



## Transportation Consortium of South-Central States

*Solving Emerging Transportation Resiliency, Sustainability, and Economic Challenges through the Use of Innovative Materials and Construction Methods: From Research to Implementation*

### Semi-Annual Progress Report #8

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# 1. Accomplishments

## Major Goals and Objectives of the Program

The **Vision** of Tran-SET is to “address the accelerated deterioration of the transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes.”

The **Mission** of Tran-SET is to “conduct all phases of research, technology transfer, education, workforce development, and outreach activities as to solve transportation challenges in Region 6 and support implementation.”

The following 14 objectives are at the heart of *all* Tran-SET activities<sup>1</sup>:

Table 1. Major Objectives of Tran-SET.

ID <sup>1</sup>	Objective
<b>RESEARCH</b>	
R1	Improve the durability and extend the service life of transportation infrastructure [IF2, IN1 <sup>2</sup> ]
R2	Preserve the environment [IF1, IN1]
R3	Preserve the existing transportation system [IF2, IN1]
R4	Address immediate transportation priorities in Region 6 [S1, IF2, IF3, IF4, IN1]
<b>TECHNOLOGY TRANSFER</b>	
TT1	Ensure that scientific and technological developments are accessible, disseminated, and transferred to a wide range of users including state agencies, universities, and industries [IN2]
TT2	Ensure that scientific and technological developments have long-term research value and significant impact to the transportation industry by direct collaboration with all levels of government and nonprofit institutions [IN2]
<b>EDUCATION</b>	
E1	Improve and support existing academic programs at Tran-SET’s partnering institutions [IF4, A2]
E2	Improve and support transportation non-degree programs at Tran-SET’s partnering institutions (architectural, business, mechanical, electrical, industrial engineering, etc.) [IF4, A2]
<b>WORKFORCE DEVELOPMENT</b>	
WF1	Ensure research outcomes are disseminated through educational and workforce development activities by supporting the development of seminars, workshops, and training courses [IF4, A2]
<b>EMPHASIS AREAS</b>	
EL1	Develop the next generation of leaders and graduate students of the transportation field by supporting mentoring, networking, training, and other development activities [IF4, A2]
EL2	Provide leadership to regional stakeholders and communities (state agencies, universities, and industries) and provide national leadership to applicable research communities [IN1, IN2]
EC1	Encourage and foster collaboration between partnering institutions and external stakeholders as to: (1) maximize sharing of human expertise and facilities among partners and stakeholders, (2) tackle transportation challenges only solvable by multi-disciplinary teams, (3) facilitate knowledge transfer among the team institutions and stakeholders, and (4) minimize duplicative research to optimize the use of available funds [IN2, A2]
ED1	Integrate diversity-related activities into Tran-SET’s efforts as to increase participation of underrepresented students in STEM fields, particularly the transportation field [IF4, A2]
<b>MANAGEMENT</b>	
M1	Operate and manage Tran-SET as to ensure the highest degree of accountability, cost-efficiency, and optimum use of available funds, facilities, and capabilities [A2]

<sup>1</sup>All activities, outputs, outcomes, and impacts are categorized under Tran-SET’s objectives (in blue).

<sup>2</sup>All Tran-SET objectives, activities, outputs, outcomes, and impacts are categorized under objectives of the US DOT Strategic Plan for FY2018-2022 (in green). Regarding ID abbreviations: S refers to Safety, IF refers to Infrastructure, IN refers to Innovation, and A refers to Accountability objectives, respectively.

## Accomplishments (During this Reporting Period)

### RESEARCH

**Project Closeout of Third-Cycle Projects:** Each Tran-SET project consists of a 12-month technical phase, followed by a 6-month implementation phase. In spite of COVID-19 and LSU shutdown (**Mar. 2020- Jul. 2020**), Tran-SET worked closely with the PIs to deliver the projects on time through (a) continuous follow up through progress reports, (b) schedule and arrange virtual meetings, and (c) following CDC practices for physical meetings. Out of the total 33 third-cycle projects, 14 projects ended their implementation phase, submitted their implementation reports, and were successfully completed and closed out (**Feb. 2021**). For the remaining 19 projects, Tran-SET staff conducted an initial review of submitted final reports and datasets (**Dec. 2020**), requested revisions (**Feb. 2021**), and received revisions (**Mar. 2021**). The finalized reports and datasets will be archived and disseminated per UTC reporting requirements (**Apr. 2021**). [M1, A2]

**Fourth-Cycle Projects in Progress:** As of **Mar. 2021**, **40** projects from Tran-SET's fourth funding cycle successfully completed 8 months of the technical phase. Figures 1a and 1b present the distribution of projects by research objective and transportation area, respectively. Detailed information can be found in Appendix A. [R1, R2, R3, R4, S1, IF2, IF3, IF4, IN1]

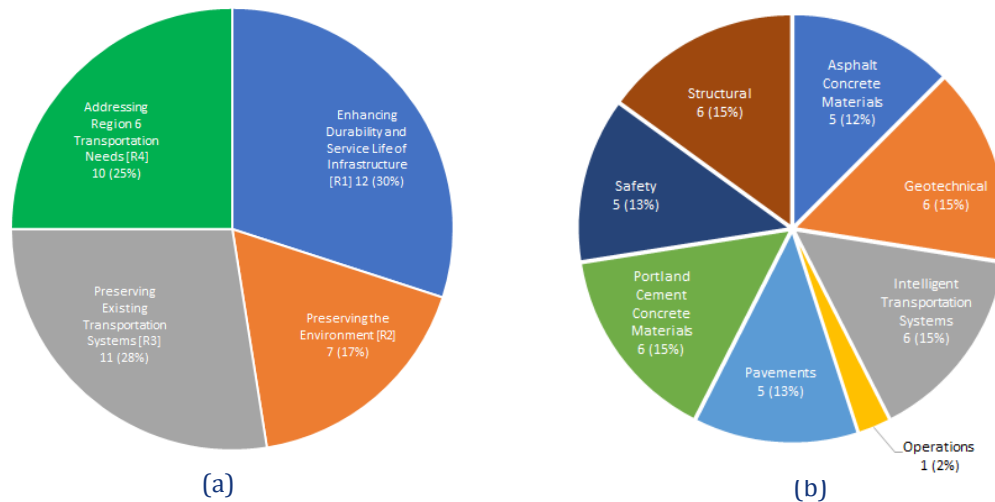


Figure 2. Fourth-Cycle Projects Categorized by: (a) Research Objective and (b) Transportation Area.

