



Program Progress Performance Report for University Transportation Centers

- **Federal Agency and Organization Element to which Report is Submitted**
United States Department of Transportation (USDOT), Office of the Assistant Secretary of Transportation for Research and Technology (OST-R)
- **Federal Grant or Other Identifying Number Assigned by Agency:** DTRT13-G-UTC59
- **Project Title:** University Transportation Center for Railway Safety (UTCRS)
- **Project Director (PD) Name, Title, and Contact Information**
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- **Submission Date:** April 30, 2016
- **DUNS and EIN Numbers:** DUNS: 069444511 and EIN: 465292740
- **Recipient Organization:**
The University of Texas Rio Grande Valley (UTRGV)
1201 West University Drive, Edinburg, TX 78539-2999
- **Recipient Identifying Number or Account Number:** 410000049 and 410000232
- **Project/Grant Period:** September 30, 2013 – September 30, 2018
- **Reporting Period End Date:** March 31, 2016
- **Report Term or Frequency (annual, semi-annual, quarterly, other):** Semi-annual
- **Signature of Submitting Official**

Constantine

Dr. Constantine Tarawneh, Director, University Transportation Center for Railway Safety



1. ACCOMPLISHMENTS:

What are the main goals and objectives of the program?

The UTCRS will develop knowledge, diverse human resources, and innovative technology in support of strategic safety plans for the U.S. rail transportation industry. The Center will engage and focus its partners' established expertise and leverage and expand their existing resources to establish comprehensive programs of railway safety research, education, technology transfer and implementation, and workforce development. UTCRS Strategic Research Goals aim to fundamentally improve railway safety outcomes by the following means:

- 1) Reducing fatalities and injuries at highway-rail grade crossings (HRGCs)
- 2) Reducing failures by developing more durable materials and systems
- 3) Developing advanced technology for infrastructure monitoring
- 4) Developing innovative safety assessments and decision-making tools

In working towards the overall goal of establishing comprehensive programs of railway safety research, leadership activities, education and outreach activities, and technology transfer and implementation, the following was accomplished for this reporting period:

Research Activities	Status	% Complete
Call for Problem Statements for 2 nd Round of 2015-2016 Call for Proposals	Complete	100%
Request for Proposals for 2 nd Round of 2015-2016 Call for Proposals	Complete	100%
External Review for 2 nd Round of 2015-2016 Call for Proposals	Complete	100%
Proposals Reviewed by Executive Committee for 2 nd Round of 2015-2016 Call for Proposals	Complete	100%
Review Budgets for 2 nd Round of 2015-2016 Call for Proposals	Complete	100%
Final Ranking & Selection of Proposals for 2 nd Round of 2015-2016 Call for Proposals (TAMU Projects)	Complete	100%
Call for Problem Statements for 3 rd Round of 2015-2016 Call for Proposals	Complete	100%
Request for Proposals for 3 rd Round of 2015-2016 Call for Proposals	Complete	100%
External Review for 3 rd Round of 2015-2016 Call for Proposals	In Progress	50%
Proposals Reviewed by Executive Committee for 3 rd Round of 2015-2016 Call for Proposals	In Progress	25%
Review Budgets for 3 rd Round of 2015-2016 Call for Proposals	In Progress	25%
Final Ranking & Selection of Proposals for 3 rd Round of 2015-2016 Call for Proposals (UNL Projects)	Forthcoming	0%
UTRGV 1 st Round of 2015-2016 Research Projects Under Contract	On Schedule	65%
2014CY Selected Research Projects Completion	On Schedule	75%
2014CY Final Reports Due	On Schedule	50%
Technology Transfer Briefs, Webinars, Symposiums, and Presentations on Research Results	On Schedule	50%
Applicable Slides, Handouts, Videos, Pictures Posted	On Schedule	100%
Final Reports Due & All Research Projects Completed	On Schedule	50%
Leadership Activities		
Coordination between UTCRS Director and Leadership Team	Complete	100%
Establishment of UTCRS Advisory Board	Complete	100%
UTCRS Leadership Team Update	Complete	100%
Student of the Year Selection	Complete	100%

Education & Outreach Activities		
Call for 2016 Research Experience for Undergraduates (REU) Program	Complete	100%
Selection of 2016 Research Experience for Undergraduates (REU) Participants	Complete	100%
Call for 2016 Research Experience for Teachers (RET) Program	Complete	100%
Selection of 2016 Research Experience for Teachers (RET) Participants	Complete	100%
Meetings with the Lower Rio Grande Valley Independent School District Superintendents and their Representatives	Complete	100%
Parent Orientation Sessions for 2016 UTCRS K-12 Summer Camps	In progress	90%
Preparations for 2016 UTCRS K-12 Summer Camps	On Schedule	95%
Technology Transfer Activities		
Preparations for 2016 UTCRS K-12 STEM Teacher National Workshop	On Schedule	90%
Development of Elementary, Middle, and High School Transportation Related STEM Curricula Available for Use in K-12 Classrooms	Complete	100%
UTCRS Website Information Dissemination Update	Complete	100%
UTCRS Open Educational Resources Tab/Borrowing Agreement	Complete	100%
UTCRS Fall 2015 Newsletter Describing Center Activities	Complete	100%
UTCRS Supported Journal and Conference Publications and Presentations	On Schedule	65%
UTCRS Supported Presentations, Symposiums, Workshops, and Short Courses	On Schedule	65%
USDOT OST-R: Reporting		
UTC Program Progress Performance Reports (Quarterly)	Complete	100%
Federal Financial Reports (Quarterly)	Complete	100%
Map 21 UTC Performance Indicators Report (Annual)	Complete	100%
UTC Specific Performance Indicators Report (Annual)	Complete	100%
Update UTCRS-UTRGV Website Research Repository	Complete	100%
Posting of 2015CY Newly Funded Research Projects & Descriptions (Exhibit Fs)	Complete	100%

What was accomplished under these goals?

UTCRS continues its timely delivery of comprehensive research, education, workforce development, technology transfer, and community outreach programs in support of the USDOT mission to train and develop the next transportation workforce that is prepared to design, deploy, operate, and maintain the complex transportation systems of the future. In particular, the UTCRS increased the number of participants in its annual Research Experience for Undergraduates (REU) Program from 12 students in 2015 to 14 students in 2016. Furthermore, the UTCRS increased the number of teachers participating in the Research Experience for Teachers (RET) Program from 8 in 2015 to 12 in 2016 to accommodate the significant growth and demand for the UTCRS Summer Camps which will be hosting 1250 K-12 students in 2016 – 250 students more than the number served in 2015. Recognizing the benefits and impact of the educational programs offered by the UTCRS, community collaborations have expanded which is evident by the financial support of the Independent School Districts in the Lower Rio Grande Valley (LRGV) for the 2016 UTCRS K-12 Summer Camps. Currently, the UTCRS offers the only transportation related STEM summer camp for elementary students in the Rio Grande Valley (RGV).

To date, the UTCRS has funded 26 research projects aligned with the UTCRS strategic research goals. Seven of the fourteen research projects initially funded as part of the inaugural 2014CY Call for Proposals have been completed on-schedule. The remaining seven research projects selected for

funding during the initial 2014CY Call for Proposals are ongoing and remain on schedule. The four UTRGV research projects selected for funding during the 1st of the 2015CY Call for Proposals are on schedule. Texas A&M University (TAMU) has finalized its selection of new research projects, which were approved by the UTCRS Executive Committee, led by the UTCRS Director, to receive funding as part of the 2nd Round of the 2015CY Call for Proposals. The University of Nebraska-Lincoln (UNL) has submitted some new projects for review and approval by the UTCRS Executive Committee. External reviewers from federal, state, and local agencies whose areas of expertise align with the subject matter of the proposed research projects were involved in the proposal peer review process. The following table contains a list of all the research projects that are/were funded by the UTCRS including links to the full project descriptions:

