

FY 2021 INDOT Research Program Summary of IMPACT

Taking INDOT to the Next Level

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. The program has also 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). The second report is the summary of IMPACT that describes 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 ran 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 as 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. This summary highlights projects completed in FY 2021. 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: (page 2)

- **Safety & Mobility** (page 2)
- **Asset Sustainability** (page 3)
- **Innovation & Technology and Economic Competitiveness** (page 5)
- **Customer Service and Organization & Workforce** (page 7)

Other Program Impact Areas: (page 10)

- **Every Day Counts, EDC** (page 10)
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NextLevel
INDIANA



Your investment
is having IMPACT

PROJECT
impact
give some. make an impact.

○ 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-4215**, Rumble Stripes and Pavement Markings Delineation
- **SPR-4218**, Performance of **Right Turn Lane Designs at Intersections**
- **SPR-4300** Investigation of Durability and Performance of **High Friction Surface Treatment**
- **SPR-4301**, Assessment of an Offset **Pedestrian Crossing for Multilane Arterials**
- **SPR-4302**, **Emerging & Extraordinary Data Sources** as Means to Improve Traffic Safety
- **SPR-4404**, **Improve and Gain Efficiency in Winter Operations**
- **SPR-4405**, Synthesis Study on Best practices for Mapping and Coordinating Detours for Maintenance of Traffic (MOT)
- **SPR-4409**, Safety, Mobility, and Cost Benefits of **Closing One Direction of Interstate in Rural Areas During Construction Work**



➤ **IMPACT on Asset Sustainability (select examples)**

- **SPR-4122 Repair and Strengthening of Bridges** in Indiana Using **Fiber Reinforced Polymer (FRP) Systems**
- **SPR-4165**, Verification of **Bridge Foundation Design** Assumptions and Calculations

- **SPR-4212**, Structural Evaluation of **Full-depth Flexible Pavement** using APT
- **SPR-4213**, Determining **Concrete Patch Locations** other than Visual for **PCC Pavements Restoration and Repairs**
- **SPR-4221**, **Post-Fire Assessment of Prestressed Concrete Bridges** in Indiana
- **SPR-4222**, **Seismic Evaluation of Indiana Bridge Network** and Current Bridge Database for Asset Management
- **SPR-4230**, Alternative **Quality Assurance Methods for Compacted Subgrade**
- **SPR-4231**, **MEPDG Traffic Load Spectra** for Local, Minor Arterial, Major Collector, and Minor Collector Roads
- **SPR-4310** **Legal and Permit Loads** Evaluation for **Indiana Bridges**
- **SPR 4311** Evaluating Reserve Strength of Girder Bridges due to **Bridge Rail Load Shedding**
- **SPR-4417** **Use of Recycled Asphalt**
- **SPR-4444** Improved Live Load Lateral Distribution Factors for use in **Load Rating of Older Continuous and T-Beam Reinforced Concrete Bridges**



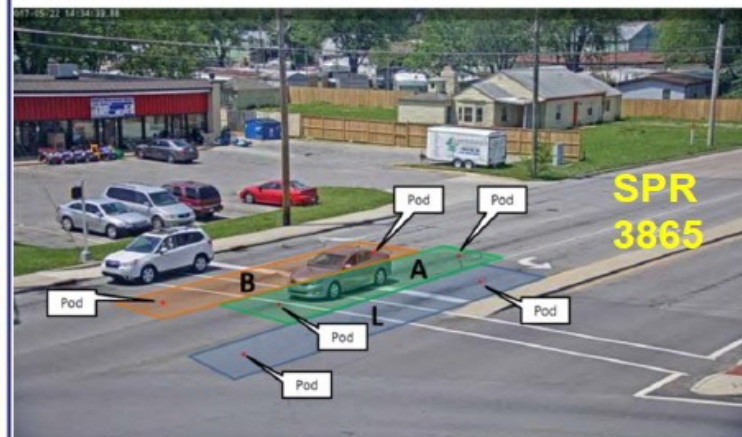


➤ **Impact on Innovation & Technology and Economic Competiveness (select examples)**

