FTA Standards Research Program – Statement of Work: Mitigations for Trespasser and Suicide Fatalities and Injuries

Introduction

FTA entered into a Cooperative Agreement with the University of South Florida and its Center for Transit Research (CUTR) to develop a Safety Standards Strategic Plan to identify areas of transit safety risk within the industry, inventory existing transit safety standards, inventory other adaptable industry standards, and establish focus areas for further research to support FTA's Standards Development Program (SDP). Through the SDP, research and background studies are being performed on safety critical emphasis areas to collect the information necessary to support the adoption of transit standards through rulemaking activities, identify and adopt voluntary standards in cooperation and coordination with standard development organizations, and provide guidance or recommended practices to the industry on measures and processes that may be instituted to improve public transit safety.

Background

In response to the Moving Ahead for Progress in the 21st Century (MAP-21) Act and its successor, the Fixing America's Surface Transportation (FAST) Act, Federal Transit Administration (FTA) established the Safety Management Systems (SMS) framework as the basis for their National Public Transportation Safety Program. Key aspects of this framework include building on existing safety foundations to detect and correct safety problems earlier and analyzing safety data in a holistic manner to ensure resources are applied effectively to mitigate risks. One such risk that the transit industry is facing is the growing problem with the number of trespassing events occurring on many transit and commuter rail systems throughout the United States. Trespassers are at great risk for being struck and severely hurt or fatally injured due to the speed and frequency of trains in the locations where many of the trespassing events occur.

However, trespasser fatalities and injuries are not limited to transit rail operations. The National Transportation Safety Board (NTSB) recognized the dangers associated with passenger and freight rail trespassers and issued numerous recommendations to the Federal Railroad Administration (FRA) dating back to 1972. FRA tracked trespasser deaths and injuries for many years and since 2009, there has been marked increases in trespasser fatalities and injuries, not just at railroad crossings, but also along rail corridors. Trespassing on railroad property is the leading cause of all rail-related deaths in the United States. More people are struck and fatally injured by trains while trespassing (illegally entering or remaining on a railroad Right-Of-Way (ROW)) than in motor vehicle collisions with trains at highway-rail grade crossings. Between 2012 and 2017, the annual number of trespass-related pedestrian fatalities increased 18 percent, from 725 in 2012 to 858 in 2017.[1] From January 1 through September 2018, there were 783 pedestrian trespass fatalities reported to FRA. Data indicate that the number of trespassing occurrences on railroad property each year far exceeds the number of fatalities and injuries. This raises the serious concern of the greater potential for even more trespasser accidents and stands as a point of reference for rail transit systems.

While trespasser and suicide safety related events are the focus of this study. It is also important to recognize that there are security elements related to trespassers that pose a significant concern for rail

[1] https://safetydata.fra.dot.gov, accessed February 5, 2019.

systems. Passenger rail systems are vulnerable to terrorist acts because they are openly accessible and offer confined environments with large numbers of passengers. IEDs activated aboard a train, in a station, or on a platform can lead to mass fatalities from explosive concussion, fire/smoke, and/or chemical/biological agent release. This presents a rail industry security risk and security issues may be a point of future consideration and research. While security enhancement is not within the specific scope of work, CUTR will identify prevention programs and technologies that are complementary to both security enhancement and trespasser/suicide prevention.

Project Objectives

CUTR will conduct this research in accordance with the Standards Development and Assistance Program Cooperative Agreement, the tasks defined in this section, and in cooperation with FTA's Research, Demonstration, and Innovation and Transit Safety Oversight offices. Primary objectives are as follows:

- Present rail transit (heavy and light rail) trespasser and suicide mitigations research results
- Present freight and commuter rail trespasser and suicide mitigations research results
- Present industry lessons learned/model practices about successful trespasser and suicide reduction measures, including those that demonstrate coordination with local mental health agencies and community associations, and awareness training for agency personnel, as examples
- Identify current and possible future technology applications that are or may be utilized to address trespassers and suicides including both passive and active intrusion detection technologies and video behavior analytic technologies
- Present the trespasser research results or demonstrations/pilot projects that were instituted to address transit security risks