RESEARCH AREAS: Addressed in Prospectus: 2014CY Call for Proposals	
Completed Projects	
1.	Structural Integrity of Railroad Bearing Adapters with Modifications for Onboard Monitoring Applications. A final report has been indexed by TRB and posted on the UTCRS website at http://www.utrgv.edu/railwaysafety/research/mechanical/2014/modified-railroad-bearing-adapter-for-onboard-monitoring/index.htm
2.	Effects of Vapor Grown Carbon Nanofibers on Electrical and Mechanical Properties of a Thermoplastic Elastomer. A final report has been indexed by TRB and posted on the UTCRS website at http://www.utrgv.edu/railwaysafety/research/mechanical/2014/conductive-railroad-bearing-suspension-element/index.htm
3.	Modeling the Residual Useful Life of Bearing Grease. A final report has been indexed by TRB and posted on the UTCRS website at http://www.utrgv.edu/railwaysafety/research/mechanical/2014/life-of-bearing-grease/index.htm
4.	Applications of Magnetostrictive Materials for Real-Time Monitoring of Vehicle Suspension Components. A final report has been indexed by TRB and posted on the UTCRS website at http://www.utrgv.edu/railwaysafety/research/mechanical/2014/applications-of-magnetostrictive-materials/index.htm
5.	Single Bearing Test Rig with Vertical, Lateral, and Impact Load Capabilities. The UTCRS test rig has been fully instrumented and operational. It is currently being used to run tests for several projects aimed at improving railroad bearing performance and optimizing bearing health monitoring. A final report has been indexed by TRB and posted on the UTCRS website at http://www.utrgv.edu/railwaysafety/research/mechanical/2014/single-bearing-test-rig/index.htm
6.	Improving Safety at Rural Highway-Rail Grade Crossings by Utilizing Light Detection and Ranging (LiDAR) Technology. A final report has been indexed by TRB and posted on the UTCRS website at http://www.utrgv.edu/railwaysafety/research/operations/improving-safety-at-hrgc-by-using-lidar-technology/index.htm
7.	High Speed Train Geotechnics. A final report has been indexed by TRB and posted on the UTCRS website at http://www.utrgv.edu/railwaysafety/research/infrastructure/high-speed-train-geotechnics/index.htm
On-going Projects	
8.	Development of Corridor-based Traffic Signal Preemption Strategies at Signalized Intersections near Highway Railway Grade Crossings. The project is nearing completion, with final report to follow. http://www.utrgv.edu/railwaysafety/research/operations/traffic-signal-preemption-strategies-near-hrgc/index.htm
9.	Drivers' Perceptions of Highway-Rail Grade Crossing Safety and Their Behavior. Project will be completed as soon as the graduate student finishes their thesis work. A final report will be posted shortly thereafter. http://www.utrgv.edu/railwaysafety/research/operations/drivers-perceptions-of-hrgc/index.htm
10.	Safety Modeling of Highway Railway Grade Crossings using Intelligent Transportation System Data. All phases of this project are progressing on schedule. http://www.utrgv.edu/railwaysafety/research/operations/modeling-of-hrgc-using-its/index.htm
11.	Rail Neutral Temperature In-Situ Evaluation. All phases of this project are progressing on schedule.

http://www.utrgv.edu/railwaysafety/research/infrastructure/evaluation-of-rail-neutral-temperature/index.htm
12. Ultrasonic Tomography for Infrastructure Inspection. All phases of this project are progressing on schedule. http://www.utrgv.edu/railwaysafety/research/infrastructure/ultrasonic-tomography-for-infrastructure-inspection/index.htm
13. Optimizing Performance of Railroad Rail through Artificial Wear. All phases of this project are progressing on schedule. http://www.utrgv.edu/railwaysafety/research/infrastructure/railroad-rail-performance/index.htm
14. Vehicle-Borne Autonomous Railroad Bridge Impairment Detection Systems. All phases of this project are progressing on schedule. http://www.utrgv.edu/railwaysafety/research/infrastructure/railroad-bridge-impairment-detection-systems/index.htm
RESEARCH AREAS: Addressed in Prospectus: 2015CY Call for Proposals
On-going Projects
15. The Effect of Heat Generation in the Railroad Bearing Thermoplastic Elastomer Suspension Element on the Thermal Behavior of Railroad Bearing Assembly. All phases of this project are progressing on schedule. http://www.utrgv.edu/railwaysafety/research/mechanical/2015/heat-generation-in-the-railroad-bearing-suspension-element/index.htm
16. Development of Predictive Models for Spall Growth in Railroad Bearing Rolling Elements. All phases of this project are progressing on schedule. http://www.utrgv.edu/railwaysafety/research/mechanical/2015/predictive-models-for-spall-growth-in-railroad-bearings/index.htm
17. Radiative Heat Transfer Analysis of Railroad Bearings Using a Single Bearing Test Rig for Wayside Thermal Detector Optimization. All phases of this project are progressing on schedule. http://www.utrgv.edu/railwaysafety/research/mechanical/2015/radiative-heat-transfer-analysis-of-railroad-bearings/index.htm
18. Demonstration of Magnetostrictive Materials for Self-Powered Monitoring of Rail Vehicle Suspension Components. All phases of this project are progressing on schedule. http://www.utrgv.edu/railwaysafety/research/mechanical/2015/energy-harvesting-applications/index.htm
19. A Mechanistic Investigation of Concrete Tie Degradation in the Rail Seat. New project that was recently selected as part of the 2 nd round of the 2015CY Call for Proposals. http://www.utrgv.edu/railwaysafety/research/infrastructure/investigation-concrete-tie-degradation/index.htm
20. Bumps in High Speed Rails: What is Tolerable? New project that was recently selected as part of the 2 nd round of the 2015CY Call for Proposals. http://www.utrgv.edu/railwaysafety/research/infrastructure/bumps-in-high-speed-rails/index.htm
21. Dynamic Live Load Effects of Railroad on Retaining Walls and Temporary Shoring. New project that was recently selected as part of the 2 nd round of the 2015CY Call for Proposals. http://www.utrgv.edu/railwaysafety/research/infrastructure/dynamic-live-load-effects-of-railroads-on-retaining-walls/index.htm
22. Estimating Bridge Span Deflections Using Data Streams from Rolling Stock. New project that was recently selected as part of the 2 nd round of the 2015CY Call for Proposals. http://www.utrgv.edu/railwaysafety/research/infrastructure/bridge-span-deflection-estimation/index.htm
23. Fatigue and Service Analysis of Railroad Eyebars Members. New project that was recently selected as part of the 2 nd round of the 2015CY Call for Proposals. http://www.utrgv.edu/railwaysafety/research/infrastructure/service-analysis-of-eyebars-members/index.htm
24. Method for Predicting Thermal Buckling in Rails. New project that was recently selected as part of the 2 nd round of the 2015CY Call for Proposals. http://www.utrgv.edu/railwaysafety/research/infrastructure/thermal-buckling-in-rails/index.htm

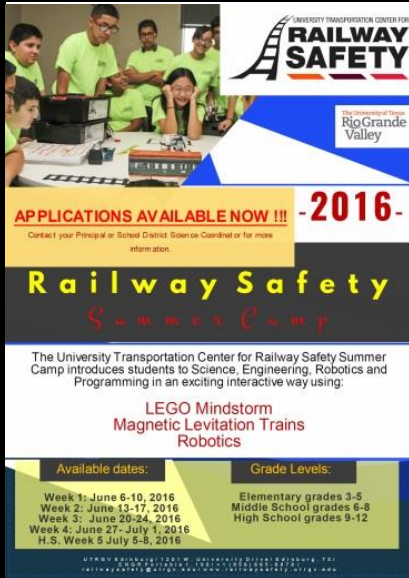
25. **Multi-scale Fatigue Damage Life Assessment of Railroad Wheels.** New project that was recently selected as part of the 2nd round of the 2015CY Call for Proposals.
<http://www.utrgv.edu/railwaysafety/research/infrastructure/wheel-fatigue-damage-life-assessment/index.htm>
26. **Strength and Fracture Toughness of Railroad Eyebars.** New project that was recently selected as part of the 2nd round of the 2015CY Call for Proposals.
<http://www.utrgv.edu/railwaysafety/research/infrastructure/fracture-of-eyebars/index.htm>

During this reporting period, the UTCRS financially supported 46 undergraduate, master’s, and doctoral students actively involved in the various UTCRS funded research projects and educational programs. As part of our commitment to transportation industry workforce development, a substantial number of research positions at the UTCRS are exclusively available for undergraduate students to experience working in a professional and research intensive environment early in their academic careers. The majority of the UTCRS undergraduate students pursue master’s degrees upon graduation, and remain actively engaged in research, workforce development, and technology transfer activities.

