

**CFIRE**

# **Program Progress Performance Report: January 1, 2016 to June 30, 2016**

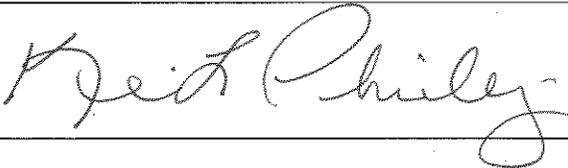
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National Center for Freight & Infrastructure Research & Education  
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This report covers CFIRE's efforts to collaboratively address research, education, workforce development, and technology transfer under DTRT12- G-UTC19 during the reporting period of January 1, 2016 to June 30, 2016.

## Accomplishments

### CFIRE Goals

1. **Research:** Through the strategic planning process, CFIRE is continuing its efforts with research initiatives and projects that support the USDOT Strategic Goals and advance the state of practice in freight and freight infrastructure systems.
2. **Education and Workforce Development:** The partner institutions of CFIRE are actively engaged in education and workforce development at the local, state, and national levels. CFIRE has built upon established successful programs to establish and leverage funding with the Midwest Transportation Workforce Center (MTWC) and continues to support new collaborative initiatives. Our education and workforce activities for university students and practicing professionals develop skills and knowledge in multimodal freight transportation systems that reinforce our Center's theme. CFIRE is assessing workforce development needs to support implementation of the Marine Highways in the Great Lakes and tributary river system.
3. **Technology Transfer:** Technology transfer is the process of transferring discoveries or innovations derived from university research into products and services that benefit the profession. CFIRE continues to engage and facilitate the freight planning community in the 10-state region comprising the Mid-America Freight Coalition (MAFC) in a cross-section of technology transfer initiatives. These include traditional as well as new, innovative approaches to disseminating information.
4. **Collaboration:** The CFIRE team has taken advantage of regional expertise by establishing both northern and southern hubs to help coordinate proposed education, training, and technology transfer efforts. The CFIRE team brings a wealth of experience and a history of collaborative work. We are developing international relationships through our participation in the World Road Association (PIARC) and in various bi-national US-Canada initiatives that include both state and national-level collaborations.

### Research Initiatives

#### RI-1: A Multi-Modal Freight Safety, Security, and Environmental Routing Tool

USDOT Priorities: Safety/Sustainability

Performing Institutions: University of Wisconsin–Milwaukee, University of Wisconsin–Superior, University of Alabama–Huntsville, and University of Southern Mississippi.

Start Date: July 1, 2012

**Major activities:**

- Nothing to report

**Specific objectives:**

- Make web version available for transportation stakeholder use.

- Once available, multiple freight transportation stakeholders will have access to a tool that allows for making more informed routing decisions taking into consideration impacts associated with efficiency, safety, security and environmental protection.

**Key outcomes:**

- Increasing confidence that a comprehensive and practical decision-support tool can be implemented

**Products:**

- Webtool is under development.
- Use of GIS techniques to generate, store, manage and manipulate data, and use of scripting language and other programming templates to enable development of analysis methodology and web-user interface.

**Collaborating organizations:**

- University of Alabama–Huntsville
- University of Wisconsin–Milwaukee
- University of Southern Mississippi
- University of Wisconsin–Superior
- Desired data and programming tools have been obtained from various federal agencies and software developers.

**Changes:**

- Decision made to include representation of the entire continental U.S. rather than limiting application to just CFIRE corridor states
- Project schedule has been set back by issues related to serving a web-based version that can be made publicly available.

**RI-2: Making Freight-Centric Communities More Livable: Measuring the Impact of Advanced Technologies**

USDOT Priorities: Livability/Economic Competitiveness

Performing Institutions: University of Memphis, University of Wisconsin–Madison, University of Toledo.

Start Date: July 1, 2012

**Major activities:**

- Paper and presentation submission, high school outreach.

**Specific objectives:**

- Finalizing project report and developing materials for dissemination.

**Key outcomes:**

- Livability module developed for use in Girls Experiencing Engineering 2016.

**Dissemination:**

- Submission of abstract and selection for presentation at 2016 Southern District Institute of Transportation Engineers, Nashville TN.
- Invitation and abstract submission for 2016 Southeast Symposium on Contemporary Engineering Topics, Jackson Mississippi.
- Girls Experiencing Engineering program (high school students), Memphis, TN.

**Products:**

- Publications:

Ivey, Stephanie (2016) "Assessing Livability of Freight Centric Communities: Memphis Case Study," Invited Presentation Southern District Institute of Transportation Engineers Annual Meeting, Nashville, TN, April 12, 2016.

Rapalo, V., Ivey, S., Hart, M., Schroeckenthaler, K., and Adams, T. (2016) "Evaluation of Factors Affecting Livability in a Freight-Centric Community in Memphis, Tennessee." Proceedings of the Transportation Research Board 95th Annual Meeting, Washington, DC, January 2016.

Hart, M., Greenstreet A. (2015) Freight Stories: Using ESRI Story Map Journal to Visualize Research 2015 Mid-Continent Transportation Research Symposium. Ames, IA.