**Proposals for Fifth-Cycle Projects:** A total of **95** problem statements that were submitted for the fifth-cycle of funding were ranked by regional transportation leaders/experts (**Oct. 2020**) and requests for proposals (RFPs) were solicited for **41** projects (**Nov. 2020**). Projects are categorized in Figures 2a and 2b, by Tran-SET research objective and transportation area, respectively. A total of **41** proposals were received (**Jan. 2021**) and are currently under review by subject matter experts. [R1, R2, R3, R4, S1, IF2, IF3, IF4, IN1]

### TECHNOLOGY TRANSFER

**2021 Tran-SET Conference:** Tran-SET will hold its fourth annual conference on **June 3-4, 2021** virtually due to the current COVID-19 situation nationwide and the continued restrictions and guidelines states and individual organizations have implemented. The Virtual Conference will be e-hosted by the Arkansas State University (A-State). The purpose of the annual Conference is to educate, engage, and work with varied stakeholders (academics, industry professionals, state DOTs, and other government agencies) to discuss and solve transportation challenges facing the South-Central United States. The Conference is an opportunity to inform stakeholders on Tran-SET's

research, education, workforce development, and technology transfer activities. Many activities have occurred during this reporting period in preparation: established Conference Planning Committee (**Oct. 2020**), created Conference website (**Nov. 2020**), solicited call for papers and student poster abstracts (**Dec. 2020**), and collected paper and abstract submissions (**Feb. 2021**). In total, 42 papers and 16 abstracts for student posters were received. More information is available on Tran-SET's website. [TT1, TT2, EL2, IN2]

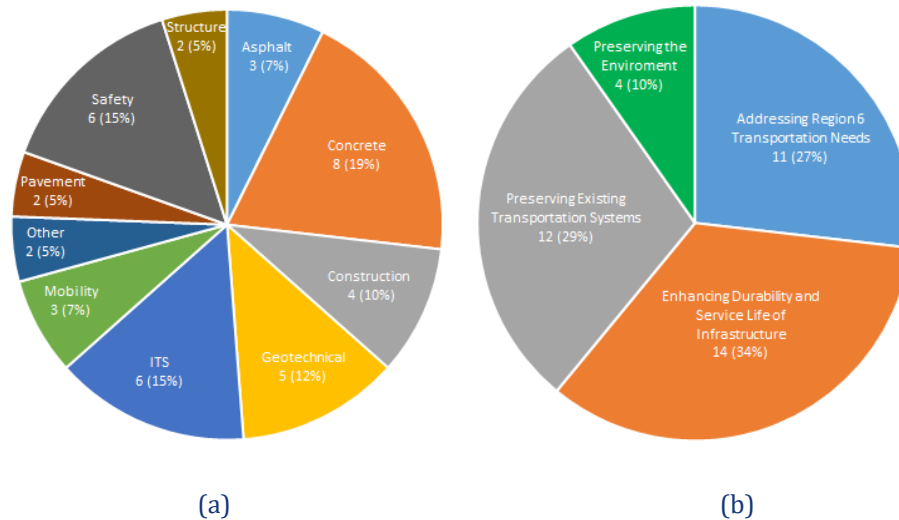


Figure 2. Fifth-Cycle Proposals Categorized by: (a) Research Objective and (b) Transportation Area.

**2021 TRB Annual Meeting:** Tran-SET had a strong presence at the 2021 TRB Annual Meeting held virtually on **Jan. 2021**. More than 40 Tran-SET researchers and students attended the annual meeting virtually and presented results and findings from Tran-SET projects. Over 13,000 transportation professionals were in attendance. [TT1, TT2, EL2, IN2]

**Joint Tran-SET Webinar Series:** Tran-SET continued its quarterly webinar series with its 10<sup>th</sup>, 11<sup>th</sup> (**Oct. 2020**) and 12<sup>th</sup> webinars (**Mar. 2021**). The 10<sup>th</sup> and 11<sup>th</sup> webinars were on the topic of “Corrosion Management System of Transportation Infrastructure for Long-Term Durability Reinforced Concrete Structures” and were offered in collaboration with Commercial Metals Company, Sherwin-Williams, Concrete Reinforcing Steel Institute, Texas A&M University, and the University of New South Wales. The 12<sup>th</sup> webinar was on the topic of “Advances in the Ultra-High Performance Concrete (UHPC)” and was offered in collaboration with the University of Florida, University of Oklahoma, and New Mexico State University. About 170 attendees participated in these webinars. Recorded webinars, presentation slides and other outreach materials are available on the [Tran-SET’s website](#). [TT1, TT2, EL1, EL2, EC1, IF4, IN2, A2]

**Newsletter:** Tran-SET continued to develop and disseminate its quarterly newsletter with the winter issue (**Dec. 2020**) and spring issue (**Mar. 2021**). Newsletters are disseminated via the Tran-SET’s list serve. Current and past newsletters are available on the [Tran-SET’s website](#). [TT1, IN2]

**Technology Transfer (T2) Plan:** Tran-SET continues to implement its T2 plan, specifically: requiring fifth-cycle proposals to include project-specific T2 plans and utilizing these plans in the review/selection process (**Mar. 2021**). [TT1, TT2, EC1, IN2, A2]

## EDUCATION

**Native American Transportation Internship:** Tran-SET will host the Native American Transportation Internship, which is a modification of the Navajo Technical University Internship



hosted by Tran-SET in previous years on **July 3-28, 2021**, pending clearance from LSU due to the **COVID-19 outbreak**. This internship will support two students from Tran-SET partnering universities to travel to LSU and work onsite on select Tran-SET-funded research projects for one month. More information on the Internship is available on the [Tran-SET's website](#). [E1, EL1, EC1, ED1, IF4, A2]

**Tran-SET Transportation Veteran Scholarship:** As part of Tran-SET's initiative to advance the transportation workforce and to develop its next generation of leaders, Tran-SET offered a scholarship to three veterans. The scholarship awards \$10,000 to each student over a period of two years (**spring 2020-fall 2021**). During this reporting period, three students were awarded the scholarship and are participating in Tran-SET-funded research projects. [E1, EL1, EC1, ED1, IF4, A2]

**LSU High School Student Research (HSSR) Intern Program:** As part of Tran-SET's commitment to engage high school students in transportation-related research, Tran-SET is participating in the HSSR Intern program organized by LSU to involve 5 high school students in research in **summer 2021**. Various activities took place during this reporting period to make the Internship a success: 5 Tran-SET PIs submitted their research plans (**Nov. 2020**), PIs met with Internship organizers (**Dec. 2020**), and PIs held several meetings with selected high school students (**Jan. to Mar. 2021**). More information regarding the Internship is available on the [LSU's website](#). [E1, EL1, EC1, ED1, IF4, A2]

**eCybermission Competition:** As part of Tran-SET's commitment to enhance education and workforce development, Tran-SET is collaborating with the U.S. Army Educational Outreach Program (AEOP) in their eCybermission. eCybermission is a web-based STEM competition for students in grades six through nine. More information about this competition could be found on their [website](#). Tran-SET recruited 13 volunteers (faculty members and graduate students from all Tran-SET partnering universities) to serve as virtual judges (**Jan. 2021**). The virtual judges evaluated, commented, and scored at least 5 Mission Folders online during the competition time period (**Mar. 2021**). [E1, EL1, EC1, ED1, IF4, A2]

**Project-Level STEM Events:** Tran-SET and its affiliates sponsored, organized, and participated in several STEM events. Examples of these activities are listed below. [E1, E2, EL1, IF4, A2]

- Dr. Zahid Hossain (Tran-SET PI) from Arkansas State University served as a judge in the 65<sup>th</sup> Northeast Arkansas Regional Science Fair, Jonesboro, AR, **March 11-15, 2021**.
- Oak Grove Primary held the STEAM Night on **March 9, 2021**, to generate interest and enthusiasm for STEAM education among students and their families in Prairieville, Louisiana. Due to COVID-19, this year's event took place outdoors as a STEAM Night Drive-In. LSU PIs participated in this event by presenting a Shout Out video on innovative pavement materials, which was broadcast on a giant inflatable screen, so that students and their families can enjoy watching STEAM fun at school from the safety and comfort of their personal vehicles.
- Dr. Kate Hyun (Tran-SET PI) from the University of Texas at Arlington served as a virtual judge in eCYBERMISSION that took place between **March 16 - 31, 2021**.
- Dr. Fernando Moreu (Tran-SET PI) from the University of New Mexico participated in a STEM event (**Feb. 2021**) hosted by the Nuclear Museum of Albuquerque.