Student Researcher Classification	Number	Male	Female
Undergraduate Research Assistants	25	15	10
Masters’ Research Assistants	9	4	5
Doctoral Research Assistants	12	6	6
Totals	46	25	21

Students funded by the UTCRS are also actively involved in education and outreach efforts through on-campus and off-campus community events where they present about the different transportation careers and opportunities available to students, and talk about railway safety issues and ongoing research projects being conducted at the UTCRS. These students facilitate, on a regular basis, presentations, tours, and symposiums, and attend various community events representing the UTCRS. This reporting period, the UTCRS experienced a significant increase in requests for tours of the UTCRS laboratory facilities. This has proven exceptionally successful in giving students professional outreach experience to promote and provide visitors with an accurate representation of the scope of railway safety research being performed at the UTCRS. The UTCRS outreach efforts reached more than 1200 community members through several information sessions and tours, and hosted an additional 1000 local K-12 students for tours of the UTCRS research facilities at UTRGV. The success of the aforementioned outreach efforts is evident in terms of participants’ recruitment for education, workforce development, and outreach programs for summer of 2016. The UTCRS received 31 applications and selected 14 participants for the 2016 Research Experience for Undergraduates (REU) Program, and received 38 applications and selected 11 LRGV teachers for the 2016 Research Experience for Teachers (RET) Program. Furthermore, the UTCRS recruited over 1250 elementary, middle, and high school students from collaborating Rio Grande Valley school districts to attend the 2016 UTCRS Summer Camps. The following is a summary of the educational, workforce development, and outreach activities carried out over the period from October 1, 2015 to March 31, 2016:

EDUCATION & OUTREACH ACTIVITIES for period (October 1st, 2015 – March 31st, 2016)
 Outreach and Educational Activities aimed at Increasing Awareness of Transportation Engineering and Railway Safety Careers



The poster features the UTRGV logo and the text 'RAILWAY SAFETY Summer Camp 2016'. It includes the following information:

- APPLICATIONS AVAILABLE NOW !!! -2016-**
- Contact your Principal or School District Science Coordinator for more information.
- Railway Safety Summer Camp**
- The University Transportation Center for Railway Safety Summer Camp introduces students to Science, Engineering, Robotics and Programming in an exciting interactive way using:
- LEGO Mindstorm Magnetic Levitation Trains Robotics**
- Available dates:**
 - Week 1: June 6-10, 2016
 - Week 2: June 13-17, 2016
 - Week 3: June 20-24, 2016
 - Week 4: June 27- July 1, 2016
 - H.S. Week 5: July 5-9, 2016
- Grade Levels:**
 - Elementary grades 3-5
 - Middle School grades 6-8
 - High School grades 9-12

Following two successful years of implementation of the UTCRS Summer Camps in 2014 (700 participants - 300 elementary, 300 middle school, and 100 high school) and in 2015 (1000 participants - 450 elementary, 425 middle school, and 125 high school), the 2016 UTCRS Summer Camps, to be held at UTRGV from June 6th to July 11th, will host over 1250 K-12 students (550 elementary, 450 middle school, and 250 high school) from the local school districts in the Lower Rio Grande Valley (LRGV). The UTCRS Summer Camps, acknowledged as the largest transportation related summer camps in the nation, have become the main program to attend for K-12 RGV students who are interested in STEM activities. To improve the 2016 Summer Camps, the UTCRS coordinated with 26 school district superintendents and coordinators and met on several occasions since November 2015 to implement new processes that will enhance the benefits to the students and teachers. The school districts once again provided financial support to cover ‘participant support’ fees to cost share program expenses. RET program participants, chaperon teachers, and volunteer staff have been recruited from participating school districts to facilitate activities during the 2016 UTCRS Summer Camps.

Participating RET teachers and volunteers will be trained by the UTCRS faculty and staff on June 2 and 3, during the K-12 STEM Teacher National Workshop, where teachers will gain valuable STEM knowledge and hands-on training to apply the UTCRS curricula. Teachers trained in this workshop can borrow the UTCRS educational kits free of charge and deliver the railway safety modules to students in their classroom.

See: <http://www.utrgv.edu/railwaysafety/education/summer-camps/utcrs/index.htm>



The UTCRS received **31** highly competitive applications from students wishing to participate in the 2016 Research Experience for Undergraduates (REU) Program. **Fourteen** UTRGV undergraduate engineering students were selected to participate in the 2016 REU Program (pictured here). The students are from three different

departments within the College of Engineering and Computer Science; namely, Civil Engineering, Mechanical Engineering, and Computer Engineering. The students will spend their ten-week REU Program (5/31 – 8/5) alongside consortium faculty, staff, and students working on research-intensive projects directly related to the UTCRS strategic research goals. **Seven** students will attend the REU Program at Texas A&M University and **seven** students will attend the University of Nebraska-Lincoln. Characteristically, students who participate in the UTCRS REU Program pursue transportation related Master’s programs upon graduation. The UTCRS REU program has funded **34 undergraduate engineering students** over the previous three years (2014-2016). As a result of their participation in the UTCRS REU program, the students develop professional-level research skills and expertise needed to succeed in transportation industry careers or in pursuing post-graduate degrees in Tier 1 Research Institutions across the nation. See: <http://www.utrgv.edu/railwaysafety/education/summer-exp/reu/index.htm>



The UTCRS hosted its Second Annual Research Experience for Undergraduates (REU) Symposium at UTRGV on November 15, 2015. The event served as a research forum for the **12 UTRGV REU students** who participated in the 2015 REU Program. Students presented their railway safety research projects through a

poster session and an oral presentation, in front of faculty and students in the College of Engineering and Computer Science and members of the community. The event demonstrated the wide range of research topics investigated by the UTCRS. The symposium was also a great opportunity for students to receive feedback and advice from faculty and peers on the future direction of their research efforts.

See: <https://www.flickr.com/photos/131769328@N02/sets/72157667180921865>



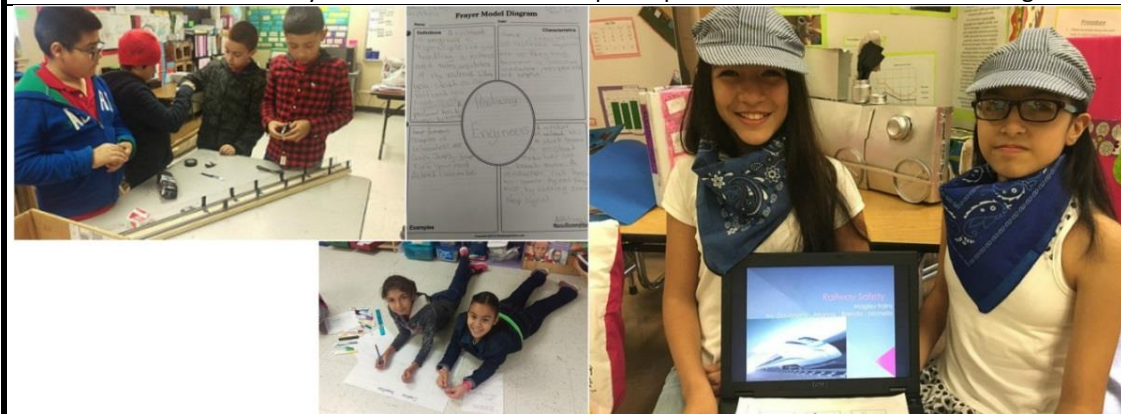
Following the successful implementation of the 2014 and 2015 Research Experience for Teachers (RET) Program through which 13 teachers were trained and provided the required tools to implement the UTCRS

developed modules to introduce students to STEM concepts using transportation engineering and railway safety applications, the UTCRS solicited and received **38** applications for the 2016 RET Program. The UTCRS Leadership Team selected 12 teachers to participate in the 2016 RET Program. The program will begin on June 2nd and end on July 11th, 2016. The participants will actively engage in a variety of UTCRS research and education activities.

