



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

Program Progress Performance Report (PPPR) #3

Submitted to: US Department of Transportation
Office of the Assistant Secretary for Research and Technology

Sub. Date: Oct. 30th, 2018

Grant: 69A3551747106

Grant Period: Nov. 30, 2016 – Nov. 30, 2022

Project Title: University of Transportation Centers Program – Region 6

DUNS: 075050765

EIN: 726000848

Account: GR-00000627

Reporting Period: Apr. 1, 2018 – Sep. 30, 2018 (semi-annual)

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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 activities¹:

Table 1. Major Objectives of Tran-SET.

ID ¹	Objective
RESEARCH	
R1	Improve the durability and extend the service life of transportation infrastructure [IF2, IN1 ²]
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]
TECHNOLOGY TRANSFER	
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]
EDUCATION	
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]
WORKFORCE DEVELOPMENT	
WF1	Ensure research outcomes are disseminated through educational and workforce development activities by supporting the development of seminars, workshops, and training courses [IF4, A2]
EMPHASIS AREAS	
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]
MANAGEMENT	
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]

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

²All 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

Final Reports for First-Cycle Projects: Each Tran-SET project consists of a 12-month technical phase, followed by a 6-month implementation phase. Tran-SET’s first-cycle projects ended their technical phase (May 2018) and submitted their draft final reports (Jun. 2018). Reports were reviewed by Tran-SET staff and their respective project review committees (Jul. 2018) and revised accordingly (Aug. 2018). Reports are being finalized, will be disseminated per the UTC reporting requirements, and will be available on [Tran-SET’s website](#). [TT1, IN2]

Project Review Committees for Second-Cycle Projects: Project review committees (PRCs) have been established and were integrated into each second-cycle project (May 2018). PRCs consist of 3 subject matter experts, typically from state government agencies, academic institutions, or industry. PRCs recently reviewed each project’s quarterly progress report (Sep. 2018). [R1, R2, R3, R4, IN2]

Problem Statements for Third-Cycle Projects: Tran-SET issued a call for problem statements (Jul. 2018) for their third cycle of research projects. A total of **74** problem statements were received from 15 institutions (Aug. 2018), including 4 submitted by the Center Advisory Board (CAB). 17 problem statements were collaborative, involving multiple partnering institutions. Submitted problem statements are categorized below, by Tran-SET research objective and transportation area, respectively. Problem statements are currently in review by subject matter experts. [R1, R2, R3, R4, S1, IF2, IF3, IF4, IN1]

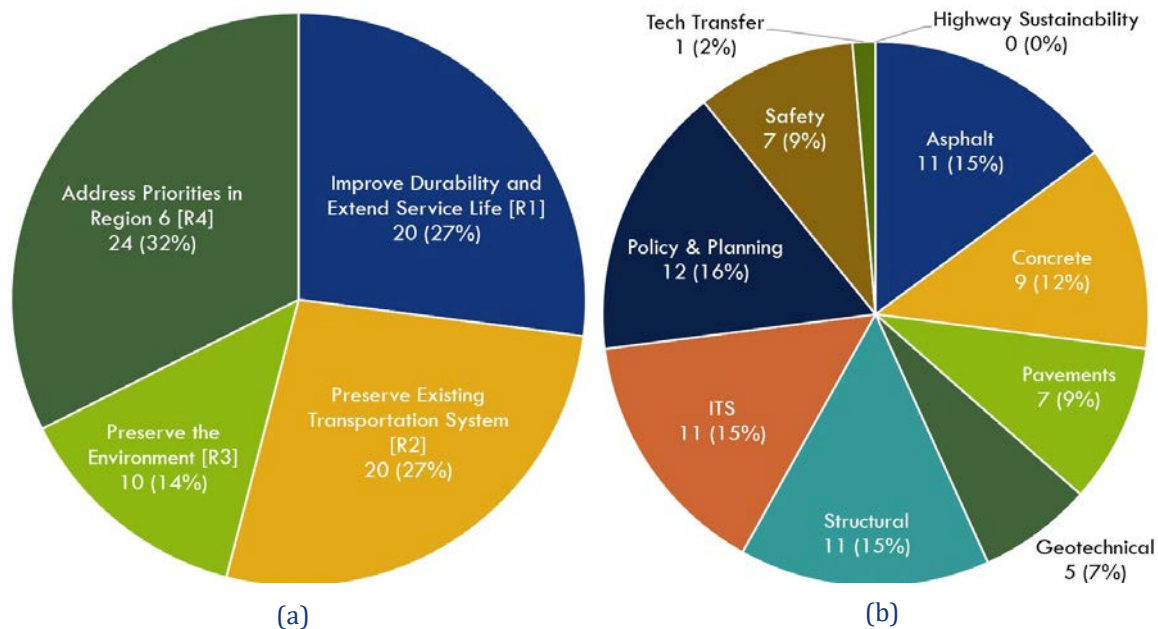


Figure 1. Third-Cycle Problem Statements Categorized by (a) Research Objective and (b) Transportation Area.

TECHNOLOGY TRANSFER

2018 Tran-SET Conference: Tran-SET held its first annual conference on **Apr. 3-4, 2018** in New Orleans, LA. The program included: 8 technical sessions with 35 lectern presentations (covering all first-cycle projects), 17 student posters (from 7 universities), and an exhibit hall where students demonstrated innovative materials and other developed technologies. The Conference had over 75 attendees from 14 different academic institutions, 6 public agencies, and 4 private entities. The Conference Program, Business Meeting agenda, and Conference Proceedings (which includes

extended abstracts of the 35 lectern presentations) are available on [Tran-SET's website](#). [TT1, TT2, EL2, IN2]

ICPIC 2018: The International Congress of Polymers in Concrete (ICPIC) is an international forum with the objective of following progress in the field of polymers and their use in concrete and construction. The ICPIC 2018 Conference was held in **Apr. 29-May 1, 2018**. Tran-SET was a diamond sponsor of the Conference, showcasing its research at its booth, through a sponsored presentation, and through a series of technical presentations in a Tran-SET-specific session track. The Conference was organized by Dr. Mahmoud Taha (Program Director) from the University of New Mexico. [TT1, TT2, EL2, IN2]

2018 WTC: The World Transport Convention (WTC) is an international conference that was held **Jun. 18-21, 2018** in Beijing, China. WTC 2018 attracted over 7,500 participants from more than 50 countries. Tran-SET PIs presented 10 lectern presentations at WTC 2018, including 5 presentations in a Tran-SET-specific session on **Jun. 20, 2018** over "Pavement Materials and Structure". [TT1, TT2, EL2, IN2]

