegan (October 20, 2023)**
- **Organizing FY 25 INDOT/JTRP Research Program Focus Groups Initiation meeting (October 23, 2023)**
- **R&D Open House (October 26, 2023)**
- **Vincennes Research Program Briefing (November 14, 2023)**
- **Organizing a visit by INDOT People Services (November 17, 2023)**
- **Organizing a Site Visit by all the DDCs Roland Fegan (November 28, 2023)**
- **Organizing a visit by INDOT Crawfordsville District CPM (December 12, 2023)**
- **TRB Annual meeting (presentations, papers, posters)**
- **NCHRP, TRB, AASHTO Committees membership.**





State and National Recognitions (select examples)

- ERIN and Inside INDOT newsletter articles
 - Two projects have been chosen for prestigious national transportation industry awards by AASHTO, “SPR 4301, Assessment of an Offset Pedestrian Crossing for Multilane Arterials,” won the **2022 Sweet 16 AASHTO High Value Research Award** and “SPR 4122, Repair and Strengthening of Bridges in Indiana Using Fiber-Reinforced Polymer Systems,” was **cited for the AASHTO construction category** (ERIN November 28, 2022)
 - Visits & Interviews by CNBC, New York Times, Indy Star, Scripps National and INPOWER Indiana regarding electric vehicles & Road Electrification
 - Research & Development Division Has a Huge Impact (Inside INDOT-January 2023)
 - Employing Traffic Safety Stats to Help Reduce Traffic Deaths (Inside INDOT-February 2023)

- Snowplow Simulator Wows INDOT Testers (Inside INDOT- March 2023)
- SPR-4436 “Road Condition Detection and Classification from Existing CCTV Feed” won the [2023 Sweet 16 AASHTO High Value Research Award](#) (Inside INDOT – August 2023)
- Colts Player, INDOT Employees Help Conferences Achieve Success. Referring to INDOT R&D proactive participation in the National Pavement Preservation Conference (Inside INDOT – October 2023)
- R&D Open House Opens the Eyes of INDOT Directors (Inside INDOT – November 2023)



FY 21 Research Program Return on Investment (ROI)

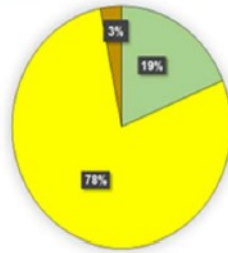
❖ 30 Completed Projects

Agency B/C ratio 6:1
non-agency B/C ratio 4:1
Total B/C Ratio 10:1

❖ 192 Completed Projects
(Moving Average)

Agency B/C ratio 11:1
non-agency B/C ratio 9:1
Total B/C Ratio 20:1

**SPR
4225**



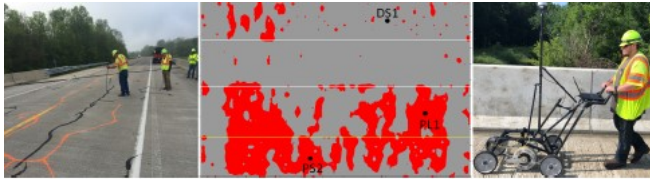
Quantifiable Benefits Projects	Qualitative Benefits Projects	Projects Not Successfully Implemented
36	150	6

- Quantifiable Benefits Projects
- Qualitative Benefits Projects
- Projects Not Successfully Implemented



- **Miscellaneous Research News, Webinars/Workshops & High-Profile Articles**
 - **CNBC Ranks Indiana the 1st Best State for infrastructure and Business.**
 - **I-69 Finish Line is the # 1 Road (Road & Bridges Top 10 Roads)**
 - **INDOT, Purdue Develop Salt Stockpile Tracking System – AASHTO Journal (September 9, 2022)**
 - **Mapping & Documenting Roadway crash scenes.**
 - **Informational Webinars**
 1. **Monthly NDE Peer Exchange Webinar Series (October 2023)**
 2. **TRB Webinar: Superpave Volumetric Mix Design—Beyond the Basics (October 2023)**





October 23, 2023 | 1:00 pm EST
Long-Term Project and Network-Level NDT Implementation Plan for Indiana

The Indiana Department of Transportation through a study with Purdue University investigated multiple NDT methods to evaluate deck conditions. Results from both in-house staff and consultants were compared to look for accuracy and repeatability. Both network-level and project level recommendations were given.