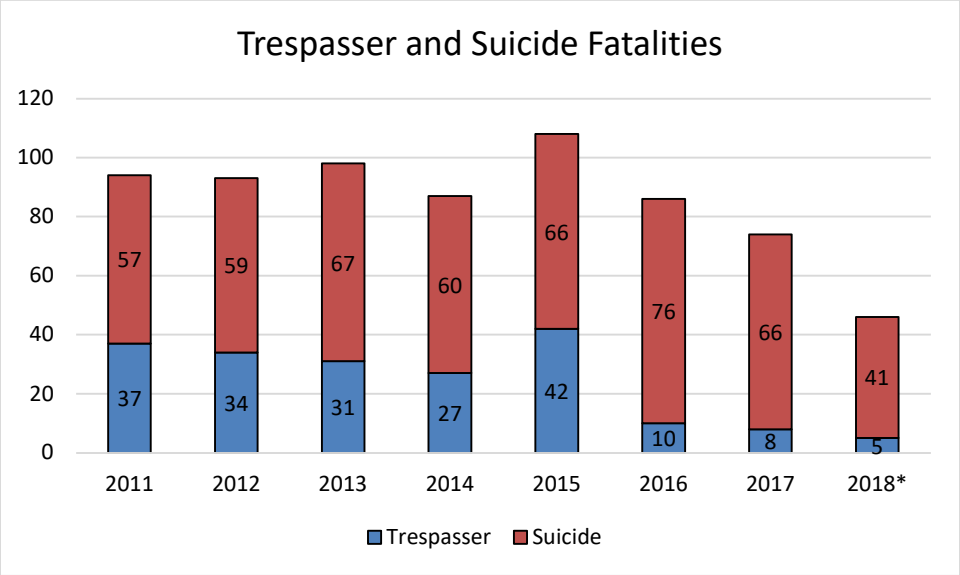
Task 1: Event Examination and Literature Review

The CUTR research team will initially examine the prevalence of trespasser and suicide events with the public transportation industry, and will focus on those events that occurred in rail transit[2] (heavy rail, light rail, and streetcar). A summary of occurrences is provided in the following section. The research team will review NTD reported entries for those events summarized below and will examine the incidents that occurred at case study and possibly other locations (described below).

Since 2008, NTD no longer exclusively uses the term "trespasser" as a classification of person type. Rather, there are additional person types describe trespassing behavior such as pedestrian not in crossing, pedestrian crossing tracks, and pedestrian walking along tracks. For this analysis, pedestrians not in road crossings, crossing the track, and walking along track are considered "trespassers." Additionally, NTD reporters can label person descriptions as "other" with explanatory information like suicidal behavior (such as laying on the tracks). Pedestrians using the crosswalk are not considered trespassers, and bicyclists are not considered trespassers either. Any mention of trespassing in the various "drop-down" menus from NTD will also be included in the review. Suicide is a separate classification, attempted suicides are classified as suicides resulting in non-fatal injuries, and those suicide attempts that result in death are classified as fatalities.

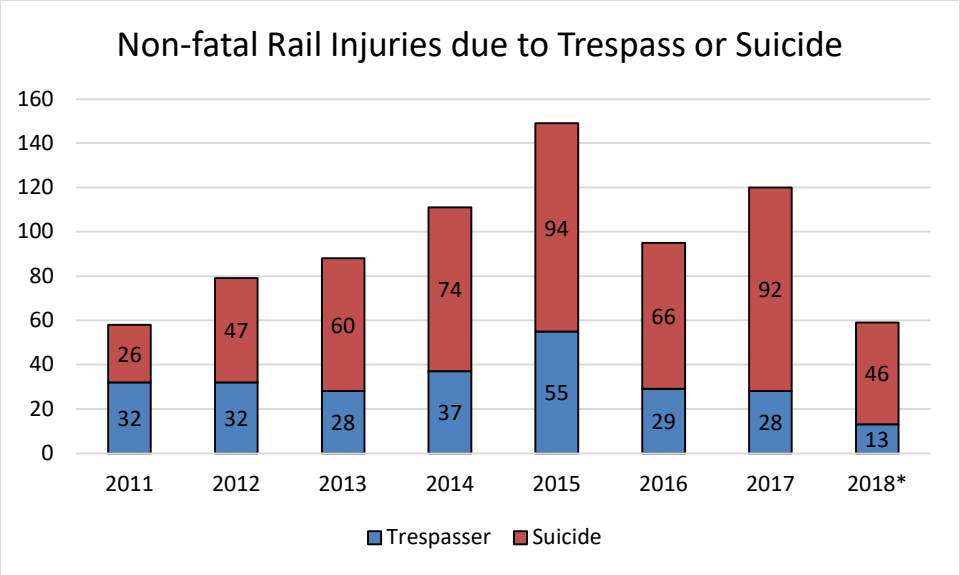
[2] For the purpose of this study, "rail transit" includes heavy rail, streetcar, and light rail. It does not include data for systems operating commuter rail.

Between January 1, 2011 and September 7, 2018, there were 492 rail transit (heavy rail, streetcar, and light rail) fatalities due to suicide, which accounted for 53% of all rail collision related fatalities. The annual number of suicides during this period ranged from 57 to 76 suicide fatalities. During this same time, there were 194 fatalities to pedestrians not in a crossing, walking along the tracks, crossing the tracks, or trespassing. Fatalities due to trespassing and suicide combined account for 73% of all rail collision fatalities between 2011 and August 2018.