Doherty, M., Hart, M., Adams, T., Wise, A., and Ivey, S. (2013) "Defining Livability for Freight-Centric Communities: Identifying Priorities of Residents of the Lamar Avenue Corridor in Memphis, TN." Proceedings of the ASCE 2nd T&DI Green Streets, Highways and Development Conference, Austin, TX.

Ivey, S., Hart, M. (2014) "Making Freight-Centric Communities More Livable: Examining Residential Perceptions and Priorities for Livable Communities." 2014 Mid-Continent Transportation Research Symposium. Madison, WI.

- Websites:

Visualization: <http://www.wistrans.org/livability/MemphisLamarAve.htm>

Story Map:

<http://uwmad.maps.arcgis.com/apps/MapJournal/?appid=090c0247e1384fcf8092e664670cb0f5>

- Other products:

Survey instruments for residential, industry and stakeholder groups. These instruments will be published in the final project report.

**Collaborating organizations:**

- University of Memphis
- University of Toledo
- University of Wisconsin–Madison
- Livable Memphis: Aid in organizing community events.
- Neighborhood leaders were contacted for target neighborhoods surrounding the Lamar Corridor. One neighborhood held a project survey event at their monthly association meeting.
- Livable Memphis was also actively engaged in both feedback on survey instruments and assistance in organizing the survey and focus group events.

**Impact:**

- Products from this research are highlighted in the TRID under Mitigating Freight Impacts on Nearby Communities.
- This project was highly interdisciplinary, with publications and presentations made in business, planning, and engineering settings.
- The project highlights were implemented as a module during the Girls Experiencing Engineering program for high school students, and the story map and a “mini research” activity will be used with Transportation Academy (high school) students in fall 2016. The research material will continue to be used in civil engineering courses at the University of Memphis to broaden students’ understanding of transportation impacts.
- Community engagement through survey/focus group events – all events were very successful in sparking conversation and interest in the project from Lamar area residents.

**Changes:**

- IRB approval process and access to neighborhood meetings took much longer than expected. This resulted in an extended timeline for the project. Additionally, the scope of the project expanded significantly and included thesis work from 3 graduate students at the University of Memphis. The project team is working to condense the final report for publication.

**RI-3: Non-Destructive Technologies for Monitoring and Condition Assessment to Support Safety, Maintenance Programming, and Cost Allocation**

USDOT Priorities: State of Good Repair

Performing Institutions: University of Wisconsin–Madison; University of Wisconsin–Milwaukee

Start Date: July 1, 2012

**Major activities:**

- Continued working to finalize the final report
- Continued working to improve the expert system performance

**Specific objectives:**

- Deploy the expert system to be available as on line tool for NDE

**RI-5: Estimating the Effects of Extreme Weather on Transportation Infrastructure**

USDOT Priorities: Sustainability

Performing Institutions: Vanderbilt University and University of Wisconsin–Madison.

Start Date: July 1, 2012

**Major activities:**

- Continued development of manuscript(s) to report project findings.
- Continued work on final report.

**Specific objectives:**

- Develop and pilot test a methodology that can identify highway infrastructure that is most threatened by flooding events.
- Estimate the actual damage due to flooding to the highway infrastructure itself and related indirect effects (e.g., delays in shipments, increased travel times and fuel costs).
- Define a risk index based on extreme weather threat and consequential impact on transportation infrastructure and operations.
- Hazus estimates a significantly greater amount of economic damage due to flooding than has traditionally been reported, due to consideration of impacts to transportation and utility infrastructure as well as indirect damages such as sheltering requirements.
- Yet, not all negative impacts to transportation infrastructure and mobility are considered in Hazus, meaning that there is an even greater amount of economic loss associated with transportation impairment than has even been captured by Hazus itself.
- Road closures do not appear to be an effective proxy measure for representing damage to highway infrastructure due to major precipitation events.
- Hazus is best used as a screening-level tool to identify highly vulnerable areas and then a more refined hydrologic model is better suited to evaluate depth and extent of flooding in areas of specific transportation assets.
- NARCCAP model outputs are not easily integrated into GIS due to differing coordinate systems of the six main models used and coordinate system/projection anomalies. Additionally, NARCCAP data uses an unusual longitude convention (i.e., from 0 - 360 degrees East). NARR uses -180 West to 180 degrees East longitude.
- Using our criterion for “key precipitation events”, tropical areas had 24-hour daily precipitation averages of over 30”.
- There is little data available to utilize in development of a risk index. Additional research and data are necessary to complete this task. One possible option is to utilize damage functions from the Hazus earthquake model as an initial basis for estimating damage costs.

**Dissemination:**

- Janey Camp presented some of the research methodology and findings to a FEMA Hazus User Group national conference call in spring 2015.
- Janey Camp presented some of the research methodology and findings at a FEMA Hazus National Users’ Conference in December 2015.

**Products:**

## Publications:

- J. Camp. (Invited) “Use of Hazus for Adaptation Planning of Transportation Infrastructure Under Extreme Conditions,” Federal Emergency Management Association (FEMA) National Hazus User Group Call, April 2015.
- J. Camp. Use of Hazus and Regional Climate Models to Identify Vulnerable Transportation Infrastructure due to Future Extreme Precipitation Events. Hazus National User Conference, 9-11 December 2015, Atlanta, GA.