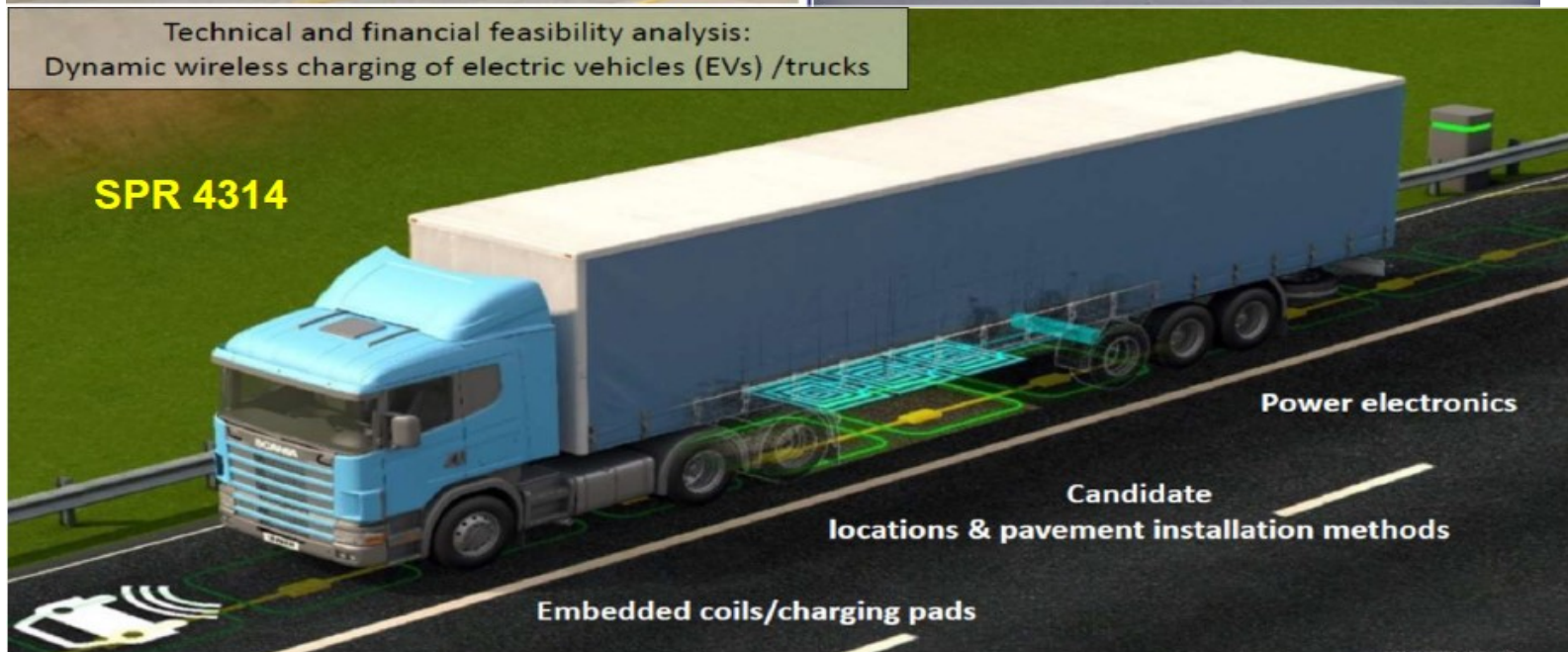
- **SPR-3865**, Traffic-Ware Valence Pod Detection Systems (**Vehicle Detection for Efficient INDOT Operations**)
- **SPR-4225**, **INDOT Research Program** Benefit Cost Analysis – **Return on Investment**
- **SPR-4314**, Feasibility Study and Design of **On-Road Electric Vehicle Charging Technologies**
- **SPR-4315**, Develop and Deploy a **Safe Truck Platoon** Testing Protocol for the Purdue ARPA-E Project in Indiana
- **SPR 4323**, Extraction of Vehicle “CAN bus” Data for **Enhanced Winter Roadway Condition Monitoring**
- **SPR-4411**, Last Mile Delivery and Route Planning for Freight



Pod and Loop Detection Zones



Technical and financial feasibility analysis:
Dynamic wireless charging of electric vehicles (EVs) /trucks





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

- **SPR-3852**, Transportation Research Board (TRB) Annual Meeting Activities
- **SPR-3915**, *S-Brite* Training on Implementing Effective Retrofits in Selected Steel Bridge Details
- **SPR-4422**, Automate the Generation of **Construction Checklists**
- **SPR-4424** Evaluation of Current Technologies for: **Training, Web Apps, and New Technologies**
- **SPR-4441**, **Public Acceptance of INDOT's Transportation Services**
- **SPR-4446**, An Assessment of the **Workforce and Occupations in the Highway, Street and Bridge Construction Industries**
- **INDOT's Damage Wise** program Implementation experienced a record-breaking fiscal year (ERIN, Posted September 2021)
- **EVOLVE** Expands to All of INDOT (ERIN, Posted October 2021)
- Advanced **Pavement Training** for District and CO Pavement Engineers
- **Salt Calibration & Liquid Routes Spreaders Calibration.**
- INDOT staff serving as **business owners/SAC** with faculty, practitioners, other DOT staff. (INDOT staff indicates positive professional development from SAC engagement).