## WORKFORCE DEVELOPMENT

**Project-Level Involvement:** Tran-SET has sponsored, organized, and participated in various workshops, developed and presented revised course materials, and contributed to several professional societies. Illustrative examples are listed below. [WF1, TT1, TT2, EL2, IF4, A2, IN2]

- Dr. Homero Castaneda (Tran-SET PI) from Texas A&M University organized two webinars (**Oct. 2020**) to educate the industry about corrosion management system of transportation infrastructure for long-term durability reinforced concrete structures. About 110 attended the webinar from different states and countries.

- Dr. Momen Mousa (Tran-SET PI) from Louisiana State University provided a 1-hour educational session (**Feb. 2021**) with 130 attendees in the American Traffic Safety Services Association (ATSSA)'s Annual CONVENTION & TRAFFIC EXPO 2021. In this session, emerging machine learning techniques were presented as promising techniques to predict the performance of pavement markings.
- Dr. Surya Chandra (Tran-SET PI) from Texas A&M University participated in the TRB webinar "The Ubiquitous Unmanned Aerial Vehicle – UAVs for Infrastructure Monitoring" on **March 16, 2021**.

## MANAGEMENT

**Project Data Management Plan:** Tran-SET required all fifth-cycle proposals to include project-specific data management plans. These plans are considered as part of the review/selection process (**Mar. 2021**). [M1, A2]

**Section 508/Accessibility:** Tran-SET has been working diligently to ensure all public facing contents (submitted to NTL and all content residing on the Tran-SET website) are 508-compliant. Completed contents include documents and reports on Tran-SET's website, Tran-SET's website and social media page, and videos content. [M1, A2]

## Dissemination of Results

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Please see the "Technology Transfer" subsections of Sections 1 (above) and 3 (below) documenting Tran-SET's main outreach and dissemination activities. As detailed in these sections, results have been disseminated via social media ([Tran-SET website](#), [LinkedIn](#), [Twitter](#), and [YouTube](#)), newsletters, other promotional documents (i.e., project briefs), conferences, educational materials, and peer-reviewed publications.

## Activities Planned (for Next Reporting Period)

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### RESEARCH

- Archive and finalize remaining third-cycle project deliverables (**April 2021**). [TT1, IN2]
- Complete review of proposals (**Apr. 2021**), revise and finalize proposals for (**May 2021**), and award fifth-cycle projects (**Jun. 2021**). [R1, R2, R3, R4, S1, IF2, IF3, IF4, IN1]
- Issue call for problem statements for sixth-cycle projects (**Aug. 2021**) and begin review of problem statements. [R1, R2, R3, R4, S1, IF2, IF3, IF4, IN1]

### TECHNOLOGY TRANSFER

- Develop and disseminate Tran-SET newsletter for summer 2021 (**Jun. 2021**) and fall 2021 (**Sep. 2021**). [TT1, IN2]
- Organize and jointly host two webinars in the "Joint-Tran-SET Webinar Series" (**June 2021, Sep. 2021**). [TT1, TT2, EL1, EL2, EC1, IF4, IN2, A2]
- Continue planning activities for the 2021 Tran-SET Conference planned on **June 3-4, 2021** including: finalizing revisions for the submitted papers (**Apr. 2021**), publishing the conference proceedings (**Jun. 2021**), etc. [TT1, TT2, EL2, IN2]
- Continue to develop, promote, and expand Tran-SET's educational video portfolio (**on-going**); and upload videos from the 2021 Tran-SET Conference (**Aug. 2021**). [TT1, IN2]
- Promote and disseminate third-cycle reports and project datasets via Tran-SET listserv and social media (**Apr. 2021**). [TT1, IN2]
- Continue developing/disseminating "Project Highlights" for third-cycle projects (**Apr. 2021**). [TT1, IN2]

## EDUCATION

- Finalize planning for, hire two Tran-SET students, and host the Native American Transportation Internship (**Jul. 2021**) pending clearance from LSU due to the COVID-19 outbreak. [E1, EL1, EC1, ED1, IF4, A2]
- Continue to offer the Tran-SET Scholarship for Veterans, disseminate, and award to three recipients in the **2021 fall** and **2022 spring** semesters. [E1, EL1, EC1, ED1, IF4, A2]
- Continue sponsoring, organizing, and participating in STEM events (**on-going**). [E1, IF4, A2]
- Continue engaging high school students in the 2021 CoE HSSR Program at LSU (**Apr.-Jul. 2021**). [E1, EL1, EC1, ED1, IF4, A2]
- Continue coordinating with the U.S. Army Educational Outreach Program (AEOP) to recruit future virtual judges (**Sep. 2021**) to participate in eCybermission. [E1, EL1, EC1, ED1, IF4, A2]
- Continue coordinating with the PIs to develop new educational modules and publishing these educational modules on Tran-SET’s website (**on-going**). [E1, EL1, EC1, ED1, IF4, A2]

## WORKFORCE DEVELOPMENT

- Integrate developed educational modules and revised courses into the recently created LSU Construction Management online programs: B.S., Post Baccalaureate Certification, and M.S. degree programs (**on-going**). [WF1, TT1, TT2, EL2, IF4, A2, IN2]
- Continue sponsoring, organizing, and participating in workshops, developing and presenting revised course materials, and involvement in professional society activities (**on-going**). [WF1, TT1, TT2, EL2, IF4, A2, IN2]
- Continue organizing and participating in STEM events (**on-going**). [WF1, TT1, TT2, EL2, IF4, A2, IN2]

## MANAGEMENT

- Provide 508 compliant captions for Tran-SET videos (**Jun. 2021**). [M1, A2]
- Solicit surveys to the CAB and PRCs to receive feedback on how well Tran-SET activities are addressing regional needs and impacting state-of-the-practice (**Apr. 2021**). [M1, all, A2]

## 2. Participants & Collaborating Organizations

During this reporting period, Tran-SET partnered with **126** organizations (43 academic institutions, 33 government agencies, 43 industrial firms, and 7 nonprofits) to accomplish and oversee its research, technology transfer, education, and workforce development activities. Please see Table 2 for details.

Tran-SET collaborated with **30** organizations/individuals (from 9 academic institutions, 6 government agencies, 7 industrial firms, and 8 nonprofits.). As shown in Table 3, these collaborations embody interdisciplinary approaches.

### Partners (Selected)

Table 2. Tran-SET Partners.