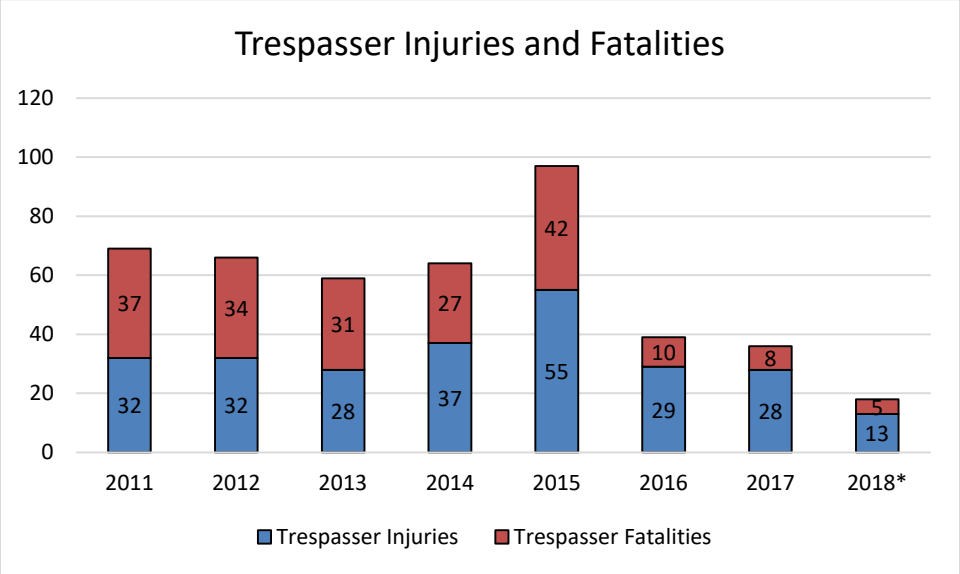


*Source: NTD - data available from January 1, 2011 through September 7, 2018

Between January 1, 2011 and September 7, 2018, there were 505 non-fatal rail injuries sustained due to attempted suicide, and 254 injuries sustained by pedestrians not in a crossing, walking along the tracks, crossing the tracks, or some other form of trespassing. Other forms of trespass include lying on tracks, sleeping on tracks, standing on tracks, and suspected trespass events as defined in the person description. Attempted suicides and trespassing events accounted for 759 non-fatal injuries sustained from 2011 to 2018, which is 18% of all transit rail collision-related injuries.