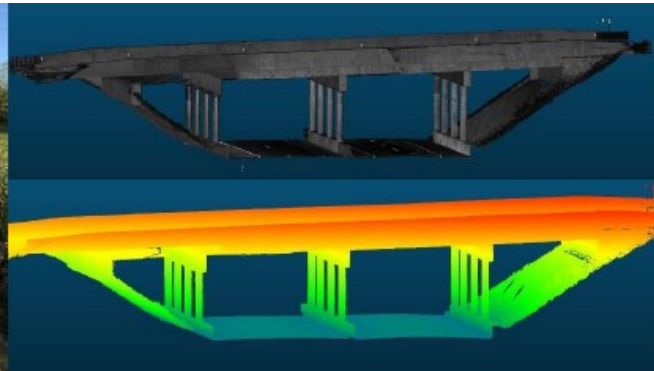
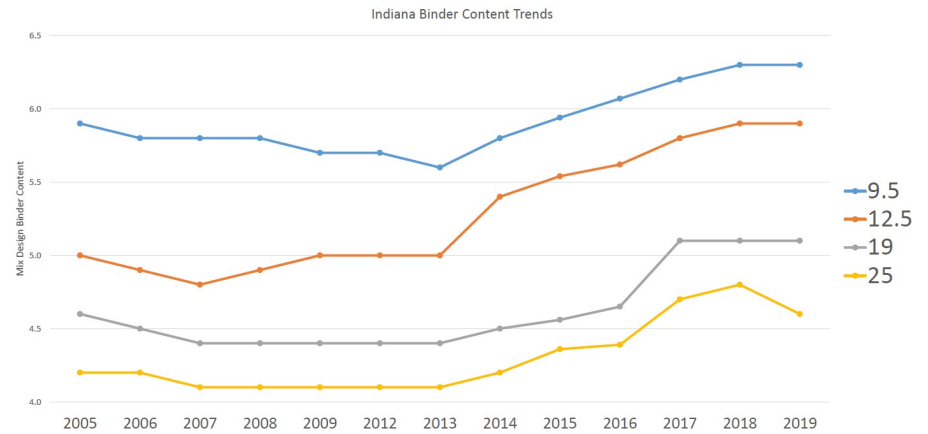
Presenters:
Anne Rearick
 Director of Bridge Management
 Indiana Department of Transportation

Prince Baah
 Bridge Structural Research Engineer
 Indiana Department of Transportation

Zoom Meeting
 Join on your computer or mobile app
[Click here to join the meeting](#)

Or call in (audio only):+1(669)254-5252
 Meeting ID: 161 682 3220
 Passcode: 010531