See: <http://www.utrgv.edu/railwaysafety/education/summer-exp/ret/index.htm>



UTCRS Director, Dr. Constantine Tarawneh, was the keynote speaker at the first annual Science Fair at IDEA McAllen on January 23rd, 2016. He and five UTCRS-UTRGV research assistants presented to over **250 attendees (elementary students, teachers, and parents)** about career opportunities in the transportation field. IDEA Academy is a tuition-free Pre-K to 12th grade charter school network recognized nationwide for maintaining 100% of graduating students accepted into college for 9 successive years. The UTCRS received positive feedback from attending parents and administration for taking the time to connect with young children, and being willing to educate the public about the transportation industry and raise awareness regarding possible career paths. This event was facilitated by one of the teachers who participated in the 2015 UTCRS RET Program.



As part of the UTCRS commitment to student education and community outreach, the UTCRS faculty and staff,

supported by teachers who participated in the 2014 and 2015 Research Experience for Teachers (RET) program, developed elementary, middle school, and high school STEM curricula and modules with the goal of introducing students to age appropriate STEM concepts using transportation engineering applications with an emphasis on railway safety. The UTCRS developed curricula utilizes LEGO® MINDSTORMS® NXT 2.0, LEGO® MINDSTORMS® Education EV3, and MagLev educational toolkits to expose students to STEM and transportation technologies through programming, engineering design, teamwork, logic, problem solving, and real-life applications in a challenging, hands-on manner. The RET Program participants have been trained to implement carefully designed STEM teaching modules that can be used to deliver STEM concepts to students inside their classroom using transportation engineering applications focused on railway safety. To facilitate the delivery, the UTCRS created an Educator Resources Borrowing Program. Through this program, former RET participants and other Rio Grande Valley teachers who have been trained through the UTCRS teacher workshops are able to borrow the UTCRS K-12 STEM curricula and educational kits to implement the material in their classroom at no cost. In less than four months, the UTCRS curricula has been implemented in the McAllen ISD, the La Joya ISD, the Donna ISD, and was used by UTRGV engineering students for a Nano-Carbon Fiber Filter Senior Design Project. Overall the program has benefited more than **200 elementary to college level** students.

ISD	Grade	Total	Females	Males
La Joya ISD	5th	114	54	60
Donna ISD	1st - 5th	40	17	23
McAllen ISD	8th	50	25	25
UTRGV	College	4	1	3
TOTAL		208	97	111

See: <http://www.utrgv.edu/railwaysafety/education/resources/index.htm>

RAILWAY SAFETY STEM Classroom
K-12 Teacher National Workshop
June 2-3, 2016
Hosted at The University of Texas Rio Grande Valley

Continuing Education Credits Available
Transportation STEM Modules and Curriculum Provided
Hands-on, Challenge-Based Professional Development

SAVE the DATE

Thursday June 2, 2016 (8:00 am – 5:00 pm)
Session 1 - Elementary School STEM Workshop
 • Explore the STEM concepts introduced in the workshop with the developed Magnetic Levitation (MagLev) Kits curriculum.
 • Make the connection between STEM concepts and hands-on experiences and ways to implement in the classroom.

Friday June 3, 2016 (8:00 am – 5:00 pm)
Session 3 - High School STEM Workshop
 • Explore the STEM concepts introduced in the workshop with the developed MagLev and Robotics Kits curriculum.
 • Make the connection between STEM concepts and hands-on experiences and ways to implement in the classroom.

Session 2 - Middle School STEM Workshop
 • Explore the STEM concepts introduced in the workshop with the developed Lego Mindstorm Robotics Kits curriculum.
 • Make the connection between STEM concepts and hands-on experiences and ways to implement in the classroom.

Session 4 - Raising the Bar - Challenge-Based Instruction
 • Learn to develop engaging, relevant challenges for K-12 students with real-world applications.
 • Learn how to implement effective STEM design challenges.

Workshop Information Contact:
The University Transportation Center for Railway Safety (UTCRS)
railwaysafety@utrgv.edu
(956) 969-3076

Through the 2014 and 2015 UTCRS Teacher Professional Development Workshops, the center has trained **155** Rio Grande Valley teachers to implement transportation engineering modules with an emphasis on railway safety in their classrooms. This year, the UTCRS will train over **120** educators and coordinators on the use of the UTCRS developed curricula in its first Annual Transportation in the Classroom K-12 STEM Teacher National Workshop. The Workshop will provide hands-on training on the use and implementation of all the UTCRS developed curricula. During the workshop, participants will be introduced

to challenge-based instruction methodologies that they can utilize to create their own challenges and modules, and implement them in their classrooms. Upon completion of the workshop, teachers should be able to design lessons and challenges that are aligned with state and national STEM learning objectives using applications in transportation engineering with an emphasis on railway safety.

Register at: https://docs.google.com/forms/d/1IXncbz-hLKUNCV5Q-KjU5Gquu6SWST--DyGjP8lu_II/viewform

UTCRS-UTRGV collaborating faculty and research assistants led four tours for **96 junior and senior high school students** (identified by UTRGV as potential engineering students) in the **“TSA Region One Leadership Conference”** November 20th, 2016. The tours featured the UTRGV Hi-Bay facilities and the UTCRS laboratories and testing facilities. The visiting students had the opportunity to observe the research conducted by the UTCRS faculty and students, and listen to the students describe their work and where it fits within the transportation engineering field and how it impacts railway safety. Tours through our laboratories and facilities have been an exceptionally successful outreach activity because they provide visitors an accurate visual representation of the scope of the railway safety research being conducted at the UTCRS.

On Friday November 30th, 2015, the UTCRS research assistants provided two guided tours through their Hi-Bay research facilities at UTRGV Edinburg, TX. During the tours, the students explained the work being performed by the UTCRS and the significance of railway safety and transportation engineering for the community we serve. A total of **51 high school students** from two different high schools in Brownsville, TX were part of the visit.

On December 18th, 2016, UTCRS collaborating faculty and research assistants led a Hi-Bay research facilities tour

for a group of **13** professionals selected by the **four-county Rio Grande Valley Area Regional Chamber of Commerce** as part of the **“2015 RGV Leadership Program”** for emerging regional leaders. The visiting professionals were exposed to the field of transportation engineering and railway safety, as well as the ongoing research being conducted in the UTCRS laboratory and testing facilities, while emphasizing the national and international economic impacts and benefits of the UTCRS research.

UTCRS-UTRGV undergraduate, Yolanda Gonzalez, represented the UTCRS as part of a panel of judges for the 6th Annual District Science and Engineering Fair held at Michael E. Fossum Middle School on January 9th, 2016. Over **500 attendees** (K-12 students, parents, and ISD administrators) from McAllen, TX were present at this event.

On March 8th and 9th, 2016, UTCRS collaborating faculty and research assistants led tours through the UTCRS-UTRGV Hi-Bay laboratory facilities for **139** high school students from IDEA Quest Academy in Edinburg, TX. Visiting students learned about the field of transportation engineering with an emphasis on railway safety from UTCRS faculty and student researchers. **Forty five** 9th and 10th grade students participated in the first day of tours and **ninety four** 11th grade students attended the second day of tours.

UTCRS Highlights for October 1st, 2015 – March 31st, 2016

UTCRS-TAMU Graduate Student

In December 2015, UTCRS student researcher, Lisa Rachal, defended her Master of Science Thesis entitled *“Determination of Bent Cap and Stringer Deflections for Timber Railway Bridges Under Live Load.”* The research performed in Ms. Rachal’s thesis project provided critical field data for a UTCRS funded project entitled: *“Vehicle-Bourne Autonomous Railroad Bridge Impairment Detection Systems.”* The research addresses the instrumentation and analysis of timber railway bridges in order to assess the health of America’s aging timber bridge infrastructure.



2015 Student of the Year Honored in the Annual Winter CUTC Banquet

The UTCRS selected Ms. Gabriela Perales as their 2015 Student of the Year (SOY). Also, former UTCRS REU student Ana Guajardo was selected as 2015 SOY representing the Nebraska Transportation Center. Both students were honored at the Annual Winter CUTC Banquet (pictured here with USDOT Director of Research, Development, and Technology, Kevin Womack, Assistant Secretary of Transportation, Greg Winfree, and UTCRS Director, Constantine Tarawneh). Ms. Gabriela Perales, a 2014 UTCRS REU participant, is currently completing her Master’s degree at UTCRS consortium institution UNL. In February 2015, she published a study entitled *“Investigation of Relations between AIMS Shape Properties and VST Friction Values”* with UTCRS Faculty Collaborator Dr. Enad Mahmoud. She presented her work at the 2015 International Highway Engineering Experience Program conference and participated in a number of internships, including the 2014 UTCRS REU Program and a TxDOT internship. See: <http://www.utrgv.edu/railwaysafety/news/index.htm>



UTCRS Faculty and Students Honored during the 1st UTRGV National Engineers Week (E-Week) Banquet

UTRGV celebrated its first Engineers Week Banquet on February 25th, 2016 as part of the activities organized by the College of Engineering and Computer Science for National Engineers Week (E-Week). During the banquet, UTCRS research assistants Ms. Luz Sotelo and Mr. Joseph Montalvo received the Mechanical Engineering 2016 Outstanding Undergraduate and Graduate Student Awards, respectively. Additionally, UTCRS Director, Dr. Constantine Tarawneh, received the 2016 Outstanding Faculty Award for the Mechanical Engineering Department.