Source: NTD



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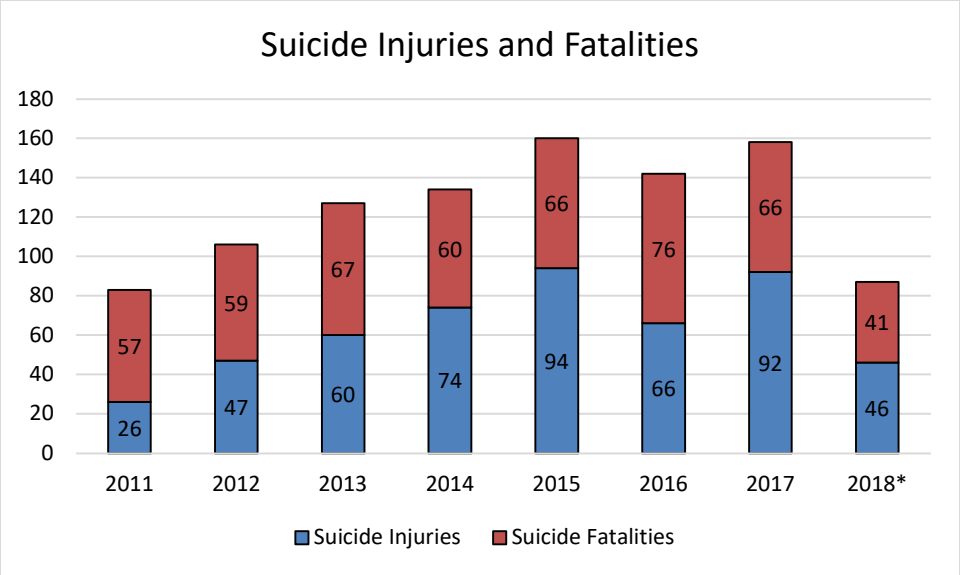
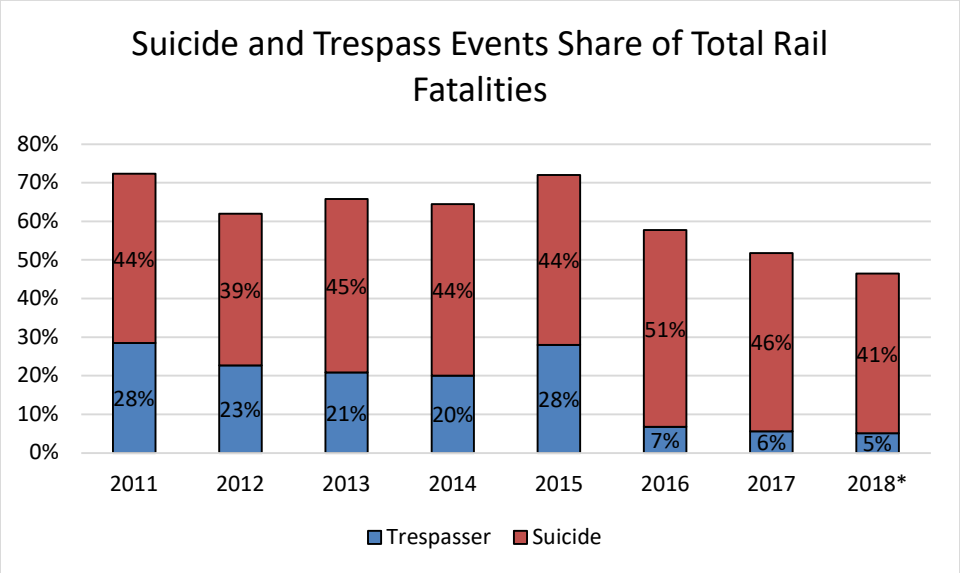
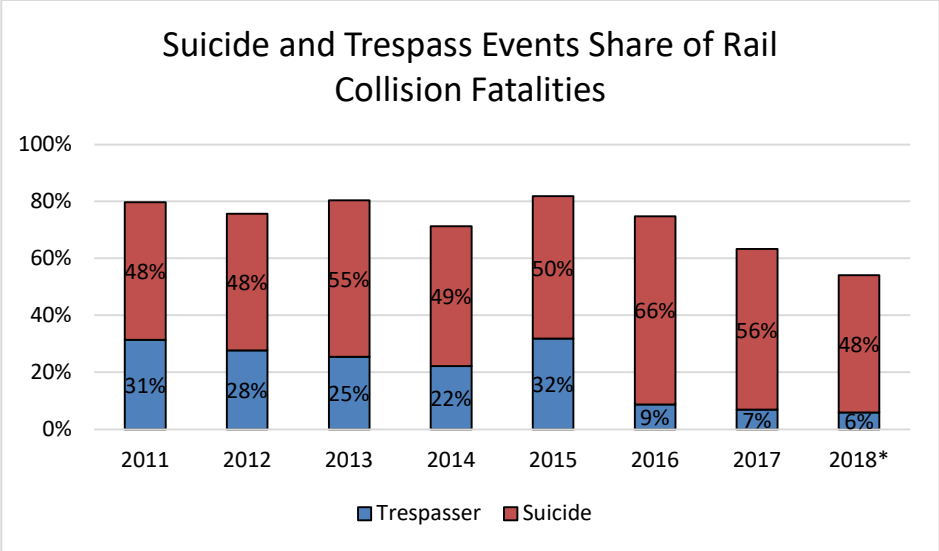


Source: NTD

Suicides accounted for at least 39% of all annual rail fatalities, and at least 48% of all annual collision related rail fatalities from 2011 to September 7, 2018. In 2016, suicides accounted for 66% of all rail collision fatalities.