Joint Tran-SET Webinar Series: Tran-SET established a quarterly webinar series (Jul. 2018), jointly hosted by (rotating) UTCs and involving (rotating) research themes. The purpose of the webinar series is: (1) to strengthen collaboration among UTCs in the development and deployment of innovations, (2) increase coordination among UTCs in technology transfer activities, and (3) increase engagement in Tran-SET and other UTCs' efforts from a wider audience. The inaugural webinar was held **Jul. 11, 2018** over "Novel Concrete Materials to Enhance the Durability of Transportation Infrastructure" and was jointly hosted by the UTC for Underground Transportation Infrastructure. A second webinar was conducted **Sep. 19, 2018** on "Transportation Infrastructure Resilience to Extreme Weather Events" and was jointly hosted by Region 2's UTC, University Transportation Research Center. Recorded webinars, presentation slides, and other outreach materials are available on [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 summer 2018 issue (Jul. 2018) and fall 2018 issue (Oct. 2018). Newsletters are disseminated locally, regionally, and nationally. Current and past newsletters are available on [Tran-SET's website](#). [TT1, IN2]

2019 Tran-SET Conference: Tran-SET will be hosting the 2019 Tran-SET Conference on **Apr. 11-12, 2019** in San Antonio, TX. The Conference theme is "developing, evaluating, and implementing cutting-edge technologies, novel materials, and innovative construction management processes to enhance the durability and service life of transportation infrastructure." Several planning activities took place during this reporting period: establish the Conference Steering Committee (Jul. 2018), select and finalize a venue (Aug. 2018), develop the Conference program (Aug. 2018), create the Conference website (Sep. 2018), announce the call for papers (Sep. 2018), and establish the Scientific Committee to review the submitted papers (Sep. 2018). More information is available on [Tran-SET's website](#). [TT1, TT2, EL2, IN2]

Technology Transfer (T2) Plan: Per UTC reporting requirements, Tran-SET prepared (Jul. 2018) and finalized (Aug. 2018) a center-wide T2 Plan. Tran-SET has taken significant steps to implement the approved plan, including: developing a project-specific T2 plan template (Jul. 2018), requiring first-cycle projects to complete project-specific T2 plans in order to successfully organize and executive activities during the implementation phase (Jul. 2018), requiring second-cycle projects to complete project-specific T2 plans (Sep. 2018), developing preparation material templates for the technology readiness level (TRL) assessments (Aug. 2018), and requiring second-cycle projects to conduct a TRL assessment at the end of the technical phase. Tran-SET is currently reviewing project-

specific T2 plans for all second-cycle projects and will continue to work with individual PIs to develop a successful, more informed engagement plan. Templates are available on [Tran-SET's website](#). [TT1, TT2, EC1, IN2, A2]

Social Media Pages: Tran-SET created a LinkedIn page (Sep. 2018) to supplement their existing social media outlets (Facebook and Twitter) and to reach a wider, more professional audience. Tran-SET also created a YouTube page (Jul. 2018) to more easily share webinar recordings and video-based educational modules. [TT1, IN2]

EDUCATION

Navajo Technical University Internship: Tran-SET established a (recurring) one-month summer internship supporting Navajo Technical University students to participate in Tran-SET-funded research at Louisiana State University (LSU). The Internship included three synergistic components: (1) hands-on research experience as a student worker (main component), (2) presentation series on diverse, relevant transportation topics, and (3) informal sessions with varied transportation professionals (from industry, practitioner community, and government). The purpose of the Internship is to expose and to educate nontraditional students to the transportation field. The inaugural Internship took place on **June 4-29, 2018** and included two Navajo students: Ms. Christine Whitehorse and Ms. Arlyssia Sells. The students were mentored in a variety of transportation topics and professions, including a site visit to the FHWA LA Division Office, a site visit to the Capital Region Planning Commission (CRPC), a site to the Alliance Safety Council, and two on-site presentations from the Deep South ITE President and Vice President, respectively. More information is available on [Tran-SET's website](#). [E1, EL1, EC1, ED1, IF4, A2]

Tran-SET Scholarship for Veterans: Tran-SET established a scholarship for US veterans at LSU (May 2018). After establishing the funding mechanisms, and basic structure of the scholarship in the previous reporting period, Tran-SET created the Scholarship application (Apr. 2018), established a Scholarship website (May 2018), and conducted outreach activities to attract applicants for the 2018 Fall semester (Jun. 2018). Unfortunately, no qualified veterans applied to date. Tran-SET is currently restructuring the Scholarship program to reach a wider pool of applicant for the Spring 2019 semester. More information is available on [Tran-SET's website](#). [E1, EL1, EC1, ED1, IF4, A2]

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

- *Jonesboro Hispanic Center* – Dr. Zahid Hossain (Associate Director) and his research team of undergraduate and graduate students administered an outreach activity at Jonesboro Hispanic Center (Jun. 2018). In a three-hour event, over 25 local Kindergarten through 8th grade students participated in a variety of civil engineering-related activities, including learning how different soil types impact the stability of structures.
- *Prairie View A&M University* – Tran-SET sponsored an outreach event at Prairie View A&M University to expose and educate incoming freshmen on the transportation field (Jul. 2018). Dr. Doeun Choe (PI) organized and supervised the event, which included over 70 students. Through this event, Dr. Choe flourished students' knowledge and interest in transportation-related careers and conducted a series of activities to illustrate how Maglev trains operate.
- *@UNM Summer Transportation Institute* – Dr. Greg Rowangould, Dr. Vanessa Valentin, and Dr. Su Zhang (PIs) engaged with high school students at the @UNM Summer Transportation Institute. In a two-week program, 16 students built and tested bridges, planned a future city, competed in a construction equipment productivity challenge, evaluated the use of UAVs in transportation, and visited New Mexico DOT headquarters.

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]

- *Tran-SET-Sponsored Workshop on Infrastructure Management and Maintenance* – Dr. Fernando Moreu (PI) organized a workshop on prioritizing developmental needs related to the application and implementation of new sensing technologies to current transportation inspection processes (Apr. 2018).
- *Gulf Region ITS* – Mr. Christopher Melson (Program Manager) presented at the 2018 Gulf Region ITS Spring Workshop on preparing for connected and automated vehicles in the Gulf Region (Apr. 2018). Mr. Melson presented on the “Traffic Flow Impacts of Adaptive Cruise Control and Cooperative Adaptive Cruise Control: An Investigation using Microscopic and Mesoscopic Models”.
- *Tran-SET-Sponsored Workshop on Ultra-High Performance Concrete (UHPC)* – Dr. Brad Weldon (PI) and Dr. Craig Newton (Associate Director) organized a workforce development symposium on UHPC (Apr. 2018). The two-day symposium consisted of a series of presentations and hands-on demonstrations to New Mexico DOT staff, contractors, designers, researchers, and concrete suppliers.
- *Sim-Cap Louisiana Educational Meeting* – Mr. Christopher Melson (Program Manager) co-organized and presented at the first educational meeting by the Simulation and Capacity Analysis Users Group of Louisiana (SimCap Louisiana) (Jul. 2018). SimCap Louisiana is a workforce development entity that promotes best practices in the application of traffic simulation and capacity analysis.