**Collaborating organizations:**

- University of Wisconsin–Madison

- Tennessee Department of Transportation
- National Oceanic and Atmospheric Administration (NOAA)
- North American Regional Climate Change Assessment Program (NARCCAP)
- Metro Nashville Government

**Impact:**

- A better understanding of the strengths and weaknesses of downscaling climate model forecasts to regional and local extreme weather scenarios
- Increased knowledge of the limitations of Hazus

**Changes:**

- Greater emphasis being placed on developing a representative risk index
- Hazus is useful for approximating depth and extent of inundation and not much else for predictive modeling related to transportation infrastructure.
- Delay in obtaining good Hazus results. The model kept crashing for some of the “hot spot” areas on the 500-yr and 1000-yr flood runs.
- Slight delay in completing final report in fall 2015 due to Janey Camp on maternity leave.

## **CFIRE PROJECTS**

### **CFIRE 08-03: Wisconsin Study on the Impact of OSOW Vehicles on Complex Bridges**

Performing Institution: University of Wisconsin–Madison

Start Date: August 8, 2013

**Major activities:**

- Final report was completed and submitted to sponsors.

**Specific objectives:**

- Objective was to suggest simplified methods for WisDOT to evaluate the load effects of OSOW vehicles on complex bridges.

**Key outcomes:**

- Project found that Wisconsin’s complex bridges are generally capable of carrying normal OSOW vehicles.
- Methods for evaluating the bridges were provided to the state.

**Dissemination:**

- Dissemination has only occurred through project report submitted to sponsors and WisDOT.

**Collaborating organizations:**

- Project was completed in cooperation with WisDOT.

## CFIRE 08-04: Region V Transportation Workforce Assessment and Summit

Performing Institution: University of Wisconsin–Madison

Start Date: October 1, 2014

### **Major activities:**

- Reproduced some content from the Summit (held in December 2015) in the form of a webinar in March 2016.
  - Highlighted three speakers from the Summit.
  - Continued to foster relationships with Summit speakers and attendees.
  - As a result of the webinar, we had an industry contact us to connect them to a speaker.
- Assembled data from a Summit exercise and developed an analysis of responses. This analysis will serve as a basis for TRB paper.
- A draft report of the Region V Transportation Workforce Assessment has been compiled.
  - Identified a list of transportation occupations that fit a high-demand, high-wage scenario.

### **Specific objectives:**

- Build community with many types of transportation stakeholders.
- Survey summit participants.
- These findings are subject to the limitations of the data:
  - Overwhelmingly, occupations in highest demand are those in the career and technical sector of transportation.
  - Openings for Truck drivers eclipse all other occupations.
  - Other positions that include computer applications and development skills are in high demand in the transportation sector.
  - Apprenticeship data is not centralized in the US. Not all states have an online presence for a list of registered (with Department of Labor) apprenticeships.
  - Transportation occupations are grouped under several career clusters. For example, engineering is under Architecture and Construction Career Cluster, while others are under the Transportation, Distributions, & Logistics (TDL) Career Cluster.

### **Key outcomes:**

- Exceeded the number of registrants for a webinar.

### **Dissemination:**

- Webinar information was disseminated via the website, MTWC network database, the National Network for the Transportation Workforce (NNTW) and other social media channels.

### **Collaborating organizations:**

- Nexttrans.

**Impact:**

- Contributions to building a network and a clearing house presence in the Midwest.
- The webinar recording is on the MTWC website and is available to any user.
- These are steps in the long-range vision of having a highly connected transportation network to ensure a pipeline of workers can meet the industry's needs.

**CFIRE 09-07: Understanding Time-of-Day Variation in Truck Transport and General Traffic Emissions: Guidance for Strategic Urban Air Quality Investments**

**Performing Institutions:** University of Wisconsin–Madison and Texas A&M Transportation Institute

**Start Date:** August 1, 2014

**Major activities:**

- Additional effort was required to update the air quality modeling platform to reflect U.S. EPA's most current Annual Emissions Inventory. This is critical to ensuring that the results of this research are relevant to transportation and air quality research and policy. The associated SMOKE-MOVES modeling runs are completed with results compilation in process.

**Specific objectives:**

- Detailed time-of-day data sets for speed and volume data developed by the Texas Transportation Institute (TTI) for 10 Eastern U.S. metropolitan areas.
- Incorporated data from above into the state-of-the-art vehicle emissions modeling platform (SMOKE-MOVES) to generate emissions inventories for experimental conditions reflecting:
  - EPA's current default conditions reflected in the National Emissions Inventory.
  - Using TTI generated speed and volume timing data to evaluate whether this information provides improved air quality modeling outcomes.
  - Levelized emissions, such that the importance (sensitivity) of considering emissions timing can be considered.
- The resulting emissions inventories for vehicles will be combined with emissions from other human and natural sources, meteorology data, and treatment of chemical processes in the EPA Community Multiscale Air Quality (CMAQ) model.
- The research team will analyze CMAQ results and compare these results with ground-based measurements of NO<sub>2</sub> and ozone.