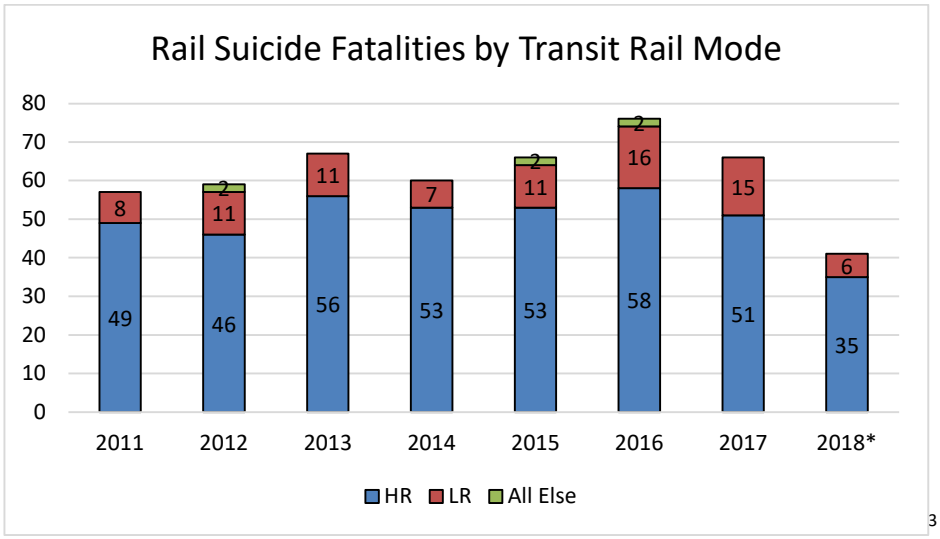


Source: NTD



Source: NTD

Suicides in heavy rail transit (e.g., subways) is a more prevalent occurrence than in any other rail or non-rail transit mode. In 2016, there were 57 suicide fatalities sustained on heavy rail transit, the highest annual suicide fatalities between 2011 and May 2017. The recent peak for light rail also occurred in 2016, with 15 suicide related rail fatalities.



[3]

Source: NTD

[3] *Data presentation does not include CR:
All Commuter Rail (CR) and Alaska Railroad (AR) modes, the Heavy Rail (HR) service reported for Port Authority Trans Hudson (NTD ID: 20098), Hybrid Rail (YR) service for the Tri-County Metropolitan Transportation District of Oregon (NTD ID: 00008), and Hybrid Rail (YR) service for Capital Metropolitan Transportation Authority (NTD ID: 60048) are excluded from this analysis because these modes and operators are only required to report security data to the NTD, while their safety data reporting is strictly voluntary. These modes and agencies report their Safety data to the Federal Railroad Administration. More information on these modes is available here: https://www.fra.dot.gov/Page/P0010

The research team will examine transit rail events reported to NTD and will collect data from case study commuter rail systems. In addition, for a better understanding of suicide trends, the research team will also examine U.S. suicide trends. With anecdotal evidence that correlates, at least in part, suicides with economic conditions, CUTR will include a brief presentation of U.S. economic heath and suicide trends that may demonstrate this correlation.

The research team will also examine documented suicide prevention techniques from other Federal agencies, including the Department of Defense, for veterans and current military personnel, and the Department of Homeland Security/Transportation Security Administration and Federal Emergency Management Agency, for first responders or others that present signs or symptoms of post-traumatic stress disorder, as examples.

In addition, the research team will examine the following literature and background resources:

- Sara Searcy, et al. *Rail Corridor Trespass Severity Assessment*, FHWA Report FHWA/NC/2017-15 (2019)
- Oswald Beiler, et al. *Rail Trespass Prevention: Spatial Analysis of Incidents to Connect to Countermeasures,* American Society of Civil Engineers (2019)
- Grigore M. Havererneau, et al. Volpe National Transportation Systems Center. *Collecting Evidence from Distributed Sources to Evaluate Railroad Suicide and Trespass Prevention Measures,* Ergonomics, 61:11, 1433-1453, DOI: 10.1080/00140139.2018.1485970
- Byron Keating and Cameron Gordon. "Prevention Railway Suicide: An Open-Systems Perspective and Application," TRB 97th Annual Meeting Paper 18-00877 (2018)
- Patrick Sherry, Mineta Transportation Institute. *Remedial Actions to Prevent Suicides on Commuter and Metro Rail Systems*, US DOT/Californial DOT (2016)
- Brian M. Jenkins, Mineta Transportation Institute. *The Challenge of Protecting Transit and Passenger Rail: Understanding How Security Works Against Terrorism,* CRC Press (2017).
- Richard R. Young, Gary A. Gordon, Jeremy F. Plant. *Railway Security: Protecting Against Manmade and Natural Disasters,* (August 2017).
- Scott Gabree, et al. Volpe National Transportations Safety Systems Center. *Countermeasures to Mitigate Intentional Deaths on Railroad Rights-of-Way: Lessons Learned and Next Steps,* DOT/FRA/ORD-14-36 (2014))
- Grigore M. Havârneanu, Jean-Marie Burkhardt & Anne Silla (2016) Optimizing suicide and trespass prevention on railways: a problem-solving model from the RESTRAIL project, International Journal of Injury Control and Safety Promotion, 24:4, 469-486, DOI: 10.1080/17457300.2016.1232275
- Marco DaSilva. Volpe National Transportation Systems Center. "Trespass Prevention Research" Presentation (2015)
- Lavern McElveen. Federal Transit Administration. "Trespass Prevention: A Hazard Management Approach" Presentation (2012)
- Tarek Omar. Federal Railroad Administration. "2012 ROW Fatality & Trespass Prevention Workshop" Proceedings (2012)
- Marco daSilva and Tashi Ngamdung. Volpe National Transportation Systems Center. "Trespass Prevention Research Study – West Palm Beach, FL" (2014)
- National Transportation Safety Board News Release. "Acting Chairman Hart Announces Slight Drop in 2013 Transportation Fatalities in Most Categories; Rail Deaths Rise" (2015)
- Ian Savage. "Trespassing On the Railroad" Research in Transportation Economics, Volume 20, 199–224. Elsevier Ltd. ISSN: 0739-8859/doi:10.1016/S0739-8859 (07) 20008-3 (2007).
- other appropriate incident-based documentation