MANAGEMENT

Tran-SET Annual Meeting: In conjunction with the 2018 Tran-SET Conference, Tran-SET held an in-person Business Meeting with the Associate Directors, Program Directors, and CAB (Apr. 2018). Each Associate Director presented on their research, T2, education, and workforce development activities. The meeting involved open discussion where CAB members supplied feedback and guidance to Tran-SET, especially on the future direction of its research. This was supplemented by an electronic survey to CAB and PRC members to receive feedback and gauge how well Tran-SET is addressing regional needs and impacting the state-of-the-practice (Apr. 2018). [M1, all, A2]

Communications Plan: Tran-SET developed an internal communications plan (May 2018) that documents objectives, performance measures, processes, and schedules as to grow Tran-SET’s online and social media presence, increase stakeholder engagement, and better communicate its successes and progress. [TT1, TT2, M1, A2, IN2]

T2 Coordinator: Tran-SET hired Dr. Husam Sadek (formerly of the University of Wisconsin-Madison) as its “Research and Technology Transfer Program Coordinator” (Aug. 2018). Dr. Sadek will aid in the administration of technical deliverables and coordination of Tran-SET’s T2 activities. [M1, A2]

Dissemination of Results

Please see the *Technology Transfer* subsections of Sections 1 (above) and 3 (below) documenting Tran-SET’s main outreach activities. More generally, results have been disseminated via: social media (Tran-SET website, Facebook, LinkedIn, Twitter, and YouTube), newsletters, other promotional documents (i.e., project briefs), conferences, educational materials (courses, seminars/workshops), and peer-reviewed publications.

Activities Planned (for Next Reporting Period)

RESEARCH

- Finalize and disseminate final reports for first-cycle projects (Nov. 2018). [TT1, IN2]
- Conduct T2 activities during the implementation phase of first-cycle projects, develop and finalize implementation reports, and successfully “close-out” first-cycle projects (Dec. 2018). [TT1, TT2, IN2]
- Complete the review and ranking of third-cycle problem statements (Oct. 2018), develop request for proposals for selected problem statements (Nov. 2018), collect completed proposals (Dec. 2018), review and finalize proposals (Feb. 2019), and award third-cycle projects (Mar. 2019). [R1, R2, R3, R4, S1, IF2, IF3, IF4, IN1]
- Prepare draft final reports for second-cycle projects (Mar. 2019). [TT1, IN2]

TECHNOLOGY TRANSFER

- Develop and disseminate Tran-SET newsletter for winter 2018 (Dec. 2018) and spring 2019 (Mar. 2019). [TT1, IN2]
- Develop and disseminate *Project Highlights*, two- to three-page fact sheets, for each second-cycle project (Dec. 2018). [TT1, IN2]
- Organize and jointly host two webinars in the *Joint-Tran-SET Webinar Series* (Dec. 2018, Mar. 2019). [TT1, TT2, EL1, EL2, EC1, IF4, IN2, A2]
- Conduct technology readiness level (TRL) assessments for each second-cycle project to inform activities during the implementation phase (Mar. 2019). [TT1, TT2, EC1, IN2, A2]
- Continue planning activities for the 2019 Tran-SET Conference, including: finalize the registration process/mechanism (Oct. 2018), open registration (Nov. 2018), collect papers for review (Nov. 2018), select publisher (Nov. 2018), review and select papers (Dec. 2018), finalize program and speakers (Jan. 2019), and prepare all other materials (Mar. 2019). [TT1, TT2, EL2, IN2]

EDUCATION

- Restructure the Tran-SET Scholarship for Veterans (Nov. 2018), disseminate, and award to two recipients in the 2019 spring or fall semesters (Jan. 2019). [E1, EL1, EC1, ED1, IF4, A2]
- Continue sponsoring, organizing, and participating in STEM events (on-going). [E1, E2, EL1, IF4, A2]

WORKFORCE DEVELOPMENT

- 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]

MANAGEMENT

- Organize and host an in-person, mid-year meeting with Associate Directors, Program Directors, and CAB members to discuss the management/operation of Tran-SET and ways to improve our processes (Jan. 2019). [M1, all, A2]

2. Participants & Collaborating Organizations

During this reporting period, Tran-SET partnered with **76** organizations (19 academic institutions, 17 government agencies, 33 industrial firms, 6 nonprofits, and 1 school) to accomplish and oversee its research, technology transfer, education, and workforce development activities. Please see Table 2 for details.

Tran-SET collaborated with **24** organizations/individuals (from 11 academic institutions, 6 government agencies, 3 industrial firms, 3 nonprofits, and 1 school). As shown in Table 3, these collaborations embody interdisciplinary approaches – with involvement from electrical and computer engineering, chemistry, journalism, art history, veteran affairs, and human resources.

Partners

Table 2. Tran-SET Partners.

Organization Name	Type	Location	Description of Contribution [Tran-SET Affiliation]
Alliance Safety Council	Nonprofit	Baton Rouge, LA	Collaborative research [CAB]
Alma Plantation	Industrial firm	Lakeland, LA	In-kind support [second-cycle]
Amec Foster Wheeler	Industrial firm	Albuquerque, NM	Collaborative research [PRC]
American Concrete Pavement Association	Nonprofit	Rosemont, IL	Collaborative research [PRC]
Arkansas Department of Transportation	State government	Little Rock, AR	In-kind support; collaborative research [CAB; first-, second-cycle]
Association of American Railroads (AAR)	Nonprofit	Washington, DC	Collaborative research [second-cycle]
Barriere Construction Co.	Industrial firm	Baton Rouge, LA	Collaborative research [CAB]
Bechtel Power Corporation	Industrial firm	Frederick, MD	Collaborative research [PRC]
Bernalillo County Public Works	Local government	Albuquerque, NM	Collaborative research [PRC]
BNSF Railway	Industrial firm	Fort Worth, TX	Facilities; collaborative research [first-, second-cycle]
BYK USA, Inc.	Industrial firm	Gonzales, TX	In-kind support; collaborative research [first-cycle]
Canadian National (CN) Railway	Industrial firm	Montreal, Canada	Facilities; collaborative research [first-, second-cycle]
Capitol Regional Planning Commission	Local government	Baton Rouge, LA	Collaborative research [CAB; first-cycle]
Carmeuse Lime and Stone	Industrial firm	Baton Rouge, LA	Collaborative research [CAB]
Charah, Inc.	Industrial firm	Louisville, KY	In-kind support [first-cycle]
City of Albuquerque	Local government	Albuquerque, NM	Financial support; collaborative research [first-, second-cycle]
City of Houston	Local government	Houston, TX	Collaborative research [PRC]
City of San Antonio	Local government	San Antonio, TX	Financial support; in-kind support [first-, second-cycle]
Columbia University	Academic institution	New York, NY	Collaborative research [PRC]
Edwards Aquifer Authority	Local government	San Antonio, TX	Collaborative research [PRC]
Epoxy Chemicals	Industrial firm	Kirkland, IL	In-kind support [first-cycle]
Ergon, Inc.	Industrial firm	Jackson, MS	In-kind support [first-cycle]
Ericsson Canada, Inc.	Industrial firm	Mississauga, Canada	Collaborative research [PRC]
Fort Wayne Metals	Industrial firm	Fort Wayne, IN	In-kind support; collaborative research [PRC; first-, second-cycle]
Greater Baton Rouge Industry Alliance	Nonprofit	Baton Rouge, LA	Collaborative research [CAB]
HVJ Associates	Industrial firm	Houston, TX	Collaborative research [CAB]
Illinois Center for Transportation	Academic institution	Rantoul, IL	In-kind support; facilities [first-cycle]
Johnson, Mirmiran, & Thompson	Industrial firm	Austin, TX	Collaborative research [PRC]
Jonesboro High School STEM Academy	School	Jonesboro, AR	Collaborative research [first-, second-cycle]