Indiana Binder Content Trends

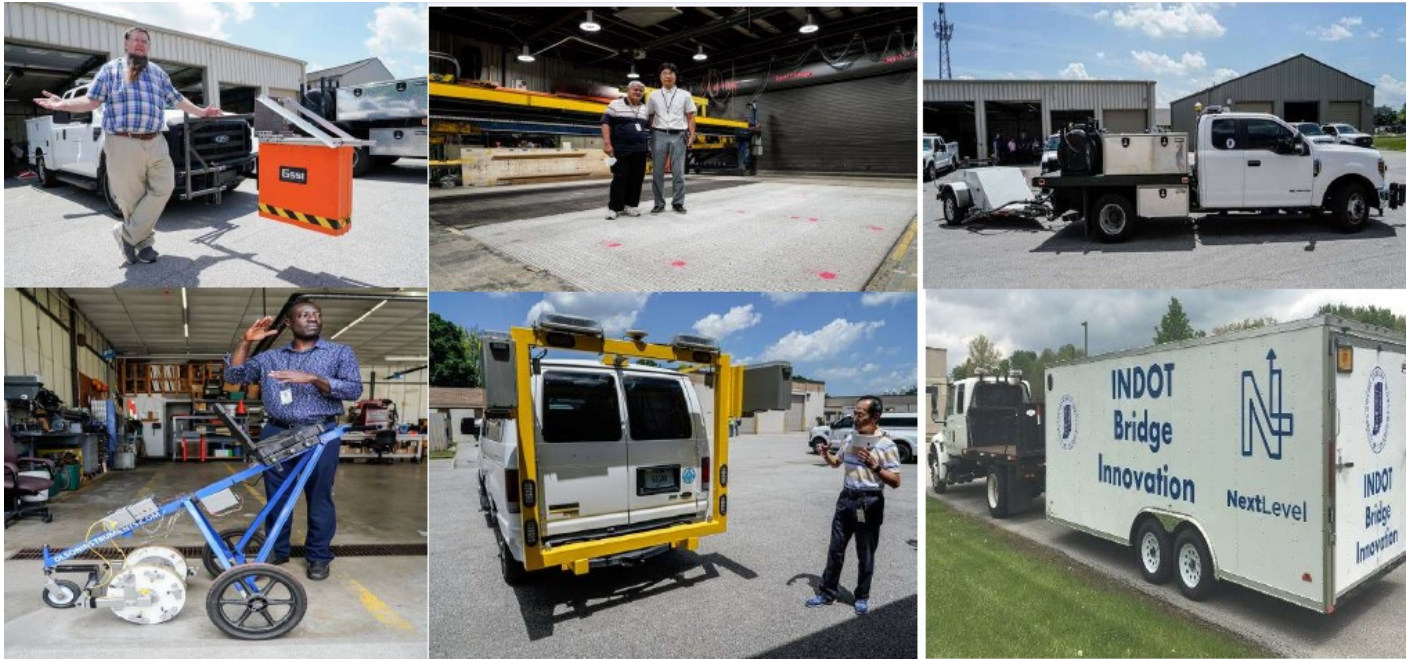


I-74/US 231 Mobile Lidar Mapping

Forensic Investigations and Specialized Testing Programs (select examples)

- Forensic capabilities & data driven decision-making capabilities, direct result of research program.
- Bridge Deck Epoxy Injects INDOT with Asset Sustainability and Innovation (Inside INDOT)
- New Trailer Helps INDOT Get Ahead in Bridge Innovation
- NDT of Bridge Decks Efforts – Results & Implications
- District recognitions for INDOT R&D testing efforts
- Friction and Texture Quality testing to ensure the material met specifications.
- Identification of bridges with low friction numbers
- 315 FWD testing & Analyses, 91 Friction Testing and evaluations, 56 NDT testing for Bridges, 35 GPR tests and analyses, 10 IRI tests and analyses, 12 tests & Analyses using the 3D Laser and 29 forensic investigations





Specialized Testing & Forensic Investigation Equipment – Pictures by Indy Star

Program Metrics & Venues for Continuous Improvement

Eight Objective Performance measures for INDOT Research Program;

#	Description	Goal
1	% Final Report submitted on time of Active Projects	>90%
2	% Successful Implementation of completed projects in a FY (KPI 6)	>90%
3	Return on Investment in a FY (B/C)	> 2
4	Percent Customer Satisfaction Score Meeting or Exceeding Expectations	> 90%
5	# & Percent of Time Extensions	Specifying a Goal
6	% Progress reports submitted on time	100%
7	% Draft Final Report submitted on time	> 90%
8	% Successful Communications	> 90%

- **Linkage of 2022 Peer Exchange Results (Focus on Resiliency, Sustainability, Mitigation of Adverse Effects of Climate Changes, and Diversity, Equity & Inclusion) to User's Manual, Summary of Impact & ROI reports, Customer Service Surveys, Implementation Plans and Template Research Need Statements.**
- **Continue Mapping research projects to INDOT Strategic Plan.**
- **Collaborate with the new Innovation Office for opportunities, to share current innovations and how the two offices can support each other's mission as in EDC National Summits.**
- **Continue exploring new methods to communicate research results and innovations using online webinars (mirror the TRB webinar format).**
- **FY 2024 (on February 21) Show Case & Peer Group meetings, focusing on peer groups to identify research needs on an ongoing basis. FY 2024 Prioritized needs and Ideas was held on February 21. Faculty Liaisons were engaged in Focus Groups.**
- **FY 2024, 204 research needs submitted, a new record of 68 research projects funded (including 22 expansions), 108 active projects.**
- **Smartsheet tracking software used for project management (active projects, needs identified, tracking implementation status).**
- **Customer Satisfaction Performance Measures, reported to Executive Board**
- **Summary of IMPACT Report, Return on Investment (ROI), Conversion Rate.**
- **User manual update.**

Resources and Links

- **Indiana Government**
www.in.gov
- **Indiana Department of Transportation, INDOT**
www.in.gov/indot
- **INDOT Research & Development Division Contact Information**
www.in.gov/indot/2700.htm
 - Submission of Research Needs & Ideas (www.in.gov/indot/2404.htm)
 - Innovative Research Needs & Ideas (www.in.gov/indot/2404.htm)
 - Research Program IMPACT Report (www.in.gov/indot/2404.htm)
 - Research Program Return on Investment (www.in.gov/indot/2404.htm)
- **Research Program User's Manual**
(https://engineering.purdue.edu/JTRP/files/UsersManual_2022_12.pdf)
- **Joint Transportation Research Program**
<https://engineering.purdue.edu/JTRP>
- **Innovation Office and Submission Link (only through the intranet) - [Innovation at INDOT](#)**