Task 2: Rail Transit Agency and Commuter Rail Case Studies

The research team will utilize CUTR Transit Standards Working Group rail transit agencies (LA Metro, WMATA, SEPTA, Houston Metro, Capital Metro, BART, MBTA, and MARTA) and commuter rail agencies (Metra, Brightline/Virgin Trains, NY MTA's Long Island Railroad, and possibly others) to learn about the programs they have in place to address trespasser and suicide injuries and fatalities. These case studies will include baseline data (defined by each agency) and the current rate of trespasser and suicide injuries and fatalities. Researchers will also identify community outreach efforts, infrastructure modifications, procedural modifications, signage, driver training, coordination with social service and crisis intervention centers, and other related activities. Any self-identified successes will be performance quantified by CUTR and reflected in the research report. Further, CUTR will identify programs that seemed to use potentially successful approaches, but were not very effective after implementation.

Task 3: Identification of Effective Existing Systems and Potential Technologies

Technology applications play a crucial role to detect, warn and address trespassers and suicides. There are existing or potential future rail trespasser and suicide detection systems and trespasser warning systems; their effects and scopes of implementation will be investigated. Various systems include passive detection systems/technologies, such as thermal detection systems and intrusion detection response technologies, such as drones. It will also include the latest technologies that have been piloted or deployed, such as video behavior analytics and facial recognition and analysis software systems. CUTR will also identify relevant technologies that may be in the proof-of-concept stage, as available. CUTR will review and identify existing systems used by agencies and potential technologies developed by technology vendors that can detect trespassers and suicides along rights-of-way or at rail stations of oncoming trains and warn trespassers. In this task, CUTR will conduct literature review and interviews with selected agencies and technology vendors. CUTR will also identify advance-warning systems to the railway staff of potential trespasser or suicide so they can help stop the train in time.

As noted, it is important to recognize that there are trespass elements that pose significant security risk for rail systems. Passenger rail systems are vulnerable to terrorist acts because they are openly accessible and offer confined environments with large numbers of passengers. This security risk and associated issues may be a point of future consideration and research. However, CUTR will identify prevention programs and technologies that are complementary to both security enhancement and trespasser/suicide prevention.

Task 4: Documentation of Research Findings, Effective Practices and Potential Technologies

CUTR will derive research findings from the detailed examination of NTD reported event details (when available), comprehensive literature reviews, and other background research.

CUTR will document effective practices derived from:

- Research reports
- Case studies and lessons-learned based upon successful and unsuccessful rail transit and commuter rail agency trespasser and suicide prevention programs
- Final summary presentation

Effective practices will include, but not be limited to:

- Agency policies and practices
- Training
- Technology applications

- Infrastructure modifications
- Signage
- Community awareness and outreach programs
- Coordination with local social service agencies, mental health advocacy groups, mental health professionals
- Coordination with national rail support and advocacy groups, such as Operation Lifesaver

CUTR will base the identification of effective existing systems and potential technologies to address trespassers and suicides on the findings from the literature review, background research, interviews with case study agencies, and technology vendors, as applicable. CUTR will specifically delineate any practices described as successful that may lend themselves to an industry voluntary standard or recommended practice.

CUTR will document all research findings, effective practices, effective existing systems, and potential technologies, provide recommendations, produce a draft final report, and a final report. CUTR will also make available to FTA all background research materials (or links) and case study interview summaries. Upon FTA's approval of the draft final report, CUTR will submit a final report to FTA. CUTR will supply a final summary presentation to FTA based upon the final report. Upon FTA approval, the research team will provide the research report, including associated findings, effective practices, and potential technologies, to APTA for their use in developing or updating recommended practices or documents.

Project Schedule & Project Milestones

Monthly conference calls with the FTA will be hosted to provide progress updates and receive guidance. This may be accomplished during regularly scheduled FTA project progress meetings. In addition, the research team will conduct subcommittee teleconference calls with industry stakeholders from the CUTR Working group. A in-person meeting with the CUTR working group will be held once Tasks 1, 2 and 3 are completed. The research team will present the preliminary results of their findings. After receiving working group preliminary results input, the research team will present final research results to the FTA. CUTR will provide a final draft report to FTA with 15 months of notice to proceed. CUTR will finalize the report based on the review comments received and submit the final report by Month 16. The project schedule and project milestones are provided below.