Organization Name	Type	Location	Description of Contribution [Tran-SET Affiliation]
Kansas State University	Academic institution	Manhattan, KS	Collaborative research [PRC]
Kozeliski Consulting	Industrial firm	Gallup, NM	Collaborative research [PRC]
Los Alamos County	Local government	Los Alamos County, NM	Facilities; collaborative research [first-, second-cycle]
Los Alamos National Laboratory	US government	Los Alamos, NM	Collaborative research [first-, second-cycle]
Louisiana Community and Technical College System	Academic institution	Baton Rouge, LA	Collaborative research [CAB]
Louisiana Economic Development	State government	Baton Rouge, LA	Collaborative research [CAB]
Louisiana Tech University	Academic institution	Ruston, LA	In-kind support [first-cycle]
Louisiana Transportation Research Center	State government	Baton Rouge, LA	Financial support; in-kind support; facilities; collaborative research [CAB; PRC; first-, second-cycle]
Louisiana Workforce Commission	State government	Baton Rouge, LA	Collaborative research [CAB]
Modjeski and Masters, Inc.	Industrial firm	New Orleans, LA	Collaborative research [PRC]
NEAR Ready Mix Concrete	Industrial firm	Brookland, AR	In-kind support [second-cycle]
New Mexico Department of Transportation	State government	Albuquerque, NM	Financial support; in-kind support; collaborative research [CAB; PRC; first-, second-cycle]
Norchem, Inc.	Industrial firm	Hauppauge, NY	In-kind support [first-cycle]
Oklahoma Climatological Survey	Academic institution	Norman, OK	In-kind support [second-cycle]
Oklahoma Department of Transportation	State government	Oklahoma City, OK	Collaborative research [CAB]
Paragon Technical Services, Inc.	Industrial firm	Richland, MS	In-kind support; facilities; collaborative research [second-cycle]
Ports Association of Louisiana	Nonprofit	Baton Rouge, LA	Collaborative research [CAB]
PPG Industries, Inc.	Industrial firm	Cheswick, PA	In-kind support [first-cycle]
Quality Concrete	Industrial firm	Baton Rouge, LA	In-kind support; facilities [second-cycle]
Raw Energy Materials Corp.	Industrial firm	Pompano Beach, FL	Collaborative research [PRC]
Riceland Foods	Industrial firm	Stuttgart, AR	In-kind support [first-, second-cycle]
San Antonio River Authority	Local government	San Antonio, TX	In-kind support [second-cycle]
Schock USA, Inc.	Industrial firm	Princeton, NJ	Collaborative research [PRC]
Sewer Shield Composites	Industrial firm	Mesa, AZ	In-kind support [first-cycle]
South Dakota University	Academic institution	Vermillion, SD	Collaborative research [PRC]
Technology Center, Inc.	Nonprofit	Pueblo, CO	Facilities; collaborative research [first-cycle]
TenCate Geosynthetics	Industrial firm	Pendergrass, GA	Collaborative research [first-cycle]
Terracon	Industrial firm	Oklahoma City, OK	Collaborative research [PRC]
Texas Department of Transportation	State government	Austin, TX	Collaborative research [CAB; PRC; first-, second-cycle]
Texas Local Technical Assistance Program	State government	Arlington, TX	Collaborative research [CAB]
The Culpepper Group, LLC	Industrial firm	New Orleans, LA	Collaborative research [first-cycle]
Transpo Industries, Inc.	Industrial firm	New Rochelle, NY	In-kind support [first-cycle]
Transplace, Inc.	Industrial firm	Frisco, TX	In-kind support [first-cycle]
Tulane University	Academic institution	New Orleans, LA	In-kind support [first-cycle]

Organization Name	Type	Location	Description of Contribution [Tran-SET Affiliation]
Union Pacific (UP)	Industrial firm	Omaha, NE	Facilities; collaborative research [first-, second-cycle]
University of Florida	Academic institution	Gainesville, FL	Collaborative research [PRC]
University of Houston	Academic institution	Houston, TX	Collaborative research [PRC]
University of Idaho	Academic institution	Moscow, ID	Collaborative research [PRC]
University of Miami	Academic institution	Miami, FL	Collaborative research [PRC]
University of New Orleans	Academic institution	New Orleans, LA	In-kind support [first-cycle]
University of Louisiana at Lafayette	Academic institution	Lafayette, LA	In-kind support [first-, second-cycle]
University of Texas at Tyler	Academic institution	Tyler, TX	Collaborative research [PRC]
University of Virginia	Academic institution	Charlottesville, VA	Collaborative research [PRC]
Utah State University	Academic institution	Logan, UT	Collaborative research [PRC]
West Virginia University	Academic institution	Morgantown, WV	Collaborative research [PRC]

Collaborators

Table 3. Tran-SET Collaborators.