**Key outcomes:**

- The research team has successfully developed emissions inventories with improved data describing the location, timing, and composition of emissions from metro-area on-road transport. The SMOKE-MOVES model was successfully deployed to process these emission inventories for use in air quality modeling. These inventories are being recalculated to reflect changes in U.S. EPA's national emissions inventories, as mentioned below. This work represents the first-ever initiative to apply time-of-day vehicle-miles of travel (VMT) and speed data to emissions across a multi-state region in a methodologically consistent manner. The research team has established unique

capabilities to test the proposed questions related to the impact of traffic timing on air quality.

**Dissemination:**

- There are no final results to disseminate at this time. Research methodology has been discussed in detail with the project advisory committee, with representatives from government and industry. Methodologies and preliminary findings published in:
  - Frost, E.A. (2015). Evaluating Air Emissions from Urban Transportation in Eight U.S. Cities. Masters Thesis. Environment and Resources. UW-Madison.

**Products:**

- This represents the first-ever initiative to apply time-of-day vehicle-miles of travel (VMT) and speed data to emissions across a multi-state region in a methodologically consistent manner.
- Shared via Frost Thesis (2015), Final Report (pending), and subsequent publication/presentation.

**Collaborating organizations:**

- Data and methodologies are shared and discussed between the research team and the Lake Michigan Air Directors Consortium (LADCO). LADCO provides advanced emissions and modeling on behalf of its member states, including Wisconsin, Illinois, Michigan, Indiana, Minnesota and Ohio.
- Project Advisory Members: Mark Janssen (LADCO), Brad Pierce (NOAA), Jason Castillo (Kimley Horn) and Jason Bittner (Applied Research Associates).

**Impact:**

- Graduated student Ethan Frost was hired by the Wisconsin DOT and performs modeling using many of the same tools and approaches for which he was trained under this project.

**Changes:**

- Following a discussion between the research team and Project Advisors, the recommendation to researchers was to reduce the project scope to fewer than 10 metro areas, so that modeling and analysis can focus on higher impact/interest areas.
- Results from revised modeling runs—and associated reporting—are still being compiled.

**CFIRE 09-08: Effects of Heavy Vehicles on Dynamic Traffic Features**

Performing Institution: University of Wisconsin–Madison

Start Date: September 1, 2014

**Major activities:**

- A draft final report was prepared. The report is currently under revision by another Co-PI.

**Dissemination:**

- We presented the results at the 95th Annual Meeting of the Transportation Research Board) in Washington DC. In January, 2016.

- A journal paper is currently in press.

**Products:**

- Chen, D., Ahn, S., Bang, S., Noyce, D. 2016. Car-following and lane-changing behavior involving heavy vehicles. Accepted in Transportation Research Record, Journal of the Transportation Research Board. (DOI: 10.3141/2561-11): nominated for the Cunard Award at TRB.
- Chen, D., Ahn, S., Bang, S., Noyce, D. 2016. Car-following and lane-changing behavior involving heavy vehicles. The 95th Annual Meeting of the Transportation Research Board, Washington D.C.

**Impact:**

Our presentation at the 95th Transportation Research Board Annual Meeting was very well received. It raised very much interests in the research community. Car-following and lane-changing behavior of heavy vehicles has not been well researched, and our study provides a better understanding of the behavior and its implications in macro traffic flow phenomena and traffic control.

**CFIRE 09-09: Enabling On-line Logistics Services Auction Platform (OLSAP): Optimal Eco-Routing Strategies**

Performing Institution: University of Illinois–Chicago

Start Date: August 15, 2014

**Products:**

Publications:

- "Green Same Day Delivery with Real-time Demand", 28th European Conference on Operational Research, session on Green Vehicle Routing, Poznan, Poland, July 3-6, 2016
- "Is Electric Commercial Vehicle a Cost-effective Alternative to Diesel Commercial Vehicle in Urban Delivery?" 28th European Conference on Operational Research, session on Routing in Practice, Poznan, Poland, July 3-6, 2016

**CFIRE 09-13: The Potential for Mode Conversion to Rail Service in Wisconsin**

Performing Institution: University of Wisconsin–Madison

Start Date: September 1, 2014

**Major activities:**

- Completed project Final Report and closed out the project.

**Dissemination:**

- Report was published on CFIRE website, was sent out via email to project Advisory Committee and other parties having expressed interest throughout the project, and was posted on author's LinkedIn page.

**Products:**

Presentations:

- Presented overview of methodology and findings to the 2016 UW Madison Geospatial Summit.

Techniques:

- Technique: classifying and quantifying shipper proximity to rail access- shared via TRB Paper submission
- Technique: use of USDOT's ITIC-IM model to estimate potential modal shift from truck to intermodal truck-to-rail by modifying the dray distance/cost associated with the current/proposed intermodal marketplace.

***Collaborating organizations:***

Partner Organizations:

- Prime Focus LLC | Green Bay, WI. Private Consulting firm. Conducted the private sector surveys (Task 2 of project)
- Canadian National Railroad | Chicago Office. Private railroad company. Tom Tisa served on the Project Advisory Committee, and provided data (name and locations of customers served in the state).
- Wisconsin Department of Transportation | Madison, WI. Frank Huntington served on the Project Advisory Committee and provided data (state rail network shapefile, freight data).
- Wisconsin Economic Development Corporation | Madison, WI. State economic development agency- Kathy Heady served on the Project Advisory Committee and provided data (state shipper locations).
- Wisconsin Manufacturers & Commerce | Madison, WI. State chamber of commerce and business trade association- Jason Culotta served on the Project Advisory Committee.