Organization Name	Type	Location	Description of Contribution [Tran-SET Affiliation]
AECOM	Industrial firm	Los Angeles, CA	Collaborative research [PRC]
Alabama Transportation Institute - University of Alabama	Academic institution	Tuscaloosa, AL	Collaborative research [PRC]

Organization Name	Type	Location	Description of Contribution [Tran-SET Affiliation]
Alliance Safety Council (Industry)	Nonprofit	Baton Rouge, LA	Collaborative research [CAB]
Alma Plantation	Industrial Firm	Lakeland, LA	Provide bagasse ash for research project.
APS Engineering and Testing LLC	Industrial firm	Baton Rouge, LA	Collaborative research [PRC]
ARA	Industrial firm	Albuquerque, NM	Collaborative research [PRC]
Arkansas Concrete Pavement Association	Academic institution	Little Rock, AK	Collaborative research [PRC]
Atlas Asphalt Inc.	Industrial firm	Jonesboro, AR	In-kind support [fourth-cycle].
AZZ	Industrial firm	Fort Worth, TX	Bare steel rebar. Materials for rebar for the concrete casting. Access to RC structures to perform field measurements
Barriere Construction Company	Industrial firm	New Orleans, LA	Collaborative research [CAB]
BNSF Railway	Industrial firm	Kansas City, MO	Input on the use of LiDAR in railroad applications
Canadian National (CN)	Industrial firm	Homewood, IL	Input on the use of LiDAR in railroad applications
Center for Advanced Research and Computing	Nonprofit	Albuquerque, NM	Laboratory space for bridge model in UNM
City of Arlington	Government	Arlington, TX	Collaborative research [PRC]
City of Tyler	Government	Tyler, TX	Collaborative research [PRC]
Commercial Metals Company	Industrial firm	Irving, TX	In-kind support [fifth-cycle]
Con Edison	Industrial firm	New York, NY	Field data for concrete samples
Concrete and Aggregates Association of Louisiana	Industrial firm	Baton Rouge, LA	Collaborative research [PRC]
Consolidated Edison	Industrial firm	Irving Place, NY	In-kind support [fourth-cycle]
CORESLAB	Industrial firm	Albuquerque, NM	Access to bridge rebar cage for field testing
Defense & Intelligence Solutions Division Southwest Research Institute	Nonprofit	San Antonio, TX	Collaborative research [PRC]
Edwards Aquifer Authority	Government	San Antonio, TX	Collaborative research [PRC]
Federal Highway Administration	Government	Washington D.C.	Collaborative research [PRC]
Fermat Capital Management	Industrial firm	Westport, CT	Collaborative research [PRC]

## Collaborators

Table 3. Tran-SET Collaborators.

Organization/Name	Type	Description of Collaboration
AECOM	Industrial firm	Shared data pertaining to CRPC vanpool program development and inflow-outflow analysis
Automated Railroad Maintenance Systems (ARMS)	Industrial firm	Provide feedback and assessment of the research project



Organization/Name	Type	Description of Collaboration
Build Baton Rouge (East Baton Rouge Redevelopment Authority)	Government	Shared unpublished plan documents and information pertaining to station area development planning and strategy
Chinese Earthquake Administration (CEA)	Nonprofit	Laboratory for testing LiDAR in large scale facilities and input on large scale applications
City of San Antonio	Government	Discussed field implementation
Commercial Metals Company	Industrial Firm	Tran-SET Joint Webinar Series
Concrete Reinforcing Steel Institute	Nonprofit	Tran-SET Joint Webinar Series
CPS Energy	Government	Presented harvesting results
ESPOL University	Academic institution	Process bagasse ash, prepare SCBA-ECC mixtures and evaluate its properties, Conduct research on zeolite-based EGC materials.
FHWA	Government	Discussed application of the vehicle classification software
Greyhound	Industrial firm	Collaboration in in-person data collection for existing intercity passenger service customers
Institute of Engineering Mechanics (IEM) China	Nonprofit	Student to provide input on LiDAR for SHM of structures
Jonesboro High School (JHS)	Academic institution	The STEM Academy of JHS selected qualified students for the internship program
LaDOTD	Government	Help the PIs visit bridge construction sites
Megabus	Industrial firm	Collaboration in in-person data collection for existing intercity passenger service
New Mexico State University	Academic institution	Tran-SET Joint Webinar Series
New Orleans Building Corp. (NOUPT)	Government	Facilitated tenant contacts and communication and provided permission and collaboration for survey distribution
PSB Engineering	Industrial firm	Basic advice and guidance for bridge deck condition evaluation
Ride New Orleans	Nonprofit	Shared past survey data of New Orleans-Baton Rouge passengers collected during final months of LA Swift Service
Sherwin-Williams	Industrial Firm	Tran-SET Joint Webinar Series
Texas A&M University	Academic institution	Tran-SET Joint Webinar Series
The University of Arkansas	Academic institution	The university is supporting the research team in using high-performance computing clusters, AHPCC.
University of Florida	Academic institution	Tran-SET Joint Webinar Series
University of Nebraska at Lincoln	Nonprofit	Sharing LiDAR experience in monitoring reinforcement, possibility of training PhD student in LiDAR applications
University of New South Wales	Academic institution	Tran-SET Joint Webinar Series
University of Oklahoma	Academic institution	Tran-SET Joint Webinar Series
UTSA/Mansourah University	Academic institution	Literature review collaboration and potential share of engineering experience

Organization/Name	Type	Description of Collaboration
Virginia Polytechnic Institute and State University	Nonprofit	Collaboration with algorithm development on point cloud data
Women4Climate (C40 Cities)	Nonprofit	Collaboration with local mentor/mentee pair to share stakeholder interview data and support survey distribution efforts
Yangzhou University (YZU)	Nonprofit	Training of Master student in smart structures and structural health monitoring

### 3. Outputs

Performance metrics and targets for outputs, outcomes, and impacts of Tran-SET’s research, T2, education, and workforce development programs are discussed below.

#### RESEARCH

Table 4 lists Tran-SET’s performance metrics for research-related outputs. In total, **41** new technologies/techniques were developed. They are briefly summarized below.

Table 4. Research Performance Metrics: Outputs.

ID	Objective ID	Metric	Value <sup>1</sup>	Ann. Value <sup>2</sup>	Ann. Target <sup>3</sup>	Percent Compl. <sup>4</sup>
	R4, S1, IF2, IF3, IF4, IN1	<b>Number of projects specifically addressing regional challenges:</b>				
R-01		Metropolitan growth and congestion	6	6	5	120%
R-02		Future transportation challenges	10	10	15	67% <sup>5</sup>
R-03		Declining public revenues	4	4	3	133%
R-04		Underserved communities	2	2	2	100%
R-05		Safety	5	5	5	100%
R-06	EC1	Number of collaborative (multi-institution) projects	10	10	11	91%
R-07	R1, R2, R3, R4, IN1	Number of new technologies or techniques developed	41	102	80	128%

<sup>1</sup>Metric value for reporting period; <sup>2</sup>Best estimate for annualized metric value; <sup>3</sup>Annual, per funding cycle, target; <sup>4</sup>Percent completion of annual target; same column definitions for Tables 4 – 13; <sup>5</sup>Tran-SET strives to increase the percent completion of this metric through funding more projects in the future addressing future transportation challenges including self-driving vehicles.

#### Discussion of Performance Metrics: Number of New Technologies or Techniques Developed

The target for this metric was re-evaluated and was raised from **60** to **80**. The increase is due to successful research conducted during the third-cycle projects. Examples of developed technologies or techniques are presented below.