See: <http://www.utrgv.edu/railwaysafety/news/index.htm#item1>

UTCRS Education and Outreach program featured in local school district newsletter

The UTCRS was recognized in the La Joya Independent School District Newsletter 'El Noticiero' 2015-2016 Edition Issue 3 for partnerning with the Evangelina Garza Elementary 5th Grade Gifted and Talented Class to implement the UTCRS Railway Safety curriculum in their classroom. The UTCRS developed teaching modules were used to deliver 5th grade STEM concepts through hands-on activities that utilized the MagLev toolkits.

See: <http://lajoya.juiceboxinteract.netdna-cdn.com/wp-content/uploads/2016/02/Noticiero3.pdf> & <https://www.flickr.com/photos/131769328@N02/sets/72157664849830964>

What opportunities for training and professional development has the program provided?

UTCRS remains committed to developing a professionally trained transportation workforce by focusing on graduating a highly-skilled and experienced cadre of graduate and undergraduate students. Students hired as research assistants by the UTCRS are required to perform at the highest level of research competence and to develop and maintain a professional-level skill set required to succeed in day-to-day research operations. To ensure research assistants' responsibilities are being met, the UTRGV Railroad Research Group provides its research assistants with quarterly mandatory trainings in which the students learn to: (1) enforce safety operational protocols, (2) maintain testing equipment and facilities, (3) disassemble and assemble bearings and testing rigs, (4) design and fabricate testing fixtures, which includes machining, milling, welding, and constructing a variety of testing components, (5) perform periodic bearing teardowns and inspections, and (6) troubleshoot mechanical systems. During Spring 2016, the UTCRS conducted three mandatory trainings attended by all 2015-2016 UTCRS research assistants; namely: Data Acquisition and Analysis Training, provided by Dr. Constantine Tarawneh; Mechanical Sensors Training, provided by Dr. Constantine Tarawneh and Dr. Stephen Crown; and Bearing Test Rig Setup and Maintenance Procedures Training, provided by Dr. Constantine Tarawneh.

The UTCRS also continued their practice, adopted last reporting period, of holding a bi-weekly seminar series in which students presented research findings and progress. UTCRS Director, Dr. Constantine Tarawneh, and the faculty who have research projects funded through the center give students feedback and discuss future tasks to be completed during these meetings. This practice guarantees that work stays on schedule and progress and needs are being met, improves verbal communication skills, builds confidence, and addresses issues before problems arise. At the same time, undergraduate and graduate students involved in funded research are expected to help create a professional and encouraging environment of support and accountability. To ensure that all UTCRS students reach their fullest potential, they are asked to serve as primary mentors for new research assistants. In this way, students are responsible for passing down knowledge, skills, and work habits before transitioning research responsibilities to a successor. While preparing for the 2016 UTCRS Summer Camps, students were given leadership roles to represent the UTCRS in front of school district representatives, parents, and center partners in order to expose them to community engagement events.

Several research assistants who have been funded by the UTCRS for more than two semesters have participated in national conferences alongside professors with whom they collaborate. Supervising professors provide support, guidance, knowledge, and wisdom allowing students the opportunity to develop a professional network and become recognized by their future peers in the transportation industry. A recent success story in this area involves UTRGV graduate student, Oscar Rodriguez, who was the recipient of the 2016 ASME Scholarship that was awarded during the 2016 ASME Joint Rail Conference, held in Columbia, SC. Mr. Rodriguez presented a paper on his initial findings and results as part of his work on a UTCRS funded project. Furthermore, Ms. Luz Sotelo, a 2015 UTCRS REU student, received an Undergraduate Research Initiative scholarship to attend the same conference based on her work on another UTCRS funded project that investigates bearing condition monitoring techniques.

The UTCRS has placed student researchers in a leadership role by allowing them to represent the UTCRS in science fairs' judging panels, providing laboratory tours, presenting to K-12 students, interacting with high profile visitors during university and community engagement events (see education and outreach section). One example of students taking on leadership roles is a group of students from the UTRGV Curriculum and Instruction Department who participated as interns through the Uteach program collaboration. After being trained by the UTCRS faculty to implement the K-12 STEM curricula during the 2015 UTCRS Summer Camps, the group of students applied the UTCRS developed STEM lessons at a local elementary school classroom of **forty** 5th grade students.

How have you disseminated your results?

The progress and results of the 26 selected research projects funded by the UTCRS are published in the UTCRS website with further dissemination including academic publications, national and international conference presentations, local and national symposiums, UTC meetings, local community engagement and outreach events, and project poster presentations. The UTCRS also released a semi-annual newsletter to further disseminate results, news, and highlights of the center. This newsletter was distributed by email to all collaborating faculty, students, UTC counterparts, industry contacts and K-12 educators and program coordinators, and it will be posted on social media for the general public. The newsletter highlights specific project achievements, upcoming trainings and educational programs.

What do you plan to do during the next reporting period to accomplish the goals and objectives?

1. Implementation and completion of research activities as outlined in the table above for all research, education, workforce development, and technology transfer projects.
2. Finalize the 3rd round of the 2015CY Call of Proposals to select the UNL projects.
3. Update the UTCRS website to reflect new progress and upload the final reports of completed research projects. Additional tabs and resources added will be maintained on a weekly basis to disseminate student opportunities.
4. Increase the UTCRS visibility and social media presence for greater dissemination, specifically to the professional transportation workforce.
5. Continue weekly conference calls with consortium Associate Directors and administrative staff to ensure an on-schedule and timely completion of all the UTCRS planned activities.
6. Continue the bi-weekly research meetings between faculty and student research assistants to address UTCRS goals and objectives, and identify tasks needed to meet project deliverables.
7. Continue to develop student experience and leadership skills through mentoring and engagement in scholarly work with the UTCRS faculty.
8. Successfully run the 2016 UTCR Summer Camps for elementary, middle, and high school students.
9. Successfully run the Transportation in the Classroom K-12 STEM Teacher National Workshop.
10. Keep promoting UTCRS STEM Curricula to be implemented in local, state, and national classrooms.
11. UTCRS Program Coordinators from the partner institutions will continue to organize and work on key activities, such as updating the UTCRS program projects within the TRB database in preparation for the semi-annual reporting.
12. Devise a student tracking system to follow the academic and professional careers of students participating in UTCRS programs and activities in order to measure longitudinal impact.
13. Continue to leverage the partnership with the local independent school districts and the community at large to grow our existing outreach and educational programs and develop new ones that are aimed at year-around community engagement efforts.