Pay Item			
ID	Description	Unit Type	
201-02015	CLEARING AND GRUBBING	LS	S

↓

Standard
Specification

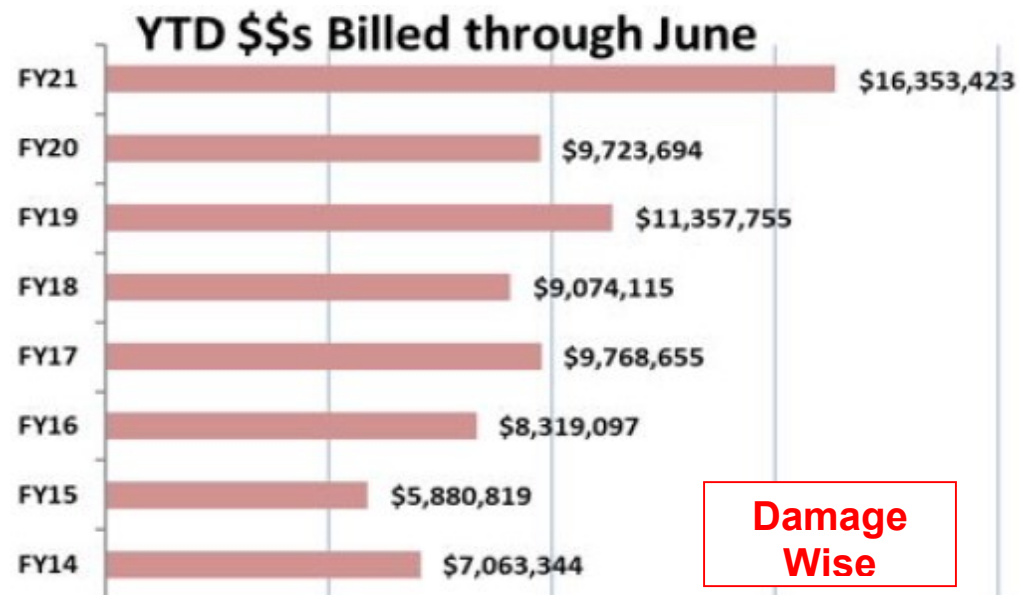
SPR
4422

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Inspection Form	
[Pay Item] 201-02015 CLEARING AND GRUBBING	
ID	Check Question
201-004	Surface objects, trees, stumps, roots, and other protruding obstructions not designated to remain are cleared, grubbed, and removed from within the limits of the work?
201-005	Undisturbed sound stumps, roots, and non-perishable solid objects do not extend more than 4 in. above the ground line or low water level?
201-007	Except in areas to be excavated, stump holes and other holes from which obstructions are removed are backfilled with suitable material and compacted in accordance with 203.23?

How to Drive a Roundabout







○ Other Program Impact Areas

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

- Partnership with FHWA in EDC Initiatives
- Participated in EDC 6 Virtual Summit and submitted 10 innovations for Indiana.
- Facilitated **8 Innovations in EDC 6** (INDOT advanced 4 for Demo 1 for Development, 1 for Assessment Stage, 1 institutionalized already and 1 not advanced).
- Facilitated **10 Innovations in EDC 5** (INDOT advanced 5, 4 institutionalized already and 1 not advanced). LTAP support for 2 of these institutionalized.
- Participated in National STIC Meetings.
- **INDOT EDC 5 Project Bundling Webinar**
- **INDIANA DOT DEVELOPS MODELS FOR SELECTING THE BEST PROJECTS TO BUNDLE – FHWA Innovator**
- **\$680K STIC Incentives** leveraging 9 INDOT studies.
- **Participated in National Pooled Fund Studies, PFS.**

Crowdsourcing for Advancing Operations

Combining data from multiple streams to improve transportation systems operations

Crowdsourcing is a low-cost, powerful tool that leverages the public to collect data to improve traveler information, traffic incident management, signal timing, weather-responsive management, work zone management, and more. Crowdsourcing overcomes gaps in geographic coverage of traditional intelligent transportation system (ITS) monitoring systems, lags in information timeliness, monitoring equipment costs, and jurisdictional data stovepipes.