- Dr. Su Zhang (PI)** and her research team in UNM developed a GIS compatible toolbox to detect and assess bridge deck wearing surface and subsurface distresses (Project No. 19STUNM04).
- Dr. Chao Sun (PI)** and his research team in LSU developed a vehicle-road coupling model for estimating the additional dynamic vehicle load induced by pavement roughness considering road surface deformation and traveling speed (Project No. 19PLSU09).
- Dr. Sara Ahmed (PI)** and her research team in UTSA developed a railway intersection detection and warning system (Project No. 19SAUTSA03)
- Dr. Zahid Hossain (PI)** and his research team in ASU developed a framework to rank different aggregate and binders used in Arkansas (Project No. 19BASU02).

## TECHNOLOGY TRANSFER

Table 5 lists Tran-SET’s performance metrics for T2-related outputs. Selected output examples are presented below.

Table 5. Technology Transfer Performance Metrics: Outputs.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
TT-01	TT1, TT2, IN2	<b>Number of stakeholders identified, specifically<sup>1</sup>:</b> Early potential adopters	46	46	30	153%
TT-02		Late potential adopters	26	26	30	87%
TT-03	TT1, TT2, IN2	<b>Number of times research products (technology) are disseminated via the following channels:</b> Featured in Tran-SET newsletter	12	24	24	100%
TT-04		Featured on Tran-SET social media	30	50	50	100%
TT-05		Peer-reviewed publications and presentations	164	299	130	230%
TT-06		Webinars	4	9	5	180%
TT-07	TT1, IN2	<b>Tran-SET website traffic:</b> Number of visitors to website	17k	34k	30k	113%
TT-08		Number of visits to website	122k	244k	250k	98%
TT-09	TT1, TT2, IN2	<b>Number of times disseminated research products have informed/been viewed:</b> Social media engagement levels(s)	7.4/3.9	7.4/3.9	4.5 <sup>2</sup> /2.5 <sup>3</sup>	164/156%
TT-010		Number of times reports (or related) are downloaded	5,059	9,575	6,000	160%
TT-011		Number of citations from publications	151	283	120	236%
TT-012		Presentation attendees or views	5,136	12,519	9,500	132%
TT-013	TT1, TT2, IN2	<b>External funds:</b> Industrial partners providing funds	8	8	4	200%
TT-014		Public agency partners providing funds	4	4	10	40% <sup>4</sup>
TT-015		Total funds from industrial partners	\$185k	\$185k	\$200k	93%
TT-016		Total funds from public agency partners	\$284k	\$284k	\$300k	95%

<sup>1</sup>Individual stakeholders as specified in third-cycle, project-specific T2 plans; may contain multiple (but distinct) stakeholders within same agency; <sup>2</sup>Average “calculated as clicks/impressions” (LinkedIn); <sup>3</sup>Average “engagement rate” (Twitter); <sup>4</sup>Tran-SET recognizes the low completion of this target; Tran-SET will work on engaging public agencies by including them in all phases of research, technology transfer, education, workforce development, and outreach.

### Discussion of Performance Metrics: Building Audience

- **Number of Times Reports (or Related) are Downloaded (TT-010):** This metric has significantly increased in this reporting period from 4,516 to 5,059. Readers originated from 122 countries (with a strong majority from the US) and included educational institutions (51%), commercial entities (38%), and government agencies (11%). The number of downloads was higher than expected, showcasing high interest in Tran-SET research activities. Therefore, the target for this metric was raised to 6,000 (from 5,000).
- **Presentation Attendees or Views (TT-012):** The target for this metric was re-evaluated and was raised to 9,500 (from 9,000). The increase is due to successful outreach activities conducted during the second-and third-cycle projects’ implementation and technical phases.

## Peer-Reviewed Journal Publications (Selected)

1. Morshed, M. M, Hossain, Z., Chen, D. H., and Baumgardner, G. (2020). "Exploration of Alternatives of Elastic Recovery and Conventional Fatigue Tests of Modified Binders," International Journal of Pavement Research and Technology (IJPRT), Vol. 13, Issue 6.
2. Nazarian, S., Duarte, J.P., Bilén, S.G., Memari, A., Radlinska, A., Meisel, N. and Hojati, M., (2020). "Additive Manufacturing of Architectural Structures: An Interplay between Materials, Systems, and Design." In Sustainability and Automation in Smart Constructions (pp. 111-119). Springer.
3. Li, Z., Hojati, M., Duarte, J.P., Nazarian, S., Bilén, S.G., Memari, A.M. and Radlińska, A. (2021). "Towards 3D-printable cementitious materials on Earth and beyond", Concrete Engineering International magazine.
4. Vemuganti, S., Chennareddy, R., Riad, A. and Reda Taha, M. M. (2021). "Pultruded GFRP Reinforcing Bars Using Nanomodified Vinyl Ester", Materials, 13, 5710.
5. Flores, E. Y., Varbel, J., Toledo, W. K., Newton, C. M., and Weldon, B. D. (2021). "Ultra-High-Performance Concrete Shear Keys in Concrete Bridge Superstructures," Volume 2675, Issue 2 of Transportation Research Record, Vol. 2675, No. 2, pp. 108-120.

## EDUCATION

Table 6 lists Tran-SET's performance metrics for education-related outputs. In total, Tran-SET supported **211** students and produced **38** educational modules. Select modules are described below.

Table 6. Education Performance Metrics: Outputs.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
	E1, E2, EL1, IF4, A2	<b>Number of students supported from Tran-SET research:</b>				
E-01		Undergraduate students	69	69	50	138%
E-02		Masters students	72	72	50	144%
E-03		Doctoral students	70	70	50	140%
	E1, E2, EL1, ED1, IF4, A2	<b>Number of research opportunities for under-representative groups:</b>				
E-04		Undergraduate students	29	29	15	193%
E-05		Graduate students	66	66	15	440%
E-06	E1, E2, EL1, ED1, IF4, A2	Total budgeted costs for women and minorities	\$0.69M	\$0.69M	\$1.1M	63%
E-07	E1, E2, EL1, IF4, A2	Number of new transportation-related educational modules delivered	38	88	50	176%
E-08	E1, E2, EL1, IF4, A2	Number of STEM events sponsored by Tran-SET or that participated in	34	53	20	265%

## Discussion of Performance Metrics

- **Total Budgeted Costs for Women and Minorities (E-06):** This metric has significantly increased in this reporting period from \$0.35M to \$0.69M. This reflects Tran-SET's recent success in engaging women and minorities in transportation-related research.

## Educational Modules (Selected)

1. In ASU, an educational module was developed on using Super Air Meter (SAM) in quantifying the air quality in fresh concrete and introduced in ENGR 6692 Engineering Research.

2. In UNO, educational modules (Lecture/presentation and applied exercises) were developed for TRNS 6300 that discussed a) transportation behavior survey methods and tools and b) discrete choice experiment development, modeling, and data analytics.
3. In UNM, an educational module on bridge inspection toolbox was developed for UNM EDAC's YouTube channel for broader access.
4. In PVAMU, an educational module on life cycle cost analysis was developed and introduced to graduate students.
5. In LSU, an educational module was developed summarizing results of a conducted survey by a diverse group of Louisiana organizations gauging their awareness and perception of CAV technologies, likelihood of impacts, and importance in preparing for such technologies. The module was featured at the 2021 TRB Annual Meeting.