2. PRODUCTS:

Publications, conference papers, and presentations:

The UTCRS sponsored projects have resulted in a number of journal, symposium, and conference publications and presentations in relevant national and international arenas, as follows:

1. **Martinez T.** Modeling the Residual Useful Life of Bearing Grease. Master's Thesis, University of Texas Rio Grande Valley, December 2015.
2. **Rachal, L.** Determination of Bent Cap and Stringer Deflections for Timber Railway Brides under Live Load. Master's Thesis, Texas A&M University, December 2015.
3. **Tarawneh, C., Sotelo, L., De Los Santos, N., Villarreal, A., Lechtenberg, R., and Jones, R.** Temperature Profiles of Railroad Tapered Bearings with Defective Inner and Outer Rings. *Proceedings of the 2016 ASME Joint Rail Conference*, Columbia, SC, April 12-15, 2016.
4. **Rodriguez, O., Carbone, J., Fuentes, A., Tarawneh, C., and Jones, R.** Heat Generation in the Railroad Bearing Thermoplastic Elastomer Suspension Element. *Proceedings of the 2016 ASME Joint Rail Conference*, Columbia, SC, April 12-15, 2016.
5. Wilson, B. M., Fuller, A. J., **Tarawneh, C.**, and Turner, J. A. Near Race Inclusions in Bearing Components and the Resultant Effect on Fatigue Initiation and Component Life. *Proceedings of the 2016 Conference on Railway Excellence (CORE)*, Melbourne, Australia, May 16-18, 2016.
6. **Chapman, A.,** Fleming, M., Walls, L., Garza, A., Hinojosa, L., Hernandez, M., Palomino, E., Rodriguez, F., Zarinana, C., Rojas, E., and Rojas, J. A Critical Examination of Social, Cultural, and Gender Research in Science Education. Presentation at the *2016 Annual Meeting of National Association for Research in Science Teaching*, Baltimore, MD, April 14-17, 2016.
7. **Villarreal, A., Ontiveros, M., Tarawneh, C., and Jones, R.** Conductive Polymer Nano-Composites for Rail Suspension Applications. Presentation at the *2nd Annual UTC Safety Summit*, Washington, D.C., March 30-31, 2016.
8. **Tarawneh, C.** University Transportation Center for Railway Safety (UTCRS) Activities. Presentation at the *2nd Annual UTC Safety Summit*, Washington, D.C., March 30-31, 2016.

UTCRS faculty participated in the following transportation related professional committees:

1. **Fry, G.** *Railway Working Technology Committee*. Technical Committee Member. October 19-20, 2015.
2. **Fry, G.** *AISC Partners in Education*. Technical Committee Member. October 27, 2015.
3. **Fry, G.** *Committee 15 and Committee 7: Steel Structures AREMA*. Technical Committee Member. February 2-3, 2016.
4. **Fry, G.** *Technology Outreach Program Committee*. Transportation Technology Center, Inc. (TTCI) Technical Committee Member.
5. **Fry, G.** *Association of American Railroads Annual Research Review*. March 28-30, 2016.

Website or other Internet Material:

The UTCRS website, hosted by UTRGV, underwent a complete renovation during this reporting period (<http://railwaysafety.utrgv.edu>) to reflect the full spectrum of research, outreach activities, trainings, and student opportunities and programs available at UTCRS. The new UTCRS website structure remains an excellent resource for individuals and organizations from the transportation industry searching for information about current railway research projects and products, technology and techniques, and workforce development opportunities. At the same time, the addition of tabs such as “News and Events”, “Student Opportunities”, “Community Outreach” and “About Us” provide website visitors with information about the UTCRS and the transportation industry, upcoming trainings, and opportunities to become involved in transportation engineering and railway safety. Educators, parents, and students

using UTCRS's educational resources, looking for age appropriate STEM programs, and engaging in the UTCRS community outreach efforts can use these new tabs to find in-depth information on available resources. The UTCRS research, workforce development, technology transfer, and community outreach tabs provide exhaustive descriptions for visitors looking for publications and trainings related to railway safety. In addition to the changes, the UTCRS opened its doors for educational tours for the community at large. Visitors can now schedule tours online to see these facilities and learn about the research being performed by the UTRGV Railroad Research Group. Undergraduate and graduate UTCRS research assistants guide the tours and provide answers to questions related to the ongoing research projects and their experience being a part of the UTCRS. The research assistants are excited to inspire the younger generation of students who are considering careers in Transportation Engineering and STEM fields. Tours are free of charge and available for any group size.

The UTCRS website received a total of 1,820 page visits per month with an average of 1 minute 48 seconds view time per visit during this reporting period. Our educational programs received most of the page visits during this reporting period: Summer Camps (27%), REU (16%) and RET (12%). A student, funded by the UTCRS and UTRGV, is currently working exclusively on updating and improving the UTCRS website on a weekly basis. The goal is to have a repository of photo galleries and videos of the various educational, ongoing research projects, workforce development, technology transfer, and outreach activities that carefully document the UTCRS operations and activities over the past three years.

Technologies or techniques:

One of the major goals of the University Transportation Center for Railway Safety (UTCRS) is to increase the railway reliability by, among other things, developing advanced technology for infrastructure monitoring and developing innovative safety assessments and decision-making tools. UTCRS-TAMU graduate assistant Lisa Rachal defended her Master's thesis entitled "*Determination of Bent Cap and Stringer Deflections for Timber Railway Bridges Under Live Load*" in Fall 2015. The research addresses the instrumentation and analysis of timber railway bridges in order to assess the health of America's aging timber bridge infrastructure. The work involved collecting valuable field data for the UTCRS sponsored project "*Vehicle-Borne Autonomous Railroad Bridge Impairment Detection Systems*." The main goal of her thesis work was to obtain and analyze bent cap and stringer deflections of a timber railway bridge under live load. The analysis of the data provides a better understanding of how aging bent caps and stringers behave while in service. The acquired data and results provide a greater understanding of timber bridges in service, and can be used to address the issue of inspection and maintenance on the thousands of aging timber bridges in the U.S. railroad network, resulting in better safety evaluations for the railroad industry.

Moreover, UTCRS-UTRGV graduate student Thania Martinez defended her Master's thesis entitled "*Modeling the Residual Useful Life of Bearing Grease*" in Fall 2015. The work involved utilizing mechanistic or first principle modeling techniques based upon process kinetics and empirical models including physics-based reliability models, non-linear regression and neural networks. The research resulted in the development of an analytical model that provides users the ability to predict the residual life of railroad bearing grease based upon operational characteristics. The latter will enhance the ability of railroad engineers to safely predict and schedule proper bearing maintenance and refurbishing cycles.

Inventions, patent applications, and/or licenses:

Nothing to report at this time.

Other products:

UTCRS faculty and staff led by the center’s educational coordinator working alongside teachers participating in the UTCRS Research Experience for Teachers (RET) Program produced comprehensive K-12 curricula which can be implemented in formal and informal learning environments. Lessons from the UTCRS Curricula can be easily incorporated into STEM classrooms, homeschool lessons, or as individual activities in STEM or afterschool programs. The curricula learning objectives have been aligned with the National and Texas Essential Knowledge and Skills (TEKS) to simplify and encourage implementation. The goal of this product is to educate students on real-life transportation issues and opportunities, while engaging them with STEM concepts. In October 2015, the UTCRS Curricula was made available to former RET participants and staff who had been trained to implement these modules during the 2014 and 2015 summer teacher workshops. Within the first three months of making the UTCRS Curricula available, they have already been implemented in five classrooms in four different school districts with 208 students.

One such implementation was accomplished by Ms. Teresa Ochoa (2015 UTCRS RET Program participant) who applied the UTCRS elementary curriculum as a full Gifted and Talented (GT) 5th grade learning unit. Ms. Ochoa prepared students with 10 lessons previous to implementing the curriculum to build a foundation of STEM knowledge within the classroom. After building base knowledge, Ms. Ochoa borrowed the educational toolkits from the UTCRS and implemented the hands-on curriculum activities. Students learned about Newtonian Physics, the history of the transcontinental railroad, the engineering design research process, transportation industry and careers in transportation engineering, and railway safety. After the GT program ended, the students were required to deliver presentations about railroad systems to attendees of a parent night public assembly. Students also presented their personal experience on working with UTCRS-UTRGV lessons. Ms. Ochoa’s initiative and efforts to apply the UTCRS curriculum to teach students STEM objectives with real-life railway safety scenarios have been recognized by her home school district, La Joya ISD. Her district has now assigned her to develop a semester long unit based on the UTCRS lessons in order to teach GT STEM learning objectives. She has also been assigned to supervise all the teachers of the entire La Joya ISD 5th grade GT program who chose to implement the UTCRS elementary curriculum lessons she will develop.

See: <https://www.flickr.com/photos/131769328@N02/sets/72157664891671913>

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS:**What individuals, organizations, or collaborators have worked on the program?**

During the current reporting period, the following individuals, organizations, and collaborators listed below have been an integral part of the various research, education, workforce development, technology transfer, and outreach activities of the UTCRS.