Other Collaborators:

- Business Transportation Solutions. Mark Cefalu provided industry knowledge and data (truck rates to various metro regions).
- USDOT. Scott Greene provided the ITIC-IM model as well as provided assistance with understanding and operating the model.
- Wisconsin & Southern Railroad. Andy Laurent provided data (customer name and address information).
- GKM Incorporated. Garry Moss provided information regarding his US copyrighted I-41/43 Circuitous Platform.

***Impact:***

- Tough to say at this point. There are no other examples of transportation agencies quantifying shippers' proximity to rail access points. However, with USDOT's push towards multi-modal freight plans and designation of multi-modal networks transportation agencies may look to do so in the future. The only other published instance of ITIC-IM use was the National Transportation Research Center, Inc.'s U30: Evaluation of Freight Vehicles in Short-Haul Intermodal Lanes. The model is not best suited for aggregated studies (looking at statewide or regional estimates), but by making some assumptions such as those in this project can be of use. Researchers attempted to use the ITIC-IM for modal diversion estimates from truck to intermodal truck-to-marine for the Wisconsin Commercial Ports Development Initiative Phase II, but were unable to modify the model's variable rail rate function to work with marine variable fuel rates. With more time and some assistance, it is believed that this could be accomplished.

## CFIRE 09-14: Field Validation of Polyurethane Technology in Remediating Rail Substructure and Enhancing Rail Freight Capacity

Performing Institution: University of Wisconsin–Madison

Start Date: July 1, 2014

### **Major activities:**

- Development of a field application site for polyurethane injection to improve rail substructure.

### **Key outcomes:**

- Three possible field sites were identified and investigated. The first site was located on a mainline track in Ottawa, IL, servicing multiple sand extraction businesses. The field site chosen for the investigation has a significant ballast and substructure deficiency causing frequent maintenance. A geotechnical and geophysical investigation was conducted including: Dynamic Cone Penetrometer, Sampling (for laboratory testing), Ground Penetrating Radar, Electrical Resistivity, and Seismic Reflection/Refraction. Soil profiles were developed as well as their in situ strength. This information was shared with URETEK USA, who designed the polyurethane injection strategy for the field site using the given data. Due to the early frost, the injections could not commence, slowing the progress. During this inactive period until the spring thaw the instrumentation was tested and calibrated, and the life cycle assessment (LCA) of this technology was completed. Eventually this site had to be abandoned. Another rail site in northern Wisconsin was identified but that also was not accessible. Finally, a rail track in Madison, WI was identified. The necessary permits were processed and the geophysical investigation was completed. URETEK, USA has developed a polyurethane injection plan and finally we are poised to undertake the field project.
- The key products and achievements include:
  - A full geophysical and geotechnical report of the selected field site
  - Fully designed polyurethane injection location and pattern
  - Verification of selected instrumentation in a laboratory setting

### **Dissemination:**

- This project involves multiple entities. UW-Madison is working in conjunction with URETEK USA, Wisconsin & Southern Railroad LLC to ensure success of the project. Information gained from the site investigation is shared with all parties.

### **Products:**

- A presentation was given at an Engineering Professional Development course (Maintaining and Inspecting Railroad Track) concerning the project. The topics included a brief description about the technology (polyurethane), site investigation, the goals of the project and future work.
- The project is not complete but once completed it will introduce a new technology for substructure improvement and remediation by polyurethane injection. Once completed, the technology will be widely shared.
- UW-Madison is sharing the current information with their collaborators in the project. Once the data is gathered, papers will be submitted for publication. In addition, a Master's Thesis and a Ph.D. dissertation will contain an in depth analysis of the project.

**Collaborating organizations:**

- We are collaborating with two industrial firms: URETEK, USA is undertaking polyurethane injection in the field site and providing both financial and in-kind support.
  - URETEK USA & URETEK ICR (Heartland)  
Location(s): Tomball, TX & Grimes, IA  
Contribution: Field personnel, in-kind support, polyurethane technology support (URETEK's cost for stabilization of the test section \$54,750)
- Wisconsin & Southern Railroad LLC is providing the test track in Madison, WI.
  - Wisconsin & Southern Railroad LLC  
Location(s): Madison, WI  
Contribution: Field personnel, in-kind support, field site access and transportation

**Impact:**

- Through use of geophysical and geotechnical methods, problem sections in railway embankments can be identified and verified. Working with the collaborating organizations, a systematic approach for remediation of problem sections in railroads can be determined.
- In addition to the Geotechnical Engineering discipline, Civil Engineering and Railroad Engineering disciplines will be impacted.
- Broadening the use of non-traditional use of geomaterials in railroad infrastructure. This may create more opportunities for companies specializing in this material.
- The methods used to characterize the sites are not novel. Because of this, much of the results can be compared to past and present research. This helps increase the certainty of findings and verify the methods chosen. However, use of the polyurethane injection technology for ballast stabilization is unique. As the project progresses the information will be made public to aid other researchers and institutions in this area.
- The findings from this stage of research can be used to indicate problem rail sections. Polyurethane injection, if chosen to remediate the problems, can create a more robust infrastructure segment. In this application, the railroad would be less susceptible to deformation and settlement, creating a safer railroad and one that requires less frequent maintenance. Although the emphasis is on freight transport, the findings may have significant ramifications for rapid transit and other rail transport.