Organization/Name	Type	Description of Collaboration [Tran-SET Affiliation]
Arkansas Department of Transportation - Human Resources Division	State government	Supplied workforce data [first-cycle]
CINVESTAV Mexico City, Mexico	Academic institution	Provided technical guidance on corrosion damage monitoring [first-cycle]
Chinese Earthquake Administration - Institute of Engineering Mechanics Beijing, China	Government	Aided with testing procedures, facilities for infrastructure inspection [first-cycle]
Harbin Institute of Technology Dr. Eduardo Mario Mendiondo Heilongjiang Sheng, China	Nonprofit	Contributed to the development and application of rainfall generator models [second-cycle]
HDR, Inc. Dr. Murat Uysal, Dr. Farshad Miramirkhani	Industrial firm	Co-authored publication and patent application; aided in simulation of vehicle headlamps light intensity [second-cycle]
Institute of Disaster Prevention Yanjia, Hefei, China	Academic institution	Aided with testing procedures, facilities for infrastructure inspection [first-cycle]
Institute of Engineering Mechanics Dr. Jim Ji Harbin, China	Nonprofit	Aided in selection and evaluation of image processing [second-cycle]
Louisiana State University -Department of Chemistry Dr. Ioan Negulescu	Academic institution	Provided expertise on self-healing materials and processes [first-cycle]
Louisiana State University - Department of Chemistry Dr. William Daly, Dr. Sreelatha Balamurugan	Academic institution	Provided expertise on microencapsulation procedures for concrete aggregates [first-cycle]
Louisiana State University - Department of Veterans Affairs	Academic institution	Advocate, aided Tran-SET in establishing scholarship program for US veterans
National Cave and Karst Research Institute	Academic institution	Provided laboratory facilities and guidance on large-scale testing [second-cycle]
New Mexico Department of Transportation - Human Resources Division	State government	Supplied workforce data [first-cycle]
Oklahoma Department of Transportation - Human Resources Division	State government	Supplied workforce data [first-cycle]
Sandia Peak Ski & Tramway	Industrial firm	Aided with onsite field demonstration of low-cost sensors [first-cycle]

Organization/Name	Type	Description of Collaboration [Tran-SET Affiliation]
SimCap Louisiana	Nonprofit	Identified research needs in the area of simulation and capacity analysis, coordinated outreach
South Valley Academy	School	Aided with onsite presentation to middle and high school students [first-cycle]
St. Charles Parish Mr. Luis Martinez	Local government	Provided GIS expertise [first-cycle]
TenCate Geosynthetics	Industrial firm	Provided materials [second-cycle]
University of Illinois at Urbana-Champaign - Department of Civil and Environmental Engineering Dr. Timothy Stark	Academic institution	Provided technical guidance, coordinated outreach through ASCE committee [first-cycle]
University of New Mexico - Department of Art and Art History Dr. Andrea Polli	Academic institution	Assisted with and provided guidance on social media activities [first-cycle]
University of New Mexico - Department of Communication and Journalism	Academic institution	Aided with mentoring high school students on engineering and communication [first-cycle]
University of New Mexico - Department of Electrical and Computer Engineering Dr. Rafael Fierro	Academic institution	Aided with drone testing using low-cost sensors [first-cycle]
University of Virginia - Department of Civil and Environmental Engineering Dr. Osman Ozbulut	Academic institution	Provided expertise on novel structural health monitoring techniques [first-cycle]

3. Outputs

Inspired by defining performance metrics for outputs, outcomes, impacts, and targeted goals in the recently developed Technology Transfer Plan, Tran-SET has developed such metrics/targets for their research, education, and workforce development programs. These newly developed metrics/targets, along with defined T2 metrics/targets, are discussed below and in Sections 4 and 5. As such, Tran-SET has adopted and utilized the format of the new *UTC Semi-Annual Progress Report*.

Please note: research-related performance metrics for outcomes and impacts are not specified, since such outcomes and impacts are achieved through T2.

RESEARCH

Table 4 lists Tran-SET’s performance metrics for research-related outputs. In total, 5 new technologies/techniques were developed. They are briefly summarized below.

Table 4. Research Performance Metrics: Outputs.

ID	Objective ID	Metric	Value ¹	Ann. Value ²	Ann. Target ³	Percent Compl. ⁴
R-01	R4, S1, IF2, IF3, IF4, IN1	Number of projects specifically addressing regional challenges:	-	6	5	120%
R-02		Metropolitan growth and congestion	-	6	5	120%
R-03		Future transportation challenges	-	11	15	73%
R-04		Declining public revenues	-	7	3	230%
R-05		Underserved communities	-	1	2	50%
R-06	EC1	Safety	-	4	5	80%
R-06	EC1	Number of collaborative (multi-institution) projects	-	7	11	64%

ID	Objective ID	Metric	Value ¹	Ann. Value ²	Ann. Target ³	Percent Compl. ⁴
R-07	R1, R2, R3, R4, IN1	Number of new technologies or techniques developed	5	14	15	93%

¹Metric value for reporting period; ²Best estimate for annualized metric value; ³Annual, per funding cycle, target; ⁴Percent completion of annual target; same column definitions for Tables 4 – 13.

Technologies or Techniques

1. Dr. Nazimuddin Wasiuddin (PI) developed a technique and standard test method to quantify age-related degradation of asphalt modifiers using a sentamanat extensional rheometer (SER) fixture inside a dynamic shear rheometer (DSR) (Project No. 17BLSU01).
2. Drs. Tieming Liu and Chaoyue Zhao (PIs) developed a new mathematical formulation and branch-and-cut algorithm to maximize the efficiency and consolidation of truck freight movement by minimizing hauling of empty truck loads (Project No. 17ITSOK02).
3. Dr. Shih-Ho Chao (PI) developed a technique to utilize ultra-high performance fiber-reinforced concrete (UHP-FRC) for repair of concrete pavement that can be easily cast onsite without special treatments (e.g., heat, pressure, and vacuum). This includes developing a method for cast-in-place UHP-FRC joints without the need for dowels bars (Project No. 17STUTA03).
4. Drs. Jose Milla, Marwa Hassan, and Tyson Rupnow (PIs) developed a technique to encapsulate bacteria in calcium alginate beads. These microencapsulated bacteria will be used in concrete to yield self-healing properties and enhance its crack-sealing efficiency (Project No. 18CLSU02).
5. Drs. Ibrahim Karaman and Darren Hartl (PIs) developed a technique to grow abnormal course grain sizes in iron-based shape memory alloys (SMA). These abnormal grain sizes are required to produce recoverable deformations (superelasticity). This property can be utilized to develop transportation infrastructure with self-sensing capabilities, and ultimately a sophisticated health monitoring system (Project No. 18STTAM02).

TECHNOLOGY TRANSFER

Table 5 lists Tran-SET’s performance metrics for T2-related outputs. In total, **4** journal publications, **81** conference papers/presentations, **34** other presentations, and **2** webinars were published/delivered. Please see the selected output examples below.

Please note: these counts do not include journal papers or books under review (to date: 15 and 1 book chapter, respectively) nor accepted conference presentations that will be delivered beyond the reporting period (to date: 12).

Table 5. Technology Transfer Performance Metrics: Outputs.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
TT-01 TT-02	TT1, TT2, IN2	Number of stakeholders identified, specifically ¹ :				
		Early potential adopters	70	70	30	233%
		Late potential adopters	75	75	30	250%
TT-03 TT-04 TT-05 TT-06	TT1, TT2, IN2	Number of times research products (technology) are disseminated via the following channels:				
		Featured in Tran-SET newsletter	12	24	25	96%
		Featured on Tran-SET social media	26	32	50	64%
		Peer-reviewed publications and presentations	119	208	130	160%
		Webinars	2	2	5	40%

¹Unique, individual stakeholders as specified in second-cycle, project-specific T2 plans; may contain multiple (but distinct) stakeholders within same agency.