## WORKFORCE DEVELOPMENT

Table 7 lists Tran-SET's performance metrics for workforce development-related outputs. During this reporting period, **165** revised courses and **32** seminars/workshops were delivered. Tran-SET re-evaluated targets for metrics WF-01 and WF-03 below and increased them from the previous reporting period (from 90 to 100).

Table 7. Workforce Development Performance Metrics: Outputs.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
WF-01	WF1, IF4, A2	Number of new or revised transportation-related courses	165	317	100	317%
WF-02	WF1, IF4, A2	Number of seminars/workshops presented	32	97	90	108%
WF-03	WF1, IF4, A2	Number of professional society-related events <sup>1</sup> sponsored or participated in	56	135	100	135%

<sup>1</sup>Events include local and regional meetings of various professional societies (e.g., AASHTO, ASCE, ITE, SAE, etc.); Tran-SET believes these local groups are a critical link in developing the transportation workforce.

### Seminars/Workshops (Selected)

1. Roy, S., and Hossain, Z. "Effects of PAC on Air Content and Strength Properties of Concrete," The 2020 Oklahoma Transportation Research Day, **October 2020**, Oklahoma City, OK.
2. Geetika Vennam, "State of Health Estimation of Lithium-ion Batteries for Electric Vehicles: The State of the Art," International Mechatronics Conference, Stillwater, OK, **2020**.
3. Hojati, M., "Digital Construction of Concrete: An Ongoing Exploration on Design and Development of Printable Mixture and Printing Process", The American Concrete Institute Convention, Virtual Convention, **Oct. 2021**.
4. Melson, C. "Broad Stakeholder Engagement in Connected and Automated Vehicle (CAV) Planning: Survey and Case Study of Louisiana". 2020 ALSITE/DSITE Fall Meeting, **Nov. 2020**.
5. Kim, N., and Ahn, C. R. "Using a Virtual Reality-based Experiment Environment to Examine Risk Habituation in Construction Safety." Proceedings of the 37th International Symposium on Automation and Robotics in Construction (ISARC), **Oct. 2020**, Kitakyushu (Japan).

## 4. Outcomes

While some of the outcomes will materialize in the long-term, the following subsections detail how current efforts are driving select outputs towards implementation and towards future and meaningful outcomes.

## TECHNOLOGY TRANSFER

Table 8 lists Tran-SET’s performance metrics for T2-related outcomes. Tran-SET re-evaluated the targets for all metrics below and increased the goals from the previous reporting period.

Table 8. Technology Transfer Performance Metrics: Outcomes.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
TT-C1 TT-C2	TT1, TT2, IN2	<b>External, derivative initiatives spurred by research products</b>				
		Number of additional research projects	24	57	25	228%
		Total funding of additional research projects	\$4.3M	\$12.2M	\$8.0M	153%
TT-C3	TT1, TT2, IN2	Number of commercialized/patented/licensed research products	4	15	8	188%
TT-C4	TT1, TT2, IN2	Number of stakeholders MOUs	2	11	8	138%
TT-C5 TT-C6	TT1, TT2, IN2	<b>Number of stakeholders who have:</b>				
		Committed to adopt research products	11	47	28	168%
		Adopted research products	8	24	18	133%

### Discussion of Performance Metrics: Further Development and Adoption of Research Products

- **Number of Additional Research Projects (TT-C1, TT-C2):** A total of **24** sponsored research projects (external to Tran-SET) were initiated as a direct result of research products developed from a Tran-SET-sponsored project. The funding agencies for these projects included but not limited to Arkansas DOT, National Science foundation, North Central Texas Council of Governments (NCTCOG), and Texas DOT.
- **Number of Stakeholders who have committed to Adopt Research Products (TT-C5):** A total of 11 stakeholders have committed to adopt research products resulting from Tran-SET-sponsored projects. As an example:
  - (1) LaDOTD’s CAV Technology Team are aware of the research results (Project No. 19ITSLSU06) and asked consultant preparing their "CAV Strategic Plan" to incorporate/utilize results as appropriate.
  - (2) NMDOT committed to use the Ultra-High Performance Concrete developed in NMSU (Project No. 19CNMS01) in bridge deck overlays.
  - (3) A toolbox was developed in UNM to detect and assess bridge deck wearing surface and subsurface distresses for New Mexico Department of Transportation District 2.

### New Policies, Regulations, Rulemaking, or Legislation (Selected)

- Dr. Hossain developed a framework to rank different aggregate and binders used in Arkansas. (Project No. 19BASU02). Using this framework is expected to assist asphalt contractors select the most compatible components for building longer lasting roadways.
- Dr. Ham (Project No. 19ASUTA03) and his research team developed an algorithm for low energy and low cost Ultrasonic Water Level Detection (UWLD). Using this algorithm may lead to more efficient techniques to monitor flooding in the United States (and related procedures/policies).
- Dr. Kommalapati (PI on Project No. 19PPPVU01) and his team developed a model to evaluate life-cycle emission and life-cycle cost when diesel buses are replaced with electric buses. These findings will result in significant steps toward a fossil fuel-free society and a reduction of emissions.

- Dr. Momen Mousa (Project No. 20BLSU03) developed new cost-effective restriping strategies for district roads in Louisiana. These findings will result in steps toward reducing the potential for under-stripped or over-stripped roads.

### Adoption of New Technology, Techniques, or Practices (Selected)

- A system to monitor the flood water level was developed (Project No. 19SAUTA03), and the results of real-time data collection and processing technology were utilized by the state of Texas.
- The New Mexico DOT started using the wildlife monitoring techniques proposed by Tran-SET researchers to prevent wildlife-vehicle collisions (Project No. 19SAUNM03).
- NMDOT is implementing Ultra-High Performance Concrete developed in NMSU (Project No. 19CNMS01) in bridge deck overlays.

### EDUCATION

Table 9 lists Tran-SET’s performance metrics for education-related outcomes. In total, **211** students participated in Tran-SET-sponsored research.

Table 9. Education Performance Metrics: Outcomes.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
E-C1 E-C2	E1, E2, EL1, ED1, IN4, A2	Number of students participating in Tran-SET research:				
		Undergraduate students	69	69	75	92%
		Graduate students	142	142	100	142%
E-C3	E1, E2, EL1, IN4, A2	Number of times educational modules have been viewed	1,124	2,787	1,000	279%
E-C4	E1, E2, EL1, ED1, IN4, A2	Number of students attending sponsored or involved STEM events	1,037	1,888	1,300	145%

### Increased Body of Scientific Knowledge (Selected)

- The Tran-SET Transportation Veteran Scholarship attracted three students to the transportation field and provided unique opportunities to better prepare veterans for the workforce. The *actual* outcome of such a program is yet to be assessed; however, the aim is to develop the next generation of transportation leaders and to advance the transportation workforce in target communities (i.e., veterans).
- Tran-SET is currently engaging five high school students in transportation-related research in Louisiana State University in spring 2021. Such engagement provides information, exposure, and positive experiences at an influential stage in students’ career trajectory.
- The developed Ultra-High Performance Concrete (UHPC) from local materials in New Mexico will aid in advancing the state-of-the-art in the application of this emerging technology in bridge deck Overlays.