**Changes:**

- Finding a railroad track where poly urethane can be injected and then tested under a locomotive load was the major problem in this project and caused delays. We dealt with three different railroad entities until we succeeded.
- No impact on expenditure due to careful management.

**CFIRE 09-15: The Impact of Fracking on Freight Distribution Patterns**

Performing Institution: Vanderbilt University

Start Date: August 1, 2014

**Major activities:**

- Completed review of regulations and policies that states and municipalities have implemented holding fracking companies accountable for damage inflicted on transportation infrastructure.
- Initiated development of a framework for helping municipalities determine equitable arrangement for having fracking companies provide compensation to maintain affected transportation infrastructure.
- Applying knowledge gained to State of Mississippi as an example application.

**Specific objectives:**

- Help counties/municipalities experiencing active or potentially active fracking operations improve their understanding of the impact of hydraulic fracturing in their jurisdiction on transportation risks, costs and benefits.
- Oil and gas wells tend to be decentralized and in rural areas, so even if there are nearby multi-modal transport methods, everything comes to and from the well via truck, and local roads were often not built to withstand such weight on such a frequent basis. Accordingly, roads are most negatively impacted on the local level. We have learned that localities across the country approach this in different ways. For example, in Mississippi a county official just calls up an operator and asks for gravel for certain roads to be fixed, and the company pays for it. Whereas in Ohio and Pennsylvania, there are more formal contracts – Road Use Agreements – between companies and townships or counties.

**Key outcomes:**

- On the basis of what has been learned to date, project tasks will now focus on the following:
  - Using the results of our study to determine how oil and gas producing counties/townships around the country approach road repair/maintenance agreements with trucking companies and/or operators, perform a legal and policy analysis regarding the authority to require trucking companies/operators to pay for road damage/repair and the underlying authority of these agreements.
  - Develop a “best approach” to addressing road damage from oil and gas development tailored for small counties and townships.
  - Apply the results using Mississippi as a case study to generate useful information for local planners and decision makers.

**Products:**

- Dundon, L.A., M. Abkowitz and J. Camp. “The real value of FracFocus as a regulatory tool: A national survey of state regulators”. Energy Policy 87 (2015) 496–504.
- Two additional papers in preparation.

**Collaborating organizations:**

- University of Southern Mississippi
- Mississippi Oil and Gas Board
- FracFocus

- U.S. Energy Information Administration

**Impact:**

- Raising awareness about policy and legal aspects of fracking operations.
- Making available a framework that municipalities can use to proactively manage transportation considerations impacted by fracking operations.

**CFIRE 09-16: Reshoring and its impact on Transportation Infrastructure & US Economy**

Performing Institution: University of Southern Mississippi

Start Date: August 15, 2014

**Major activities:**

- Completed Manufacturing Location Quotients analysis (Task 4)
  - Map Production: developed 64 maps for Appendix A - (2) county employment levels and location quotients for (16) 15 industry subsectors and 1 industry group, and (2) different datasets. Also developed 32 maps for Appendix B- the same (16) industries and (2) datasets, but a combination of the county employment indicators from Appendix A.
  - Hot-Spot Identification: researchers decided methodology to combine the two employment indicator maps into a single map.
  - Research Report: produced research write-up for Chapter 4 and Appendices A & B.
- Developed the optimization model to distribute expected reshoring commodity volume and import volume from Asia (Task 5).
  - Assigned the volume on the nationwide network and analyzed freight flow and market shares of reshoring target regions.
- Completed impact study of reshoring on the CFIRE region (Task 6)
- Based on the Reshoring Initiative database of reports of reshoring, a total 13,043 direct manufacturing jobs were added to the regional economy. With the multiplier effect, the aggregate effect on jobs amounts to 64,795 jobs, representing less than 2% of the total amount of manufacturing jobs in that region.

**Specific objectives:**

- Most of the regional supply chain demand (75%) can be satisfied from within the CFIRE region limiting the impact on the transportation networks into the region. This highlights the importance of a regional supplier base for increasing the attractiveness of reshoring for American businesses. Some sectors, including electronic component and electro medical and control instruments manufacturing, will likely increase transportation requirements into the region. Possible ports of entry are identified and more data driven research is recommended.
  - Redistributed import volume from East Asia, changes of ports` volume
  - Inland areas have more potentiality to be reshoring target regions because of the inland transportation costs.
  - Kentucky is one of the best locations for reshoring
- Outliers in the county employment levels and location quotients ended up skewing the final hotspot analysis. Specifically in the CBP data analysis, extremely high location

quotients from the Leather and Allied Product Manufacturing Industry Subsector resulted in the final hot-spot analysis favoring/skewing towards the employment level. Instead of a ratio using the true maximum value (either employment levels or location quotients), an upper range indicator could be used instead. The only impact this would have on the final score would be to produce ratios of plus one, resulting in higher maximum hot-spot values.