Project Milestone	Anticipated Date of Completion
Kickoff Meeting / presentation	Month 1
Completion of Task 1 - Event Examination and Literature Review	Month 5
Completion of Task 2 - Rail Transit Agency and Commuter Rail Case Studies	Month 8
Completion of Task 3 - Identification of Effective Existing Systems and Potential Technologies	Month 13
Draft Final Report	Month 15
Final report	Month 16

CUTR Research Team – Lead Investigators

Project Lead

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Education

1995 Ph.D., University of Florida, Major: Civil Engineering (Transportation), GPA: 4.0/4.0
1991 M.S., University of Texas at Austin, Major: Civil Engineering (Transportation)
1986 B.S., National Chung-Hsing University. Major: Civil Engineering

Professional Experience

2006-Present Program Director, CUTR, University of South Florida, Tampa, FL
2018-Present Director, Florida Local Technical Assistance Program Center, CUTR, University of South Florida, Tampa, FL
2004-2006 Senior Research Associate/Faculty, CUTR, University of South Florida, Tampa, FL
1998-2004 Professional Engineer, Sarasota County Public Works, Sarasota, FL
1996-1998 Senior Engineer, Sarasota County Transportation Department, Sarasota, FL

Selected Awards

1. Edward A. Mueller - District 10 Transportation Engineer of the Year, ITE District 10, 2017
2. Best Paper Award, ICTPA 30th Annual Conference, Houston, Texas, 2017
3. Distinguished Service Award, ICTPA, Houston, Texas, 2017
4. Best Technical Paper, FLITE Magazine, ITE, Florida Section – District 10, 2016
5. Excellent Paper Award, ICTPA 24th Annual Conference & NACGEA International Symposium on Geo-Trans Los Angeles, California, 2011
6. Best Project of the Year Award, Tampa Bay Institute of Transportation Engineers, 2010
7. Florida ITE Newsletter/Magazine Outstanding Paper Award, 2009

Relevant Experience

- Served as Principal Investigator (PIs) or Co-PI for more than 100 research projects and grants
- Conducted and managed more than $50M on research projects and highway safety grants
- Published more than 180 conference and journal papers, technical reports and professional articles
- Conducted more than 150 presentations via statewide, national and international conferences
- Received more than 50 media and internet quotes or citations

Relevant Projects

1. Testing and Evaluation of FLIR Thermal Camera-based System on Wong-Way Driving and Stalled Vehicles, Johnson, Mirmiran & Thompson, Inc., 2019-2019
2. Pilot Implementation for Preventing Incorrect Turns at Highway-Rail Grade Crossings, FDOT, 2018-2019
3. Campus Automated Shuttle Service Deployment Initiative, National Center for Transit Research, NCTR/FDOT, 2018–2019
4. Integration of a Robust Automated Pedestrian Detection System for Signalized Intersections, FDOT 2017-2019

5. Understanding Interactions between Drivers and Pedestrian Features at Signalized Intersections, Phase 3, FDOT/FHWA, 2017-2019
6. Testing and Evaluation of Freeway Wrong-way Driving Detection Systems, FDOT, 2017–2018
7. **Comparing Countermeasures for Mitigating Wrong-way Entries onto Limited Access Facilities, FDOT, 2016-2016**
8. Pilot Study for Preventing Incorrect Turns at Highway–Rail Grade Crossings, FDOT, 2014-2015
9. Improved Traffic Control Measures to Prevent Incorrect Turns at Highway–Rail Grade Crossings, FDOT/NCTR, 2012-2013
10. Coordinated Pre–Preemption of Traffic Signals to Enhance Railroad Grade Crossing Safety in Urban Areas and Estimation of Train Impacts to Arterial Travel Time Delay, FDOT, 2012–2013
11. Evaluation of Camera-based Systems to Reduce Transit Bus Side Collisions – Phase II, FDOT, 2011-2012