Peer-Reviewed Journal Publications

1. Ahsan, M. and Z. Hossain. Potential of rice husk ash (RHA) as a supplementary cementitious material in concrete. *Advances in Civil Engineering Materials*, 7(3), 473-488. [Published] [Federal support acknowledged] [Accessible [here](#)].
2. Braham, A., Aschenbrener, T., and Z. Hossain (2018). Forensic investigation of ten asphalt interstate pavements with varying performance in Arkansas. *Journal of Transportation Engineering Part B: Pavements*, 144(2). [Published] [Federal support acknowledged] [Accessible [here](#)].
3. Hossain, Z., Chowdhury, N., and A. Braham (2018). Forensic evaluation of premature pavement failures in Arkansas. *Journal of Performance of Constructed Facilities*, 32(3). [Published] [Federal support acknowledged] [Accessible [here](#)].
4. Zhirzad, S., Hassan, M., Aguirre, M., Cooper, S., and I. Negulescu (2018). Effects of light-activated self-healing polymers on the rheological behaviors of asphalt binder containing recycled asphalt shingles. *Journal of Transportation Research Record*, 0361198118772726. [Published] [Federal support acknowledged] [Accessible [here](#)].

Journal Publications under Review (Selected)

1. Abuella, H., Miramirkhani, F., Ekin, S., Uysal, M., and S. Ahmed. ViLDAR – Visible light sensing based speed estimation using vehicle’s headlamps. In review, *IEEE Transactions on Vehicular Technology*. [Federal support acknowledged]
2. Changkyu, K., Choe, D., and H. Castaneda. Corrosion reliability and probabilistic model of corrosion initiation for coastal concrete structures: Computational framework. In review, *Materials and Structures*. [Federal support acknowledged]
3. Noorvand, H., Arce, G., Hassan, M., Rupnow, T., and L. Mohammad. Investigation of the mechanical properties of engineered cementitious composites with low fiber content and crumb rubber and high fly ash content. Accepted in *Journal of Transportation Research Record*. [Federal support acknowledged]
4. Shirzad, S., Hassan, M., Aguirre, M., Cooper, S., and I. Negulescu. Rheological properties of asphalt binder modified with recycled asphalt materials (RAS/RAP) and light-activated self-healing polymers. In review, *Journal of Transportation Research Record*. [Federal support acknowledged]
5. Soliman, M. and S. Ahmed. Life-cycle cost analysis of reinforced concrete bridge deck with conventional and corrosion resistant reinforcements. In review, *Journal of Bridge Engineering*. [Federal support acknowledged]

Conference Papers/Presentations (Selected)

1. Alam, S. and Z. Hossain (2018). “Changes in chemical fingerprints of asphalt binders due to aging and chemical modification”. In *Civil Infrastructures Confronting Severe Weathers and Climate Changes Conference*, 44-54. Springer, Cham. [Published] [Federal support acknowledged] [Accessible [here](#)]
2. Al-Basha, A., Toledo, W., Newton, C., and B. Weldon. “Ultra-high performance concrete overlays for concrete bridge decks”. 3rd World Multidisciplinary Civil Engineering, Architecture, and Urban Planning Symposium, June 2018, Prague, Czech Republic. [Federal support acknowledged]
3. Ali, H. and M. Soliman. “Reliability analysis of steel bridges under propagating fatigue cracks.” 9th International Conference on Bridge Maintenance, Safety, and Management, July 2018, Melbourne, Australia. [Federal Support acknowledged]

4. Arce, G., Noorvand, H., Hassan, M., Rupnow, T., and L. Mohammad. “Low fiber content PVA-ECC for transportation infrastructure.” 2018 World Transport Convention, June 2018, Beijing, China. [Federal support acknowledged]
5. Ballor, J., McClain, O., Mellor, M., Cattaneo, A., Harden, T., Shelton, P., Martinez, E., Narushof, B., Moreu, F., and D. Mascareñas (2018). “Augmented reality for next generation infrastructure inspections”. In *Model Validation and Uncertainty Quantification*, 3, 185-192, Springer, Cham. [Published] [Federal support acknowledged] [Accessible [here](#)]
6. Dessouky, S. “Experimental and assessment of thermoelectric energy harvesting from asphalt pavements.” 4th Conference of the Middle East Society of Asphalt Technologists, July 2018, Beirut, Lebanon. [Federal support acknowledged]
7. Hossain, R., Omer, W., and N. Wasiuddin (2018). Evaluation of degradation of polymer due to aging in asphalt binder using a novel and DSR-based extensional deformation test. In *Advances in Materials and Pavement Performance Prediction*, 167, Taylor and Francis Group. [Published] [Federal support acknowledged] [Accessible [here](#)]
8. Khandel, O. and M. Soliman. “Maintenance optimization for deteriorating bridges under uncertainty”. Structures Congress 2018, April 2018, Fort Worth, TX. [Published] [Federal support acknowledged] [Accessible [here](#)]
9. Liu, B., Ozdagli, A., and F. Moreu (2018). “Direct reference-free dynamic deflection measurement of railroad bridges under service load”. In *Sensors and Instrumentation, Aircraft/Aerospace and Energy Harvesting*, 8, 83-91. Springer, Cham. [Published] [Federal support acknowledged] [Accessible [here](#)]
10. Ozdagli, A., Liu, B., and F. Moreu (2018). “Real-time low-cost wireless reference-free displacement sensing of railroad bridges”. In *Sensors and Instrumentation, Aircraft/Aerospace and Energy Harvesting*, 8, 103-109. Springer, Cham. [Published] [Federal support acknowledged] [Accessible [here](#)]

Websites or other Internet Sites (Selected)

The Tran-SET website, Facebook, LinkedIn, Twitter, and YouTube pages are continuously updated and leveraged for outreach initiatives and activities:

- [Tran-SET website](#);
- [Tran-SET Facebook page](#);
- [Tran-SET LinkedIn page](#);
- [Tran-SET Twitter page](#); and
- [Tran-SET YouTube page](#).

Partnering institutions have reported on Tran-SET-sponsored activities through their own social media outlets. Selected, demonstrative examples are shown below:

- [Video](#) from the University of Texas at San Antonio summarizing Dr. Arturo Montoya’s (PI) research on computational methods for evaluating the integrity of structures (Project No. 18STTSA04);
- [Article](#) from LSU documenting Dr. Mukhopadhyay’s, Dr. Yimini Zhu’s, and Dr. Ravindra Gudishala’s (PIs) research using virtual reality tools to study traffic (Project No. 18STOKS02);
- [Article](#) from University of New Mexico summarizing Dr. Fernando Moreu’s (PI) research on preventing railroad overpass crashes (Project No. 17STUNM02).