**Key outcomes:**

- Cartographer learned new method for optimizing the production of a map series.

**Dissemination:**

- Ayuby, M. presented a paper on “Assessing Reshorability of US Manufacturing Industries” at the Annual Industrial & Systems Engineering Research Conference (ISERC), Anaheim, California on May 21, 2016.
- Ayuby, M. presented the research finding of Reshoring and Its impact on US transportation at the Graduate symposium at USM on March 24, 2016.
- Sarder, MD. presented the research finding of Reshoring and Its impact on US transportation at the International Society of Logistics (SOLE) event at Ocean Springs, MS on June 7, 2016.

**Products:**

- Ayuby, M., and Sarder, MD. (2016). Assessing Reshorability of US Manufacturing Industries, Proceeding of the Annual Industrial & Systems Engineering Research Conference (ISERC), Anaheim, California.
- Authors: Jaehoon Kim, Dr. Michael D. Anderson, Dr. MD Sarder. Title: Impact of Reshoring Phenomenon on Freight Flow in the U.S. 2017 TRB Annual Meeting (plans to submit).
- A web-based tool was developed for public to calculate reshoring index for specific industries at <https://www.usm.edu/logistics-trade-transportation/reshoring-index-backup>.
- The combining of employment levels (concentrations) and location quotients (specializations) is new as far as I know. Only the final report as on now.

**Collaborating organizations:**

- Harry Moser, President and Founder, Reshoring Initiative.
- Bruce Lambert, Executive Director Institute for Trade and Transportation Studies.
- Matthew Wypyski - Deputy Executive Director & COO, MS State Port Authority.
- Bill Martin, Director, Franklin Furniture Institute, MSU.

**Impact:**

- The decision of reshoring is not that straight forward as the United States and China have very different socio-economic reality. We have accumulated those economic indicators to assess the reshoring potential for different U.S. manufacturing industries from Asian countries (China, India, Japan and South Korea). The factors that drive the reshoring decision carry different weights for different manufacturing industries. We have scored each of those factors based on the related indicators of the country. We have developed a Reshorability Index, applying weighted average method. Our analysis has revealed that motor vehicle, computer and electrical equipment, appliance

manufacturing industries have high potential for reshoring. These are also among the seven tipping point industries for reshoring proposed by Boston Consultancy Group. This research is the first in literature that defines reshoring possibilities with established socio-economic indicators.

### CFIRE 09-17: Nationwide Best Practices to implement Freight Transportation Careers

Performing Institution: University of Alabama–Huntsville

Start Date: September 1, 2014

#### **Major activities:**

- Completed the report on identifying best practices of Master's in Logistics and Transportation related programs in the United States. Part of this project was to conduct a survey of U.S. universities that offer a master's program in logistics and transportation related areas.
- Also, developed a list of junior college programs and began developing evaluation criteria to rank programs.

#### **Specific objectives:**

- Of those 20 Universities who responded in the survey, 7 of those mentioned online learning and flexible class options as a benefit to working professionals. 6 of those cited location as a benefit to their programs, 9 of those stated that their relationships with government organizations and major corporations as a benefit and 2 of those stated that the reputation and legacies of their Universities as a benefit to students. Only 3 Universities responded that they require internship/co-op program completion for their students; however, almost every University mentioned the option for internships/co-ops existed and could help students if they wished to pursue it.
- In general, it seems that the structure of graduate level programs in logistics and transportation are focused on working professionals and are built around a focused curriculum. This focused curriculum means that most of these programs can be completed in 2 years or less. Another trend noticed was that most of these programs are non-thesis master's programs, with only a few requiring a capstone project. The only programs, which seemed to have a broader range of courses as part of the program, were the MBA and business-focused programs. While programs such as Transportation Engineering focused more strongly on the coursework specific to the field.

#### **Key outcomes:**

- There are a large number of programs at every level including high school, undergraduate, junior college and graduate level. We will work to establish best practice at each level.

#### **Dissemination:**

- Research findings were shared with local industry professionals in Mississippi in the industry advisory board meetings and partner's industry network.
- Presented at the American Society of Engineering Education conference in New Orleans, June 27, 2016.

**Products:**

- “An Analysis of the Status of Undergraduate Transportation Management Education in the United States,” Stewart, Richard, Natalie Burger, Erica Hansen, Gavin Johnson, Transportation Research Forum Annual Meeting, Toronto Canada, May 5, 2016
- Sarder, MD. (2016). Developing Master's Program in Logistics & Transportation, Proceeding of the American Society of Engineering Education Conference (ASEE), New Orleans, Louisiana.
- [www.usm.edu/cltt](http://www.usm.edu/cltt) - Waiting to receive all reports to upload in this site.

**Impact:**

- Will provide place for professionals to look for programs related to transportation at all levels.
- Will provide a place for people looking to get into transportation industry a place to find programs that meet their needs.