### WORKFORCE DEVELOPMENT

Table 10 lists Tran-SET’s performance metrics for workforce development-related outcomes. In total, **4,056** attendees participated in new/ revised transportation-related courses, seminars, or workshops.

Table 10. Workforce Development Performance Metrics: Outcomes.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
WD-C1	WF1, IF4, A2	Number attending offered new or revised courses	2,615	7,164	4,000	179%
WD-C2	WF1, IF4, A2	Number attending presented seminars/workshops	1,441	4,702	4,000	118%
WD-C3	WF1, IF4, A2	Sponsorship: Number of stakeholders sponsoring seminars/workshops/conferences	15	33	20	165%
WD-C4		Total funds of sponsorship	\$116k	\$179k	\$200k	90%

### Enlargement of Trained Transportation Workforce (Selected)

- Dr. Momen Mousa (PI) from Louisiana State University provided a 1-hour educational session attended by 130 professionals in the American Traffic Safety Services Association (ATSSA)'s Annual CONVENTION & TRAFFIC EXPO 2021. This session educated the attendees about optimizing the performance of pavement markings to enhance drivers' safety.
- An educational module was developed summarizing results of a conducted survey by a diverse group of Louisiana organizations gauging their awareness and perception of CAV technologies, likelihood of impacts, and importance in preparing for such technologies. The module was featured at the 2021 TRB Annual Meeting and posted to the PI's website.
- Dr. Su Zhang (PI) at UNM developed a new training course on drone aerial mapping for New Mexico Local Technical Assistance Program (Project No. 19STUNM04). This course provides the necessary information to contractors, designers, and NMDOT to successfully detect bridge deck surface and subsurface distresses at a low cost using Small Unmanned Aircraft Systems (sUAS).

## 5. Impacts

As with the outcomes, the project impacts will be updated as they become available. The following subsections detail how select project outcomes are *envisioned to impact* the transportation system and workforce.

### TECHNOLOGY TRANSFER

Table 11 lists Tran-SET's performance metrics for T2-related impacts. These metrics cover related products from second-cycle projects.

Table 11. Technology Transfer Performance Metrics: Impacts.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
TT-I1	TT1, TT2, R1, IF2, IN1, IN2	Improve the durability and service life of transportation infrastructure <sup>1</sup>	-	35%	20%	175%
TT-I2	TT1, TT2, IN2	Reduce costs associated with repair and upgrade of transportation infrastructure <sup>2</sup>	-	\$75k	\$10k	750%

<sup>1</sup>Represents the average percent improvement to service life estimated by second-cycle project PIs of their specific infrastructure component of study, assuming a full-scale implementation and all other factors constant; <sup>2</sup>Represents the average cost savings per lane-mile estimated by second-cycle PIs associated with repairs using their specific infrastructure component of study, assuming all other factors constant.



## Discussion of Performance Metrics: Impact on Effectiveness of the Transportation System

- Improve the Durability and Service Life of Transportation Infrastructure (TT-I1):** This metric encompasses **23** applicable products. For example:
  - Implementation of developed methods to effectively synthesize geopolymer cement (GPC) for soil stabilization may improve performance of roadway sublayers by 15-20% (Project No. 18CTAM03); and
  - Better characterization of asphalt binders can reduce premature pavement failures, potentially increasing the service life of asphalt pavements (with modified binders) by 25% (Project No. 18BASU02).
- Reduce Costs Associated with Repair and Upgrade of Transportation Infrastructure (TT-I2):** This metric encompasses **9** applicable products. For example:
  - Improved understanding of how recurring cycles of wetting and drying impact soil strength may reduce the frequency of shallow embankment failures, and based on failure frequency rates in Louisiana, may produce a cost savings of \$50k/mile (Project No. 18GTLSU06).
  - Accurately detecting and mapping sinkholes can assist engineers in identifying causes and repairing sinkholes before they significantly damage transportation infrastructure (Project No. 18GTUNM01). In the scenario of gradual subsidence, a road section may be gradually damaged, and repairs in New Mexico can be approximated as \$100k/mile (will vary based on the type of damage incurred).

## Impact on Adoption of New Practices and Commercialization (Selected)

- The developed Ultra-High Performance Concrete (UHPC) from local materials in New Mexico is expected to provide an increase in service life of about 300% compared to normal strength concrete (Project No. 19CNMS01).
- The developed restriping strategy (Project No. 20BLSU03) for 4-inch wide markings is expected to save Louisiana about \$20 million annually when restriping the whole network without jeopardizing user safety. The developed strategy for 6-inch wide markings is expected to save the State about \$2 million annually when restriping the whole network in addition to enhancing the user safety.

## EDUCATION

Table 12 lists Tran-SET’s performance metrics for education-related impacts. As shown, funded projects have led to the graduation of a large number of students that will effectively contribute to the transportation workforce. Tran-SET re-evaluated target for E-I1 and increased it significantly from the previous reporting period (from 80 to 100).

Table 12. Education Performance Metrics: Impacts.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
E-I1	EL1, EL2, IF4, A2	Number of graduated, supported students entering the transportation field	75	164	100	164%
E-I2	EL1, EL2, IF4, A2	Feedback <sup>1</sup> of graduated, supported students who’ve entered the transportation field <sup>2</sup>	4.5	4.5	5	90%

<sup>1</sup>Feedback solicited from students’ advisors; <sup>2</sup>Scale: 0 to 5 (5 being perfect); same definitions for Table 13

### Impact on Scientific Knowledge (Selected)

- Project No. 19PLSU13 developed a new prediction model that can estimate the future performance of pavement subjected to future flooding. This has contributed to the body of knowledge in the field of transportation and led to a better understanding of the impacts of flooding on pavement damage.
- The optimized manufacturing process of high mast illumination poles (Project No. 19STUTSA02) included a model that simulates the welding and galvanizing process of high-mast illumination poles. This model will provide a better understanding of the root causes of galvanizing cracks in high mast illumination poles.

### WORKFORCE DEVELOPMENT

Table 13 lists Tran-SET’s performance metrics for workforce development-related impacts.

Table 13. Workforce Development Metrics: Impacts.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
WD-I1	WF1, IF4, A2	Feedback of seminar/workshop/Conference attendees: Related to skills gained	5	5	5	100%
WD-I2		Related to improved practices	5	5	5	100%

### Impact on Transportation Workforce Development (Selected)

- Over 100 researchers and industry leaders from many states and different countries attended an educational session lead by Dr. Momen Mousa (PI) in the American Traffic Safety Services Association (ATSSA)'s Annual CONVENTION & TRAFFIC EXPO 2021. This session successfully educated the attendees about optimizing the performance of pavement markings to enhance drivers’ safety. The attendees provided an average session rating of 3.4 out of 5 and an average speaker rating of 3.5 out of 5. Comments from the attendees included “ Outstanding presentation.” Interest from this session resulted in a collaboration between LSU and Franklin Paint, Inc. to develop an enhanced tool to predict the performance of future markings.
- The 11<sup>th</sup> and 12<sup>th</sup> Tran-SET webinars on the corrosion management of transportation infrastructure engaged a diverse audience of designers, state DOTs personnel, contractors, industry suppliers, and researchers. More than 150 professionals attended this webinar (record high). The webinar successfully transferred knowledge and educated the audience on enhancing the durability of reinforced concrete structures. The number of attendees, positive feedback, and post-webinar engagement indicate its success.