EDUCATION

Table 6 lists Tran-SET’s performance metrics for education-related outputs. In total, Tran-SET supported **160** students and produced **11** educational modules. Select modules are described below.

Table 6. Education Performance Metrics: Outputs.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
E-01	E1, E2, EL1, IF4, A2	Number of students supported from Tran-SET research:				
		Undergraduate students	59	30	25	120%
		Masters students	45	22	25	88%
E-03		Doctoral students	56	28	25	112%
E-04	E1, E2, EL1, ED1, IF4, A2	Number of research opportunities for under-representative groups:				
		Undergraduate students	42	21	15	140%
E-05		Graduate students	44	22	15	146%
E-06	E1, E2, EL1, ED1, IF4, A2	Total budgeted costs for women and minorities	\$0.558M	\$0.858M	\$1.1M	78%
E-07	E1, E2, EL1, IF4, A2	Number of new transportation-related educational modules delivered	11	14	35	40%
E-08	E1, E2, EL1, IF4, A2	Number of STEM events sponsored by Tran-SET or that participated in	7	14	15	93%

Educational Modules (Selected)

1. An educational module on opportunities in transportation-related careers was developed and presented to incoming freshman at Prairie View A&M University (Project No. 18PPVU01).
2. A hands-on module to demonstrate asphalt binder-related tests using a SER was developed and will be incorporated into 2 courses at Louisiana Tech University: “CVEN427: Design of Highway Pavements” and “CVEN517: Advanced Pavement Design” (Project No. 17BLSU01).
3. A new module on how augmented reality can be used to enhance learning in STEM-related fields was developed (Project No. 18STUNM03).
4. An educational module on engineered cementitious composite (ECC) materials and implications of its implementation was developed and presented in “CM2100: Construction Materials, Methods, and Equipment” at LSU (Project No. 18CLSU01).

WORKFORCE DEVELOPMENT

Table 7 lists Tran-SET’s performance metrics for workforce development-related outputs. During this reporting period, **9** revised courses and **7** workshops were delivered. Select workshops are listed below.

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	9	19	25	76%
WF-02	WF1, IF4, A2	Number of seminars/workshops presented	7	13	15	87%
WF-03	WF1, IF4, A2	Number of professional society-related events ¹ sponsored or participated in	4	7	15	47%

¹Events 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.

Workshops (Selected)

1. Hossain, Z. “Effects of moisture in asphalt concrete pavements.” May 31, 2018, Jonesboro, AR. [Federal support acknowledged]
2. Moreu, F. “Infrastructure management and maintenance using new technologies.” April 19, 2018, Fort Worth, TX. [Federal support acknowledged]
3. Moreu, F. and D. Mascarenas. “Human-machine interfaces for structural engineering assessment.” May 1, 2018, Cambridge, MA. [Federal support acknowledged]
4. Weldon, B. and C. Newton. “Workforce development symposium on ultra-high performance concrete (UHPC).” April 17-18, 2018, Las Cruces, NM. [Federal support acknowledged]

4. Outcomes

Given that first-cycle projects recently began conducting T2-related activities and second-cycle projects are still in the research phase, outcomes will be updated in future reporting cycles. The following subsections detail how selected outputs are expected to *lead* to meaningful outcomes.

TECHNOLOGY TRANSFER

Table 8 lists Tran-SET’s performance metrics for T2-related outcomes. Tran-SET disseminated research results to various entities (DOT, professionals, students, educational personnel, companies, etc.) in a wide-range of transportation areas.

Table 8. Technology Transfer Performance Metrics: Outcomes.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
TT-C1	TT1, IN2	Tran-SET website traffic:				
TT-C2		Number of visitors to website	17k	35k	30k	167%
		Number of visits to website	123k	253k	250k	101%
TT-C3	TT1, TT2, IN2	Number of times disseminated research products have informed/been viewed:				
TT-C4		Social media engagement levels(s)	11/1.	7/1.8	9 ¹ /2.5 ²	78%/72%
TT-C5		Number of times reports (or related) are downloaded	8	-	30	%
TT-C6		Number of citations from publications	-	8 ³	120	-
TT-C7	TT1, TT2, IN2	External funds:				
TT-C8		Industrial partners providing funds	-	3	4	75%
TT-C9		Public agency partners providing funds	-	9	10	90%
TT-C10		Total funds from industrial partners	-	\$102k	\$200k	51%
		Total funds from public agency partners	-	\$479k	\$300k	156%
TT-C11	TT1, TT2, IN2	Number of stakeholders who have:				
TT-C12		Committed to adopt research products	+	+	3	-
TT-C13	TT1, TT2, IN2	Adopted research products				
		Number of commercialized/patented/licensed research products	++	++	1	-

¹Average “post engagement” (Facebook); ²Average “engagement rate” (Twitter); ³All publications recently published, leading to lack of citations; +New metric to be reported by 10/30/19; ++New metric to be reported by 4/30/19; same column definitions for Tables 9 – 13

Increased Understanding and Awareness of Transportation Issues (Selected)

- The analysis of congestion mitigation strategies at the I-10 Mississippi River Bridge in Baton Rouge, LA has instilled local planners and policymakers with a better understanding of its sources of congestion and effective solutions (Project No. 17ITSLSU09).
- The safety analysis of urban intersections located in the City of San Antonio led City planners and officials to have a better understanding of factors leading to crashes and implementable countermeasures (Project No. 17ITSTSA01).

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

- The investigation of alternative maintenance financing options of public sidewalks, utilizing the City of Albuquerque as a case study, and corresponding white paper/policy brief, may improve City policies, potentially leading to a more systematic, effective, and efficient funding mechanism (Project No. 17PPUNM01).
- The evaluation of recruiting, training, and retaining practices by state DOT agencies and resulting recommendations may inform current DOT practices and lead to policy changes (Project No. 17PPLSU07).

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

- The developed method utilizing UHP-FRC for repair of concrete pavement (specified in Section 2) has led to a 25'x25' pavement repair field implementation at Dallas Fort Worth (DFW) Airport (Project No. 17STUTA03). This may lead to further adoption of the technique (long-term) and further implementations at DFW Airport (short-term).
- The developed test method and protocol to quantify moisture susceptibility of asphalt pavements is expected to aid and inform Arkansas DOT in adopting an appropriate moisture resistance test (Project No. 17BASU03).
- The assessment of mechanical characterization devices determined the shortcomings (as related to practitioner needs) of existing alternatives to the nuclear density gauge (NDG) test, informing new, more adoptable methods (Project No. 17GTNMS02).

Commercialized Research Products (Selected)

Tran-SET is firmly committed to implement the processes specified in our Technology Transfer Plan in order to support and encourage commercialization of developed products. Tran-SET has identified **10** suitable technologies (to be developed from second-cycle projects) and will work with respective PIs to pursue their commercialization. This has led to the following patent application filed by the Technology Development Center at Oklahoma State University (Project No. 18ITSOKS01):

- Abullea, H., Ekin, S. and M. Uysal. "System and method for speed estimation, detection, and ranging using visible light in vehicles." US Patent No.: P2514US01/18-028.