NAME	ORGANIZATION NAME	RELATION	GENDER
State			
Acton, Jessica	Texas Higher Education Coordinating Board (THECB)	Education	Female
Crown, Stephen, PhD	Director of UTRGV Texas Pre-Freshman Program (TexPrep)	Education	Male
Nayeli Parra	Texas Department of Transportation (TxDOT)	Governmental	Female
Local			
Dr. Roni Rentfro	Brownsville ISD	Community	Female
Dr. Alma Benavides	La Joya ISD	Community	Female
Kelly Watson	Donna ISD	Community	Male
Sandra Tovar	Harlingen CISD	Community	Female
Cynthia Torres	La Feria ISD	Community	Female

Wendy Grouler	McAllen ISD	Community	Female
Dr. Sharon Roberts	Mission CISD	Community	Female
Dr. Daniel P. King	PSJA ISD	Community	Male
Dr. Maria Leo	Sharyland ISD	Community	Female
Ana Castro	South Texas ISD	Community	Female
Dr. Nora V. Casarez	BETA	Community	Female
Ramiro Balderas	Valley View ISD	Community	Male
Robert L. Ramirez	Vanguard Academy	Community	Female
Jorge Chipres	IDEA ISD	Community	Male
Joseph Villarreal	Los Fresnos ISD	Community	Male
Brenda DeHoyos	Hidalgo ISD	Community	Female
Ana Zepeda	Monte Alto ISD	Community	Female
Sister Cindy Mello	Catholic Diocese of Brownsville School District	Community	Female
Sarah Leal-Mendez	RGV Homeschool Cooperative Resource	Community	Female
Molly Mejia	Boyscouts of America	Community	Female
Benitez, Andres	2014 and 2015 RET Program Participant - Sharyland ISD	District Level	Male
Camargo, Angela	2015 RET Program Participant - McAllen ISD	District Level	Female
Ochoa, Teresa	2015 RET Program Participant - La Joya ISD	District Level	Female
Private			
Wilson, Brent, PhD	Director of Research and Development, Amsted Rail	Advisory Board	Male
Connell, David	Vice President – Engineering Union Pacific Railroad Co.	Advisory Board	Male
Kalay, Semih	Vice President – Research and Development, Transportation Technology Center, Inc. (TTCI)	Advisory Board	Male
Staplin, David	Deputy Chief Engineer – Amtrak	Advisory Board	Male
Consortium			
Tarawneh, Constantine, PhD	UTCRC – Director Professor, Mechanical Engineering, UTRGV 1201 West University Drive, Edinburg, TX 78539-2999	Researcher/ Executive Committee	Male
Fry, Gary, PhD, PE	UTCRC – TAMU Associate Director Associate Professor, Civil Engineering, TAMU 3135 TAMU, College Station, TX 77843-3135	Researcher/ Executive Committee	Male
Rilett, Laurence, PhD, PE	UTCRC – UNL Associate Director Professor, Civil Engineering, UNL 262D Whittier Research Center P.O. Box 830851, Lincoln, NE 68583-0851	Researcher/ Executive Committee	Male
Freeman, Robert, PhD	UTCRC – UTRGV Associate Director Professor and Chair, Mechanical Engineering, UTRGV	Executive Committee	Male
Lawrence-Fowler, Wendy, PhD	UTCRC – Diversity Coordinator Professor, Computer Science, UTRGV	Executive Committee	Female
Chapman, Angela, PhD	UTCRC – Education Coordinator Assistant Professor, Curriculum & Instruction, UTRGV	Researcher/ Executive Committee	Female
Garcia, Citlalli, MAIS	UTCRC – UTRGV Sr. Program Coordinator	Staff	Female
Pena, Melissa Iliana	UTCRC – UTRGV Program Assistant	Staff	Female
Dove, Russell	Web Designer II, Internet Services, UTRGV	Institutional	Male
White, Amy	Program Coordinator, Center for Railway Research, Texas A&M Transportation Institute (TTI)	Staff	Female
Thandayithabani, Laviania, MBA	Assistant Director of Operations, UNL 262D Whittier Research Center, Lincoln, NE 68583-0851	Staff	Female
Foltz, Heinrich, PhD, PE	Professor and Chair, Electrical Engineering, UTRGV	Researcher	Male

Fuentes, Arturo, PhD	Professor, Mechanical Engineering, UTRGV	Researcher	Male
Jones, Robert, PhD	Professor, Mechanical Engineering, UTRGV	Researcher	Male
Mahmoud, Enad, PhD	Assistant Professor, Civil Engineering, UTRGV	Institutional	Male
Hurlebaus, Stefan, PhD	Civil Engineering, TAMU	Researcher	Male
Briaud, Jean-Louis, PhD	Civil Engineering, TAMU	Researcher	Male
Khattak, Aemal, PhD	Civil Engineering, UNL	Researcher	Male
Villalobos, Cristina, PhD	Director – UTRGV C-STEM Center	Center	Female
Lozano, Karen, PhD	Director – UTRGV Nano Materials Center	Center	Female
Kurts, Jaime, PhD	Co-director, UTRGV Uteach Program	Institutional	Male
Contreras, Robert, PhD	Co-director, UTRGV Uteach Program	Institutional	Male
Maldonado, Theresa, PhD	VP for Research, Innovation, and Economic Development, UTRGV	Institutional	Female
Gonzales, Veronica	VP for Governmental and Community Relations, UTRGV	Institutional	Female
Garza, Barbara	Director, Office of P-16 Initiatives, UTRGV	Institutional	Female
Aranda, James	Society of Automotive Engineers (SAE)	Institutional	Male
Villarreal, Domingo	MiniBaja Student Organization (SAE)	Institutional	Male
Belmares, Milagros	Society of Women Engineers (SWE)	Institutional	Female
Ortega, Gabby	Society of Hispanic Professional Engineers (SHPE)	Institutional	Female
Salazar, John	American Society of Mechanical Engineers (ASME)	Institutional	Male
Pruneda, Ana	American Society of Civil Engineers (ASCE)	Institutional	Female

4. IMPACT:

What is the impact on the development of the principal discipline(s) of the program?

The UTCRS is able to report various indicators of impact, including:

- A clear pathway to graduate studies between the three consortium institutions has been established providing students with several options to pursue their postgraduate studies on mechanical, operations, and infrastructure railway research. The seven REU Program participants that will be traveling to TAMU this summer will be taking an online GRE preparation course during their stay in order to empower them to apply to graduate programs, and pursue transportation related master's degrees. Since 2014, there are eight UTRGV students who participated in the UTCRS REU program that currently pursuing their master's degree in the consortium institutions working on railway research. These students come from mechanical and civil engineering departments, and this year, two students from computer engineering have been selected to participate in the 2016 REU Program; a fact that demonstrates the impact of the UTCRS on several engineering programs.
- The UTCRS has been successful in attracting a large percentage of minorities, typically underrepresented in transportation engineering fields, to the discipline. These groups are receiving rigorous hands-on training through active engagement in railway safety research applications that are vital for the railroad industry.
- Training of a critical mass of engineering students on hands-on skills that include welding, machining, design specifications, assembly, and the use of hydraulic machinery.
- Six graduate and six undergraduate students have gained valuable technical writing and oral presentation experience by co-authoring paper publications, writing and defending theses, and presenting at national and international conferences relevant to the rail transportation industry.
- Students also gained experience in using complex mathematical and statistical modeling and state-of-art engineering software tools and packages such as SolidWorks, Algor, MatLab and Labview.

- The success of the UTCRS REU Program has highlighted the need for a Master's Program in Civil Engineering at UTRGV. Currently, the Civil Engineering Department at UTRGV is putting together a proposal to establish a Master's of Science in Civil Engineering Program with an emphasis on transportation. The department has made offers to two faculty with expertise in transportation.

What is the impact on other disciplines?

The UTCRS continues to emphasize the interdisciplinary nature of the transportation industry in all research and educational programs the center develops. To this end, the UTCRS activities are developed as college and university wide initiatives rather than a single department or unit. Hence, the UTCRS activities span across the mechanical, electrical, civil, manufacturing, computer engineering, and computer science from the college of engineering and computer science, as well as the department of curriculum and instruction from the college of education and P-16 integration. Faculty, staff, and students from these different disciplines are working in unison towards promoting transportation engineering, improving railway safety, and raising awareness and interest in the transportation field.