In Every Day Counts round five (EDC-5), most participating agencies focused on improving one aspect of operations using crowdsourced data, most commonly traveler information and incident management. The EDC round six (EDC-6) initiative on **crowdsourcing for advancing operations** helps agencies transform crowdsourcing from single-source, single-purpose data use into a system that gathers multiple streams of data and integrates the data for use in multiple areas to improve real-time operations and operational systems planning.

"Most agencies have the potential for far greater benefits from crowdsourcing," said James Colyar, Federal Highway Administration transportation specialist and co-leader of the EDC-6 team. "The EDC-6 focus is on deepening crowdsourcing roots for more fruitful benefits, including evolving to modern data management practices, integrating crowdsourced and traditional transportation data, analyzing archived data to improve operational planning and performance management, and expanding real-time application and types of crowdsourced data."

One Data Set for Many Uses

Agencies such as the Indiana Department of Transportation (INDOT) have found that even a single integrated, archived, and shared crowdsourced data stream can transform traffic operations. "Crowdsourced data has proven to be extremely versatile and INDOT is very pleased by the savings in time and money it has enabled across the department," said Ed Cox, INDOT's engineering director of traffic management.



Virtual Summit
December 8-10, 2020





Presenters: David Unkefer, FHWA
EDC-5 Project Bundling Co-lead

Romeo Garcia, FHWA
EDC-5 Project Bundling Co-lead

Vern Herr
Group Solutions

Louis Feagans
Indiana DOT

Facilitator: Daniel D'Angelo, Applied Research Associates

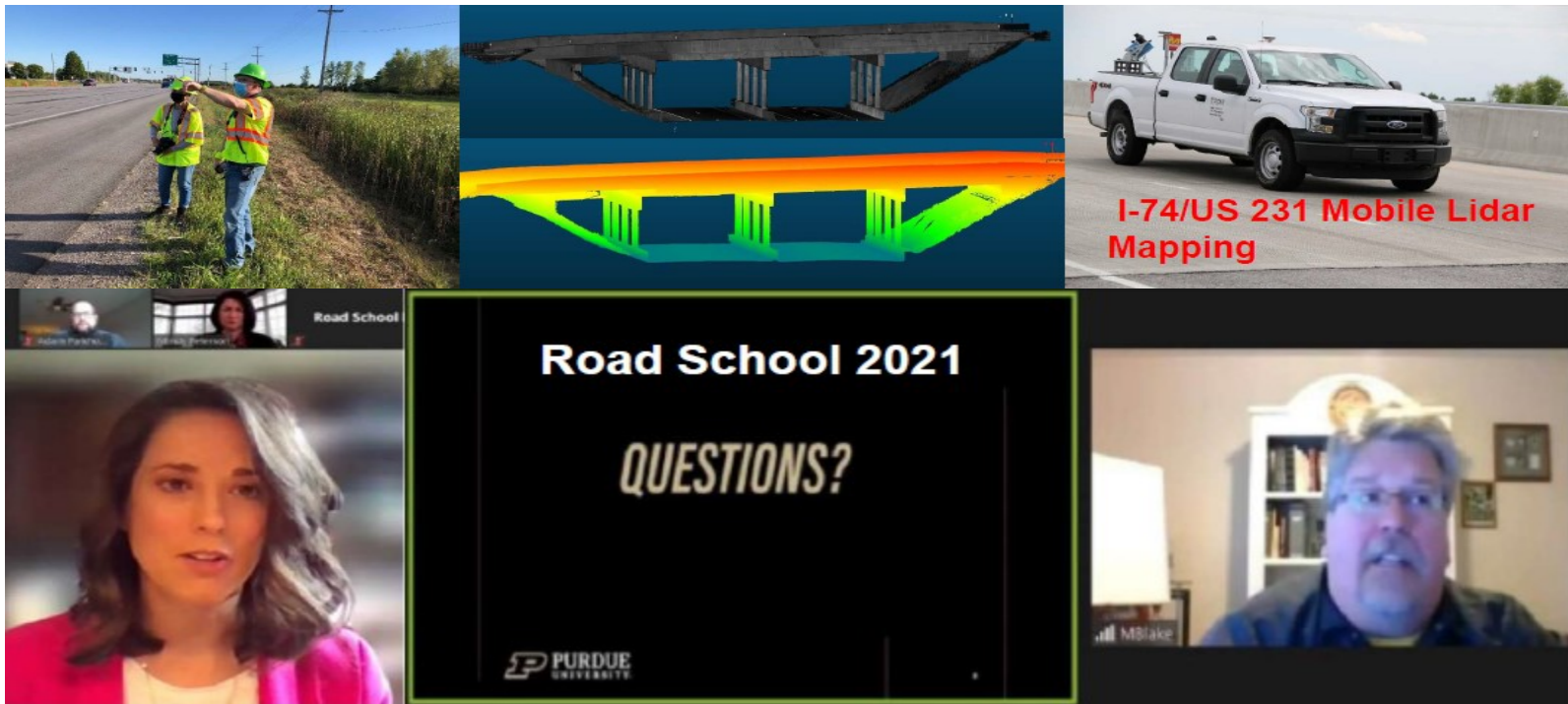


Advancing Project Bundling: How-to January 20, 2021

Fiscal Year	Innovations	Indiana STIC Incentive Projects Project
2021	Crowdsourcing, weather	Upgrade web-based Winter Operations Dashboard using enhanced probe data (\$100,000)