Relevant Publications

1. **Pei-Sung Lin**, Cong Chen, Seckin Ozkul, "Evaluation on Implementation of Rectangular Rapid Flashing Beacons at Freeway Off-Ramps to Mitigate Wrong-Way Driving", Final Report, FDOT Project Number BDV26 TWO 962-6, December 2018.
2. **Pei-Sung Lin**, Seckin Ozkul, Rui Guo and Cong Chen, "Assessment of countermeasure effectiveness and informativeness in mitigating wrong-way entries onto limited-access facilities", Accident Analysis & Prevention, Volume 116, pp 69-93, July 2018.
3. **Pei-Sung Lin**, Cong Chen, Seckin Ozkul, "Testing and Evaluation of Freeway Wrong-way Driving Detection Systems", Final Report, FDOT Project Number BDV25 TWO 977-40, 2018.
4. **Pei-Sung Lin**, Zhenyu Wang, Abhijit Vasili, Deborah Schultz, "A Pilot Study for Preventing Incorrect Turns at Highway-Rail Grade Crossings", Final Report, FDOT Project Number BDV25 TWO 977-11, December 2017.
5. **Pei-Sung Lin**, Achilleas Kourtellis, Zhenyu Wang, Cong Chen, Rui Guo, "Understanding Interactions between Drivers and Pedestrian Features at Signalized Intersections – Phase 2", Final Report, FDOT Project Number BDV25 TWO 977-26, May 2017.
6. **Pei-Sung Lin**, Zhenyu Wang, Qing Wang, Rui Guo, "Improved Traffic Control Measures to Prevent Incorrect Turns at Highway-Rail Grade Crossings," Final Report, FDOT Project Number BDK85 977-45, November 2013.
7. **Pei-Sung Lin**, Zhenyu Wang, Qing Wang, Rui Guo, "Coordinated Pre-Preemption of Traffic Signals to Enhance Railroad Grade Crossing Safety in Urban Areas and Estimation of Train Impacts to Arterial Travel Time Delay," Final Report, FDOT Project Number BDK85 977-44, November 2013.
8. **Pei-Sung Lin**, Seckin Ozkul, "Danger Alert, Mitigating wrong-way driving through red RRFB implementation", Road and Bridge Magazine, January 4, 2016.
9. **Pei-Sung Lin**, Zhenyu Wang, Rui Guo, Qing Wang, "Development of Coordinated Pre-Preemption of Traffic Signals to Enhance Highway-Rail Grade Crossing Safety and Mobility," FLITE Volume 55, No.1, ITE Florida Section, May 2014.
10. Xuanwu Chen, Yan Xiao, Mohammed Hadi, Melissa Ackert, **Pei-Sung Lin**, "Assessment of Pre-Preemption Strategy of Traffic Signals near Railroad Grade Crossing Utilizing Simulation Analysis," TRB 93rd Annual Meeting, Compendium of Papers DVD, Transportation Research Board, Washington DC, January 12-16, 2014.
11. **Pei-Sung Lin**, Achilleas Kourtellis, Matthew Wills, "Evaluation of Camera-Based Systems to Reduce Transit Bus Side Collisions-Phase II," Final Report, prepared for NCTR/FDOT, December 2012.
12. Achilleas Kourtellis, **Pei-Sung Lin**, Chanyoung Lee, "Evaluation of Video Camera System to Reduce Side Collisions of Transit Buses," Transportation Research Record 2265, pp 3-12, 2011.

Leading Researcher

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Education

2009 Ph.D., University of South Florida, Civil Engineering (Transportation),
2006 M.S., University of South Florida, Civil Engineering (Transportation)
2004 B.S., University of South Florida, Civil Engineering

Professional Experience

2017- present Program Assistant Director of ITS, Traffic Operations & Safety, CUTR, University of South Florida
2015-2017 Senior Research Associate, CUTR, University of South Florida
2010-2015 Research Associate, CUTR, University of South Florida
2006-2009 Research Assistant, CUTR, University of South Florida

Relevant Experience

- Served as Principal Investigator (PIs) or Co-PI for more than 30 research projects and grants
- Conducted and managed research funding exceeding $4M on research projects and grants
- Co-Managed the SHRP2 Naturalistic Driving Study Data Collection in Tampa
- Published more than 40 research papers, journal papers, technical reports and professional articles
- Presented more than 50 research journal papers, conference papers, technical reports and articles
- Developed and conducted controlled driving experiments for technology evaluation
- Focused recent research on connected vehicle safety research via large scale deployment

Relevant Projects

1. Connected Vehicle Pilot Deployment Program, USDOT/FHWA, Co-PI
2. Development of Low Voltage/Extended Runtime Signalized Intersection Using Backup Power after the Loss of Utility Power Due to Hurricanes, FDOT, Co-PI
3. Understanding Interactions between Drivers and Pedestrian Features at Signalized Intersections, Phases 1,2 & 3, FDOT/FHWA, Co-PI
4. Campus Automated Shuttle Service Deployment Initiative, National Center for Transit Research (NCTR), Co-PI
5. Smartphone-based Connected Bicycle Prototype Development for Sustainable Multimodal Transportation System, NCTR, PI
6. Integration of a Robust Automated Pedestrian Detection System for Signalized Intersections, FDOT, Co-PI
7. Application of Demographic Analysis to Pedestrian Safety, FDOT, Co-PI
8. Crash Typing of Pedestrian and Bicycle Crashes, FDOT, PI

9. Evaluation of Camera-Based Systems to Reduce Transit Bus Side Collisions-Phases 1 & 2, FDOT/NCTR, Co-PI
10. SHRP2 Naturalistic Driving Study Data Collection: Tampa Site, FHWA, Co-PI
11. Evaluation of Power Line Motor Carrier Rear Vision System, FDOT, Co-PI