One of the most significant impacts the UTCRS had on other disciplines has been in the field of STEM education. The UTCRS and the College of Education and P-16 Integration at UTRGV have been working on researching techniques to improve retention of underrepresented groups, in the Rio Grande Valley, in STEM fields and careers. Findings of this ongoing study have been presented at the National Association for Research in Science Teaching (NARST), and particular approaches resulting from the research were introduced in the UTCRS STEM Curricula. UTRGV Uteach program interns are now implementing the UTCRS curricula, testing the different methods for teaching STEM in classroom settings, and collecting data on the effectiveness of teaching techniques being proposed by their research to improve retention of underrepresented groups in STEM fields and careers. The benefits of the pedagogical approaches being studied have already been observed in classrooms and school districts of former RET participants who implemented the UTCRS curricula. The teaching approaches utilized in the UTCRS STEM Curricula have demonstrated promise in influencing underrepresented minority populations of students to consider careers in engineering and the transportation industry. UTCRS has also recorded an increase in the number of participants from years 2014 and 2015 UTCRS Summer Camps reapplying to be part of the 2016 UTCRS Summer Camps making them second time and, in some cases, third time participants, which demonstrates continued interest and engagement.

What is the impact on the development of transportation workforce development?

Since its inception in the fall of 2013, the UTCRS has engaged over 120 undergraduate and graduate students in its various research, education, technology transfer, professional development, and community outreach activities. These students are mentored by a team of highly qualified and dedicated faculty that is committed to provide a well-rounded education and research experience in the transportation engineering field. Students develop valuable skill-sets through hands-on projects relevant to the railroad industry, co-authorship of journal and conference papers, presentation at local and national symposiums and conferences, and writing theses and dissertations.

One example of the UTCRS workforce development efforts is the training and expertise that Ms. Lisa Rachal, a UTCRS-TAMU graduate student, received while working on her master's thesis in structural engineering entitled "*Determination of Bent Cap and Stringer Deflections for Timber Railway Bridges under Live Load,*" which she defended in December 2015. The analysis of the data gave Ms. Rachal a better understanding of how aging bent caps and stringers behave while in service. Her data is leading railway safety structural research closer to address the issue of inspection and maintenance needed on the thousands of aging timber bridges in the U.S. railroad network, resulting in better safety evaluations.

In addition to developing well-rounded transportation engineering workforce skills in research students, the UTCRS educates and provides development opportunities for a largely Hispanic student population that is statistically underrepresented in the professional transportation field (as reported by the Department of Labor Statistics of 2014). Moreover, of the 120 UTCRS students that were engaged in the various center activities, 35% of them are female, which more than doubles the national average of 15.7% female in Professional Transportation and Materials Moving Occupations. In fact, six of the eight UTCRS REU participants who are now pursuing their master's degrees in transportation engineering fields are females who were not previously considering pursuing their graduate education.

The UTCRS K-12 education outreach and workforce development efforts are led by a dedicated group of faculty comprised of members from the UTRGV College of Education and P-16 Integration, in collaboration with the various engineering programs involved in the Center (mechanical, civil, electrical, manufacturing, computer engineering, and computer science). This group has facilitated a number of hands-on STEM workshops for educators, offered to develop the skill-sets required to teach transportation engineering concepts in their classroom, and to expose educators to the use of appropriate pedagogy to engage students in STEM fields. The UTCRS has been diligently working on planning and recruitment of attendees for its First Annual Transportation in the STEM Classroom K-12 Teacher National Workshop. This two-day STEM Teaching Workshop will take place on June 2-3, 2016 at UTRGV, and will provide hands-on training to 100+ teachers, program coordinators, counselors, and administrators on how to implement the UTCRS Curricula in diverse educational settings. The UTCRS STEM Curricula offered in this workshop contains complete lesson plans based on state and national science standards. Attendees will learn how to implement all levels (elementary, middle, and high school) of the UTCRS curricula to enable them to deliver age-appropriate STEM concepts, related to transportation engineering with an emphasis on railway safety, in their classrooms.

What is the impact on physical, institutional, and information resources at the university or other partner institutions?

The community outreach activities of the UTCRS have strengthened institutional collaborations between UTRGV and more than **26** school districts that collaborated with the UTCRS in the organization of the 2016 Railway Safety Summer Camps. Of particular importance is the establishment of interlocal cooperation contract agreements between UTRGV and the school districts that will facilitate the partnership on current and future education and workforce development initiatives. In addition to the local school districts, the UTCRS established collaborations among UTRGV, the Boy Scouts of America, and the RGV Homeschool Cooperative Resource Organization who will be participating in the 2016 UTCRS Summer Camps for the first time. These community collaborations have brought recognition in the community, and guaranteed the participation of over 1250 K-12 students and 100+ teachers in the 2016 Summer Camps. The UTCRS outreach efforts and educational programs are well-aligned with UTRGV's institutional mission and educational goals of encouraging K-12 students to attend college and pursue degrees and careers in STEM fields.

The advanced research conducted by the UTCRS has generated national and international institutional visibility for the three consortium universities. In particular, UTRGV has benefited from the high-caliber publications produced by the UTCRS, as well as the national and international exposure of its research in conferences. The aforementioned is in-line with the overall institutional research goal of becoming a Tier 1 Research Institution. Furthermore, the effective collaboration among the consortium institutions has provided students accessibility to resources available at all three institutions. Through the UTCRS REU Program, the consortium has facilitated pathways for undergraduate and graduate students from

UTRGV to enroll in graduate and doctoral programs with strong emphasis on transportation engineering. This reporting period, four more REU participants have enrolled in graduate programs at all three consortium institutions; a trend that will persist as more students participate in the REU program.

What is the impact on technology transfer?

Technology transfer activities include publication of theses and research papers, presentations at conferences, trainings, field testing, and deployment. For this reporting period, the UTCRS technology transfer activities included two theses, four conference papers, two research symposiums, and six professional presentations. Moreover, as part of a project funded through the 2015CY call for proposals, UTCRS researchers designed and implemented a unique system that can be used to assess the efficacy and accuracy of the current wayside thermal detector systems employed in our rail network. Since it is not feasible to have the railroad bearing pass over the infrared thermal detector at speeds of 30-35 mph in a laboratory setting, UTCRS researchers devised a fully-automated pneumatic system that allows the infrared thermal detector to sweep underneath the bearing at speeds that can range anywhere from 5 to 35 mph. The focus of this study is to quantify the accuracy and limitations of the current wayside thermal detectors, and identify ways to optimize their use in field service.

What is the impact on society beyond science and technology?

The UTCRS serves a population that is 90% Hispanic, of which approximately 85% are of Mexican descent, and 50% earn incomes that are significantly below the state average. The UTCRS outreach efforts in the Rio Grande Valley (RGV) have facilitated many opportunities for the community that will otherwise not be possible. The UTCRS Summer Camps are the only elementary camps in the RGV that promote and raise awareness about the need to go to college. Through the strong collaborative partnership that has been established between the UTCRS and the local school districts, these educational summer camps are available to students at no charge to them, thus, affording them the same opportunities as those available to students whose parents are not financially challenged. The impact of these camps becomes apparent when considering that more than 60% of parents in the RGV did not attend college, and that these camps are the first exposure to a university setting for their kids. Moreover, the UTCRS offers the necessary teaching tools, experiences, trainings, and professional development opportunities to K-12 students and teachers at no cost to them, which, in some cases, is the only way that some of the poorer school districts can afford these experiences for their students and teachers. Most teachers involved in the UTCRS RET Program have been able to improve their professional careers through the work experience they gained by working with UTCRS faculty and Staff.

Finally, an estimated 5,000 community members have been made aware of the work and importance of the USDOT and the transportation fields in their society. The UTCRS has highlighted the initiatives and goals of the USDOT UTC Program, and the need to keep developing the talent that will feed into the various transportation fields, especially among underrepresented groups. Videos and photographs highlighting the various UTCRS activities during this reporting period can be found at:

Community Outreach: <http://www.utrgv.edu/railwaysafety/education/community/index.htm>

News and Events: <http://www.utrgv.edu/railwaysafety/news/index.htm>

Visitor Information: <http://www.utrgv.edu/railwaysafety/about/visitor/index.htm>

5. CHANGES/PROBLEMS:

Website has undergone changes due to institutional changes in UTRGV. Nothing else to report.

6. SPECIAL REPORTING REQUIREMENTS:

Nothing to report.