2020	Workzone	Implement Enhanced Probe Data for Tactical Work Zone Operations (\$41,000)
2020	Bundling	Expand project bundling with machine learning for local agencies (\$35,000)
2020	VPI	Expand current Virtual Public Involvement (VPI) efforts (\$24,000)
2019	CAV, GNSS	Develop Mobile Mapping System Manual of Operations. (\$100,000)
2018	Weather	Implementation of Intelligent Snowplow System (\$100,000)
2017	V2I	Implementation of Connected Vehicle Corridor Deployment and Performance Measures for Assessment (\$100,000)
2016	Smarter Work Zones	Implementation of LiDAR-Based Mobile Mapping System for Lane Width Evaluation and Reporting in Work Zones for INDOT Traffic Management (\$100,000)
2014	Intelligent Compaction	Development of Intelligent Compaction standard specification for soil embankment and subgrade compaction (\$80,000)

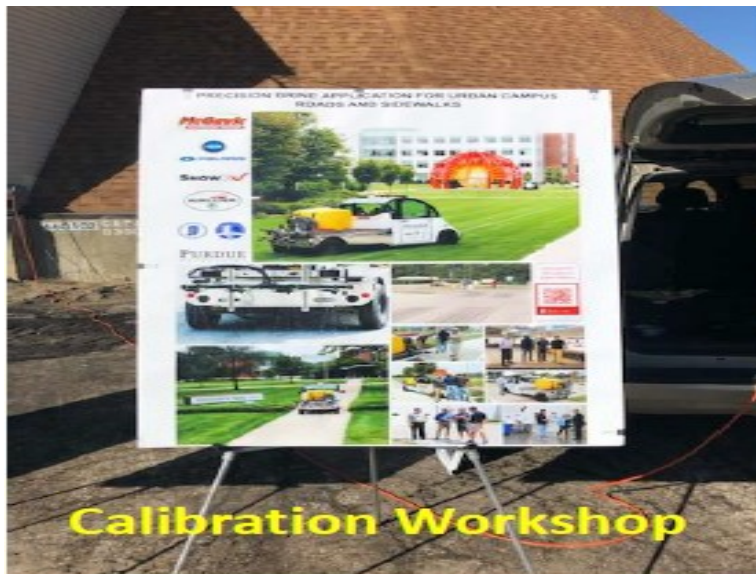
➤ **Engagement & Networking (select examples)**

- **Mobile LiDAR Survey on I-74** (August 2020)
- **Road School Educates Participants Virtually for the First Time** (Inside INDOT - March 2021)
- **INDOT Develops Automated Brine Tankers** (Inside INDOT - February 2021)
- **INDOT Chief of Staff Site Visit to INDOT R&D**
- **Virtual Reality Training Is Getting Real at INDOT**
- **TRB Annual meeting** (presentations, papers, posters)
- **NCHRP, TRB, AASHTO** Committees membership.



The Fort Wayne District's Angela Nicholson speaks in a Purdue Road School seminar while the LaPorte District's Adam Parkhouse (top, from left) and consultant Mindy Peterson listen.

Greenfield District Project Manager Mark Blake answers questions after his presentation



An INDOT smart brine tanker at work on I-465.



Virtual Reality Training

INDOT's J.D. Brooks (left in top photo) holds the controls while talking with Purdue's Yu-Ting Huang (from left) and Taratal Ghosh Mondal. Then, Brooks dons the virtual reality headset (right photo).



Statewide Maintenance Operations Engineer Frank Sailer tests a virtual reality-based training module in July.