## 6. Changes/Problems

Nothing to report

## 7. Special Reporting Requirements

Not applicable.

## Appendix A

Table 14. Awarded Fourth-Cycle Projects.

Project No.	Title	Total Cost	Leading Institution	Research Objective	Topical Area
20STLSU01	Bridge Load Posting Prediction	\$180,122	LSU	R3	Structural
20BLSU02	Viability Assessment and Cost-Effectiveness of Using High-Modulus Asphalt Concrete (HMAC) as Base Course in Asphalt Pavements in Louisiana	\$120,000	LSU	R1	Asphalt
20BLSU03 <sup>1</sup>	Maintenance and Restriping Strategies for Pavement Markings in Louisiana	\$86,975	LSU	R1	Asphalt
20PLSU04 <sup>2</sup>	Development of Decision Trees for the Selection of Pavement Maintenance and Rehabilitation Activities in South-Central United States	\$106,975	LSU	R3	Pavements
20CLSU05 <sup>2</sup>	Determination of the Optimal Parameters for Self-Healing Efficiency of Encapsulated Bacteria in Concrete in a Simulated Subtropical Climate	\$135,000	LSU	R1	Concrete
20SAOSU06	Safety of Road Users in Light-Rail Transit Environment	\$130,000	OSU	R4	Safety
20CLSU07 <sup>1,3</sup>	Evaluation of Alternative Sources of Supplementary Cementitious Materials (SCMs) for Concrete Materials in Transportation Infrastructure	\$433,527	LSU	R2	Concrete
20CLSU08 <sup>2</sup>	Development of Novel Ultra-High Performance Engineered Cementitious Composites (UHP-ECC) for Durable and Resilient Transportation Infrastructure	\$135,000	LSU	R1	Concrete
20GTLSU10	Calculating Pile Downdrag: Experimental and Numerical Investigations	\$90,042	LSU	R1	Geotechnical
20GTLSU11	Rapid Repair of Cracks on the Embankment Slopes Using Bio-Cement	\$90,001	LSU	R3	Geotechnical
20STLSU12	Efficient, Low-cost Bridge Cracking Detection and Quantification Using Deep-learning and UAV Images	\$90,165	LSU	R3	Structural
20SALSU13	Exploring traffic safety problems and challenges of older roads' users in Louisiana: Causes and countermeasures	\$90,000	LSU	R4	Safety
20PPLSU14	Deep reinforcement learning-based prioritization for rapid post disaster recovery of transportation infrastructure systems	\$150,000	LSU	R4	Pavements
20ITLSU16	Combining Virtual Reality and Machine Learning for Enhancing the Resiliency of Transportation Infrastructure in Extreme Events	\$60,000	LSU	R4	ITS
20ITLSU17	Developing Notification and Enforcement Systems to Communicate and Administer Bridge Load Postings	\$120,000	OPEN	R3	ITS
20GTLSU18	Mining of Unmanned Aerial System Operations and Data to Improve Emergency Operations during Natural Disasters	\$210,000	LSU	R4	Geotechnical
20BLSU19	Catalyst Regeneration of RAP-Binder in Asphalt	\$74,998	LSU	R1	Asphalt
20SATAMU20	Preventing Struck-by Hazards: Defying Risk-desensitization via Virtual Accident Simulation	\$40,000	TAMU	R4	Safety
20GTTAMU21	Evaluation of Sustainable and Environmentally Friendly Stabilization of Cohesionless Sandy Soil for Transportation Infrastructure	\$65,000	TAMU	R2	Geotechnical
20CTAMU22 <sup>1</sup>	Multifunctional corrosion control system as a sustainable approach for reinforced concrete elements	\$220,000	TAMU	R3	Concrete
20BASU23 <sup>1</sup>	Effectiveness of Softening Agents for Enhancing Properties of Asphalt Mixes with High RAP Contents.	\$60,500	ASU	R2	Asphalt
20BASU24 <sup>1</sup>	Feasibility Assessment of Warm Mix Asphalt in Arkansas	\$100,099	ASU	R1	Asphalt
20STUTA25	Residual life and reliability assessment of underground RC pipelines under uncertainty	\$112,001	UTA	R3	Structural
20STUTA26	Study on hybrid model combining super learner and physic-based models for SHM in bridges using low-cost BWIM	\$122,000	UTA	R3	Structural
20ITSUTA27	Development of a Multi-Level Dynamic Model to Measure the Resilience Level of Transportation Infrastructure Networks: A Comprehensive Approach to	\$112,235	UTA	R3	ITS

Project No.	Title	Total Cost	Leading Institution	Research Objective	Topical Area
	Quantification of Resilience Dimensions in Highway and Bridge Projects				
20PUTA28	Network analysis to identify critical links for relief activities during extreme weather events	\$112,000	UTA	R4	Pavements
20STUNM30	Field retrofit and testing of a corroded corrugated metal culvert using Glass Fiber Reinforced Polymers	\$160,000	UNM	R1	Structural
20GTUNM31	An automated system for inspecting rock faces and detecting potential rock falls using machine learning	\$100,000	UNM	R3	Geotechnical
20ITSUNM32	Autonomous Vehicle Communication Strategies Modeled in Virtual Reality	\$120,000	UNM	R4	ITS
20STUNM33 <sup>2</sup>	Bridge Cracks Monitoring: Detection, Measurement, and Comparison using Augmented Reality	\$120,000	UNM	R3	Structural
20PUTSA34	Expanding the Concept of Comprehensive Area Ratio Parameter to the South-Central States: Towards Simplifying the Structural Evaluation of Flexible Pavements at the Network Level	\$120,180	UTSA	R1	Pavements
20SAUTSA35	Urban Transportation Infrastructure and Cyclist and Pedestrian Safety	\$100,000	UTSA	R4	Safety
20SAUTSA36	Modeling Crash Severity and Collision Types Using Machine Learning	\$80,010	UTSA	R4	Safety
20OPOSU037	A Resource Guide for State DOT's Maintenance Equipment Fleet Management Decisions	\$140,000	OSU	R1	Operations
20ITSOSU38	Smart Battery Management System for Electric Vehicles: Self-learning Algorithms for Simultaneous State and Parameter Estimation, and Stress Detection	\$110,000	OSU	R2	ITS
20GTNMSU39	Compaction Multimeter	\$120,000	NMSU	R1	Geotechnical
20CNMSU40	Durability of Concrete Produced with an Alternative Supplementary Cementitious Material	\$120,000	NMSU	R2	Concrete
20CUNM41	Resilient 3D-Printed Infrastructure with Engineered Cementitious Composites (ECC)	\$146,000	UNM	R1	Concrete
20PUTSA42	An innovative thermo-energy harvesting Module for asphalt roadway pavement	\$138,001	UTSA	R2	Pavements
20ITSUTSA43	A multi-AI-agent framework for vehicle-infrastructure integration and electric vehicle robust charging	\$80,000	UTSA	R2	ITS

<sup>1</sup>Industrial firm providing matching funds (public-private partnership); <sup>2</sup>Government agency providing matching funds (public-public partnership); <sup>3</sup>Multi-institution project