EDUCATION

Table 9 lists Tran-SET's performance metrics for education-related outcomes. In total, **244** students participated in Tran-SET-sponsored research.

Table 9. Education Performance Metrics: Outcomes.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
	E1, E2, EL1, ED1, IN4, A2	Number of students participating in Tran-SET research:				
E-C1		Undergraduate students	103	50	75	67%
E-C2		Graduate students	141	70	100	70%

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
E-C3	E1, E2, EL1, IN4, A2	Number of times educational modules have been viewed	++	++	700	-
E-C4	E1, E2, EL1, ED1, IN4, A2	Number of students attending sponsored or involved STEM events	++	++	300	-

Increased Body of Scientific Knowledge (Selected)

- The developed ultraviolet, light-activated polymers, production processes, lab investigations, and video-based educational modules will aid in advancing the state-of-the-art in the application of this emerging technology in asphalt materials (Project No. 17BLSU02).

WORKFORCE DEVELOPMENT

Table 10 lists Tran-SET's performance metrics for workforce development-related outcomes. In total, **194** attendees participated in new or revised transportation-related courses.

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	194	575	500	115%
WD-C2	WF1, IF4, A2	Number attending presented seminars/workshops	++	++	225	-
WD-C3	WF1, IF4, A2	Sponsorship: Number of stakeholders sponsoring seminars/workshops/conferences	++	++	3	-
WD-C4		Total funds of sponsorship			\$15k	-

Enlargement of Trained Transportation Workforce (Selected)

- The conducted symposium on UHPC created a more informed and educated workforce on the use and implementation of UHPC, providing guidance to enable New Mexico DOT engineers and contractors to successfully adopt and implement uses of UHPC.

5. Impacts

Given that first-cycle projects recently completed their research deliverables and research from second-cycle projects is on-going, project *impacts* will be updated as they become available. The following subsections detail how select outcomes are *expected to impact* the transportation system and workforce.

TECHNOLOGY TRANSFER

Table 11 lists Tran-SET's performance metrics for T2-related impacts. Tran-SET has identified several viable opportunities for MOUs involving products developed from second-cycle projects. Tran-SET will support and work with respective PIs to pursue these MOUs as outlined in the Technology Transfer Plan.

Table 11. Technology Transfer Performance Metrics: Impacts.

ID	Objective ID	Metric	Value	Ann. Value	Ann. Target	Percent Compl.
TT-I1	TT1, TT2, IN2	Number of stakeholder MOUs	+	+	1	-
TT-I2	TT1, TT2, IN2	Adopter feedback on implemented research products ¹	+	+	*	-
TT-I3	TT1, TT2, IN2	External, derivative initiatives spurred by research products ²				
		Number of additional research projects	2	2	1	200%
TT-I4		Total funding of additional research projects	\$194k	\$194k	\$100k	194%

¹Feedback solicited from electronic surveys or in-person/phone interviews; ²Sponsored research projects (external to Tran-SET) initiated as a direct result of research products developed from a Tran-SET-sponsored project; *Target equivalent to a “satisfactory” rating; same notation for Tables 12 and 13

Impact on Effectiveness of the Transportation System (Selected)

- The developed framework for risk quantification and optimum management of bridges susceptible to damage during extreme weather events will enable optimal management of infrastructure systems and improve their longevity, sustainability, and resilience to natural disasters (Project No. 17STOKS01).
- The design and characterization of the use of multifunctional materials that stabilize structures during thermal expansion offers a new generation of transportation infrastructure with enhanced longevity, safety, and abilities in predicting condition/lifespan (Project No. 18STTAM01).

Impact on Adoption of New Practices and Commercialization (Selected)

- The developed technique for retrofitting metal culverts using glass fiber reinforced polymers (GFRP) significantly extends the service life of maintained metal culverts to beyond 75 years, more than doubling the current average operating life of 30 years (Project No. 17STUNM03). The technique is suitable for field installation and capable of nationwide adoption and implementation.

EDUCATION

Table 12 lists Tran-SET’s performance metrics for education-related impacts. As shown, funded projects have led to the graduation of a number of students that will effectively contribute to the transportation field.

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	22	22	30	73%
E-I2	EL1, EL2, IF4, A2	Feedback ¹ of graduated, supported students who’ve entered the transportation field	++	++	*	-

¹Feedback related to how well educational experiences prepared student for workforce; solicited from electronic surveys or in-person/phone interviews;

Impact on Scientific Knowledge (Selected)

- Drs. Miladin Radovic and Anand Puppala are currently developing an innovative, sustainable, and durable geopolymer cement (GPC) for soil stabilization of infrastructure (Project No.

18CTAM04). The study will produce a better understanding of the structural-processing-property relationship of GPC, contributing to the current body of knowledge and allowing for faster development and implementation of GPC in transportation infrastructure.

- The performed laboratory tests to determine the nano-mechanical properties of asphalt binders using atomic force microscopy (AFM) will advance sciences related to surface chemistry and AFM techniques (Project No. 17BASU03).

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 ¹ of seminar/workshop/Conference attendees: Related to skills gained	++	++	*	-
WD-I2		Related to improved practices			*	-

¹Feedback solicited from electronic surveys or in-person/phone interviews;

Impact on Transportation Workforce Development (Summarized)

- Tran-SET research has supported a high number of students, especially those from under-representative groups – educating and training the future workforce with the needed skills and capabilities to meet the current and future needs of the transportation industry.
- The developed educational modules, revised transportation-related courses, and provided seminars/workshops have educated and trained the current and future workforce on emerging innovations – supplementing its capabilities and increasing its competitiveness.

6. Changes/Problems

Changes in Approach

Table 14 lists second-cycle projects originally selected for award that were cancelled due to the respective PI departing from the Tran-SET-affiliated institution. Recovered funds will be utilized in third-cycle projects.

Table 14. Changes in Second-Cycle Projects.

Project No.	Title	Total Cost	Leading Institution	Research Objective	Topical Area
18ITLSU07	Investigating and Analyzing Factors Affecting Lane-Capacity Variations in the Roadway Network in Baton Rouge, LA: Measures for Mitigating Traffic Congestion	\$90,001	LSU	R4, IF3	ITS
18SALSU05	Truck Crash Causation in Louisiana	\$50,318	LSU	R4, S1	Safety
18STLSU11	FRP Composite Decks for Movable Bridges	\$88,556	ULL	R1, IF2, IN1	Structural
18STLSU12	Exterior Bridge Girder Fender System for Over-height Vehicle Impact Protection	\$132,536	ULL	R3, IF2, IN1	Structural

7. Special Reporting Requirements

Not applicable.