➤ **State and National Recognitions (select examples)**

- **ERIN articles, Inside INDOT newsletter articles**
 - **INDOT Research Program's Return on Investment Rivals Any 401(k)** (Inside INDOT June 2021)
 - **TRB Webinar (October 2020): Non-Destructive Bridge Deck Testing**
 - **Tining and Grooving Enable Motorists to Enjoy Sounds of Silence** (Inside INDOT – December 2020)
 - **Thank You Card from Mike Lane to Barry Partridge regarding Employee Safety Research Studies Initiative** (January 2021)
 - **Automatic Vehicle Location Is Our Newest Tool for Winter Operations** (Inside INDOT January 2021)
 - **Inside Indiana Business TV interview & ASCE Game Changing Award – Sensors in Concrete Pavement** <https://www.youtube.com/watch?v=6HpaCVGeSHc&t=96s>
 - **2021 AASHTO Region 3 High Value Research Selections - Safety Supplemental Category "RoadHAT 4D - A Practical Tool for Identifying Road Safety Needs and for Adequate Scoping of Road Design Projects"**
 - **Virtual Town Hall Educates Public About Work-Zone Safety** (Inside INDOT June 2021)



"The Research Program's focus remains on INDOT needs, and not straying too far into what would be interesting to researchers," said INDOT Multimodal Director Kristin Brier (*left photo*). "Each research project is managed by competent and capable researchers and project advisers."

Just like property taxes, values of the Research Program's ROI are calculated in arrears to allow time for research findings to be implemented and cost savings to incur.

In 2019, INDOT unveiled its updated [Strategic Plan](#). Strategic objectives include safety, mobility, economic competitiveness, customer service, asset sustainability, organization and workforce, and innovation and technology. The Research Program provides direct support to helping INDOT fulfill these strategic objectives.

ROI

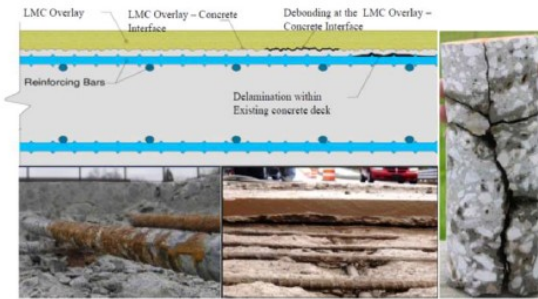
"The Research Program is reinforcing science in INDOT's approach to transportation rather than rules of thumb or convention", said INDOT Managing Director of Strategic Planning Brad Steckler (*right photo*). "INDOT would benefit from a greater share of research in understanding driver/customer behavior and beliefs as they relate to our practices and infrastructure."



For FY 2022, the program received 146 [Innovation and Research Needs & Ideas](#). All [Submission of Research Ideas to INDOT](#) are reviewed and prioritized by subject matters experts and focus groups. Of these priority needs, 35 were selected for potential funding.

Application of Non-Destructive Evaluation on Bridge Decks

INDIANA DOT'S EXPERIENCE



Anne Rearick
Director of Bridge Management, INDOT

Bridge Inventory in Indiana

INDOT and LPA Bridge Statistics

- Approximately 330 Toll Road Bridges
- Approximately 5900 INDOT Bridges
- Approximately 13200 Local Bridges (LPA)
- Approximately 2900 NHS Bridges
- 19 Border bridges
- Approximately 9000 INDOT Culverts
- 6 Complex Bridges
- 5 Tunnels



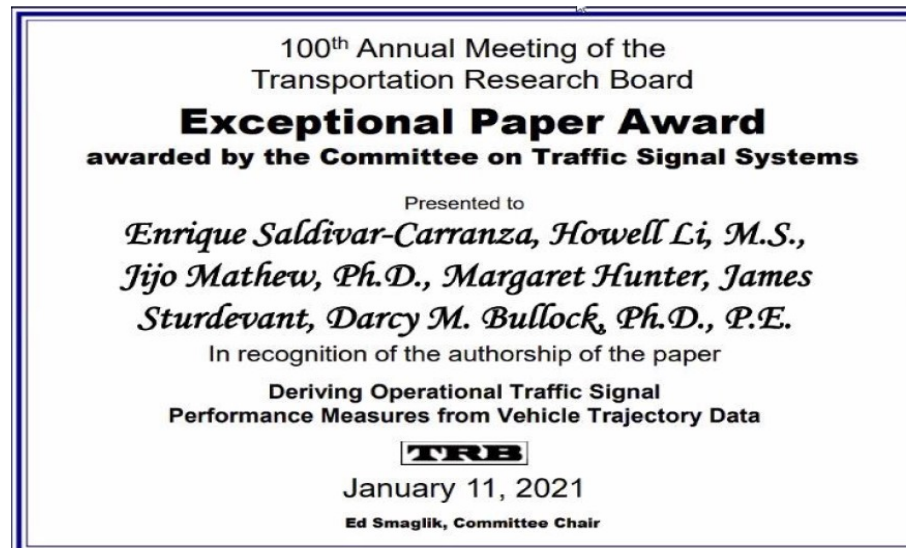
TRB Webinar
(October 2020)



Participating in the virtual town hall are Deputy Chief of Staff Scott Manning (clockwise, from top left), Traffic Operations Director John McGregor, Joint Transportation Research Program Director Darcy Bullock, and Work-Zone Safety Supervisor Mischa Kachler.



- **TRB Awards and high-profile articles**
 - **NCHRP Research Report 954 Performance-Based Management of Traffic Signals** (January 2021)
 - **TRB Exceptional Paper Award: Deriving Operational Traffic Signal Performance Measures from Vehicle Trajectory Data** (January 2021)
 - “Ontology-Based Knowledge Management System for **Digital Highway Construction Inspection**,” winner of the TRB, K. B. Woods Award.
 - **TRB Paper: Monitoring of the Response of the Sagamore Parkway Bridge and its Foundations During a Live Load Test**



- **Miscellaneous Research News, Webinars/Workshops & high-profile articles**
 - Engineering News Record Names INDOT "Owner of the Year" Commissioner email
 - CNBC Ranks **Indiana the 3rd Best State for infrastructure**
 - FHWA Innovator – **INDOT DEVELOPS MODELS FOR SELECTING THE BEST PROJECTS TO BUNDLE**
 - **Mapping & Documenting Roadway crash scenes.**

- **Informational Webinars**
 1. April 26 Webinar: **Truck Queue – Protect the Queue Initiative (Back of Queue Efforts)**
 2. April 26 TRB Webinar **Paving the Way to Successful AASHTO Ware Pavement ME Implementation**
 3. May 10 Webinar: **Traffic Winter Operations/Dashboards**
 4. June 10 Roads & Bridges Webinar: **Implementation of Internal Curing of Bridge Deck Concrete in Indiana**
 5. June 15 EDC Webinar: **A Strategic Approach to Project Bundling**
 6. August 19 **Virtual workgroup with Ford (EV & Wireless charging)**
 7. August 30 **Virtual workgroup with FHWA and OST (EV & Wireless charging)**
 8. September 16 **Virtual workgroup with MnDOT, FHWA & OST (EV & Wireless charging)**
 9. September 29 Roads & Bridges Webinar: **Development of An Intelligent Snowplow**
 10. September 30 TRB Webinar: **Ensuring Construction Quality Assurance with Lightweight Deflectometers**
 11. **December 7 State EV Infrastructure Workshop: Medium- and Heavy-Duty Considerations (EV & Wireless charging)**
 12. **December 13 Inductive Charging Research Plan Working Group with FHWA (EV & Wireless charging)**

➤ **Forensic Investigations and Specialized Testing Programs (select examples)**

- Forensic capabilities & data driven decision-making capabilities, direct result of research program
- **Commissioner Message** commenting on **Epoxy Injection** (Inside INDOT – September 2020)
- **Bridge Deck Epoxy Injects INDOT with Asset Sustainability and Innovation** (Inside INDOT – December 2020)
- **New Trailer Helps INDOT Get Ahead in Innovation**
- **NDT of Bridge Decks** – Impact Echo Emerging Technology – Crawfordsville District – Results & Implications
- **Greenfield District recognition for INDOT R&D testing efforts** on I-465, I-70, and I-65 testing in Marion County.
- **Failed Materials Committee Looks After INDOT’s Best Interests** – January 2021
- **Districts Recognitions for FWD Testing & Analysis**
- **INDOT R&D personnel collected GPR data at the Purdue Airport.**
- R&D was requested to employ ground-penetrating radar (**GPR**) vehicle to investigate eastbound and westbound I-265.
- **Sinkhole Prompts District to Rise to the Occasion.**
- Newsletter story on **I-465 ramp fire Friction Testing.** – Erin Article.

- **Friction and Texture Quality testing** on crack sealing material to ensure the material met national specifications on the roads with the highest number of complaints of low skid resistance.
- Identification of **bridges with low friction numbers**



A Message from the Commissioner

Hello Team,

You know, I'm not sure six months ago I would have imagined we would still be dealing with the COVID-19 pandemic, but we are. And, while I think we're all getting a little tired of it — I know I am — I could not pass up this opportunity to tell you how enormously proud I am of each and every one of you.

I know it hasn't been easy during these times, but you have continued to be high performers, not only taking care of our roadways, but also supporting one another. I am so honored to be a part of our INDOT team.

I've mentioned before that this year I'm traveling the state visiting with many of you more than I ever have. As I've done that, I continue to be so impressed about how good our roads are. They have never looked better! Just last week I traveled up north to give a presentation to the Elkhart Chamber, and U.S. 31 was great!!

While I was in the Seymour District a few weeks ago, I experienced a soil-nailing procedure to stabilize a roadway slope, and that was kinda cool. And when I was in the Crawfordsville District, I watched a team use a new epoxy-filling process on a bridge. That was really neat to see, and it's gratifying to know that the bridge will now last a lot longer and provide a smoother surface.

These are just a couple of examples that show how dedicated our team is. You haven't stopped doing what is best for the state, and you have continued to get up every morning committed to do the right thing, even during these absolutely crazy times.

Our INDOT team is the best!

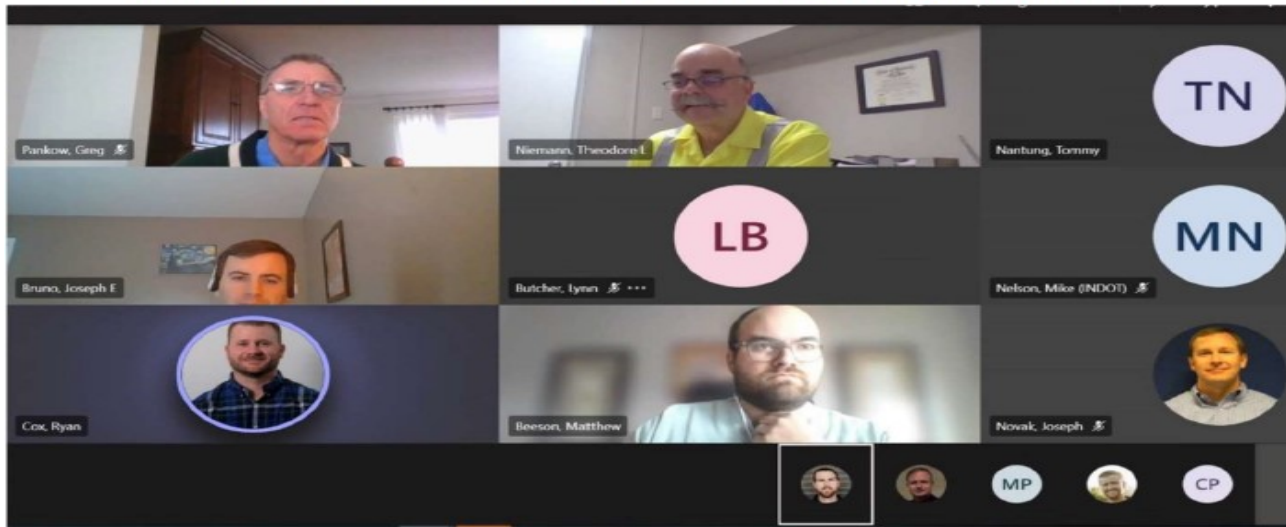
Thank you for all you do, and please continue to stay safe.

A handwritten signature in black ink, appearing to be the name 'Joe' in a cursive script.



Inside INDOT

Failed Materials Committee Looks After INDOT's Best Interests



➤ 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 **INDOT Strategic Plan** to User's Manual, Summary of Impact & ROI reports, Customer Service Surveys, Implementation Plans and Template Research Need Statements.
- **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 2023 (on February 24) Show Case & Peer Group meetings, focusing on peer groups to identify research needs on an ongoing basis. **FY 2022 Prioritized needs and Ideas was held on February 25.** Faculty Liaisons were engaged in Focus Groups.
- Title VI impact/compliance training.

- FY 2022, 158 research needs submitted, 44 research projects funded (including 9 expansions), 19 projects completed thus far, 95 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_20191201.pdf)
- **Joint Transportation Research Program**
<https://engineering.purdue.edu/JTRP>
- **Innovation Office and Submission Link (only through the intranet)**
[https://ingov.sharepoint.com/sites/INDOTIntranet/SitePages/Innovation-at-INDOT\(2\).aspx](https://ingov.sharepoint.com/sites/INDOTIntranet/SitePages/Innovation-at-INDOT(2).aspx)
- **Testimony to the U.S. House of Representatives Committee on Science, Space, and Technology, Subcommittee on Research and Technology: “Bumper to Bumper: The Need for a National Surface Transportation Agenda”, July 11, 2019**
<https://science.house.gov/imo/media/doc/Ness%20Testimony.pdf>