**CFIRE 09-18: Addressing MAP-21 Freight Objectives using GPS Data**

Performing Institution: University of Memphis

Start Date: July 1, 2014

**Major activities:**

- Finalized the ArcGIS toolbox “GPS-based FPMs Estimation” after receiving comments from partner universities. The current version the toolbox includes six tools, which perform the following procedures: 1) Estimation of link-based freight performance measures (FPMs), 2) Estimation of OD-based FPMs; 3) Estimation of average link/OD-based FPMs over specified time period; 4) Analysis of truck parking locations; 5) Estimation of hours of delay; and 6) Estimation of congested lane miles.
- Updated and finalized a user guide for researchers who want to use the above-mentioned toolbox and the GPS Data Processing and Extracting Tool, developed in previous stage of this project.
- Estimated OD-based FPMs for the state of Tennessee.
- Estimated path-based reliability for Shelby county in Tennessee.
- Estimated hours of delay and congested lane miles for 10 counties in the state of Tennessee.

**Specific objectives:**

- The developed GPS-based FPMs Estimation toolbox will allow estimating different FPMs, which can be further used by private and public agencies in freight transportation planning;
- The developed freight facilities tool estimates hourly volumes, turn times, and entry/exit volumes per time of day, allowing stakeholders analyze how the facilities perform for future planning;
- The proposed methodologies and results for estimation of OD-based FPMs, path-based reliability, calculation of hours of delay and congested lane miles for a given transportation network, may provide insightful outcomes for different stakeholders.

**Key outcomes:**

- Updated the GPS-based FPMs Estimation toolbox.
- Estimated OD-based FPMs for the state of Tennessee.
- Estimated path-based reliability for Shelby county in Tennessee.
- Estimated hours of delay and congested lane miles for 10 counties in the state of Tennessee.

**Dissemination:**

- Discussed the activities in the regional Freight Advisory Committee.

**Products:**

- Mania Flaskou; Maxim Dulebenets; Karlis Pujats; Nikos Deligiannis; Afrid Sarker; Sabyasachee Mishra; Mihalis Golias. Freight Performance Measures Estimation Using Truck GPS Data. 2015. Poster presentation at the 9th Annual Intermodal Freight Conference, Memphis, TN. Acknowledgment of federal support: Yes
- Alireza Naimi; Maxim Dulebenets; Karlis Pujats; Mihalis Golias; Sabyasachee Mishra. Tools for Processing Truck GPS Data and Analysis of Freight Corridors. 2015. Poster presentation at the 9th Annual Intermodal Freight Conference, Memphis, TN. Acknowledgment of federal support: Yes
- Khademul Haque; Sabyasachee Mishra; Rajesh Paleti; Mihalis M. Golias; Afrid A. Sarker; Karlis Pujats. Truck Parking Utilization Analysis Using Truck GPS data. 2015. Poster presentation at the 9th Annual Intermodal Freight Conference, Memphis, TN. Acknowledgment of federal support: Yes
- Khademul Haque; Sabyasachee Mishra; Rajesh Paleti; Mihalis M. Golias; Afrid A. Sarker; Karlis Pujats. Truck Parking Utilization Analysis Using Truck GPS data. 2016. Lectern session 472 at the 95th TRB Annual Meeting, Washington, D.C. Acknowledgment of federal support: Yes
- Khademul Haque; Sabyasachee Mishra; Rajesh Paleti; Mihalis M. Golias; Afrid A. Sarker; Karlis Pujats. Truck Parking Utilization Analysis Using Truck GPS data. 2016. Transportation Research Record: Journal of the Transportation Research Board. Status of publication: Pending. Acknowledgment of federal support: Yes.

**Collaborating organizations:**

- American Transportation Research Institute (ATRI)
- University of Alabama–Huntsville
- University of Southern Mississippi
- University of Wisconsin–Madison
- Center for Freight and Infrastructure Research and Education (CFIRE)

**Impact:**

- The developed tools and the results from their implementation on the provided truck GPS data will assist private and public agencies with freight transportation planning.

CFIRE 09-19: Freight Economic Vulnerabilities Due to Flooding Events

Performing Institution: Vanderbilt University

Start Date: July 1, 2014

**Major activities:**

- Task1
  - Continued analyzing and synthesizing survey responses (109 responses) with plans to produce a paper from the results and also use the results to develop the “risk matrix” which may now become more of a regression curve that links severity of impacts with the magnitude of the precipitation event.
  - For this part of this project, we are considering Davidson County, TN, due to availability of data on roadway damages from the 2010 flood event to “validate” the impacts “scores” from the survey. We hope to develop relationships between inundation, roadway characteristics, and damage costs.
- Task 2
  - Developed “scenarios” for future “worst case” conditions with respect to flooding at a county level using University of Georgia’s downscaled climate data for mid-century time period.
  - Future mid-century 500-yr storm event will be similar to today’s 1000-yr event.
  - Identified 4 key counties that are of concern for the future with regards to heavy precipitation, performed drill-down of two adjacent counties in middle-west Tennessee.
  - We also used the FHWA’s CMIP Climate Data Processing Tool to better understand the mid-century projections for daily precipitation for the counties of concern.
- Task 3
  - From another project, we have identified critical transportation assets in Tennessee. We may test the methodology used for another state for this project.
  - Identified key transportation assets in the counties identified to be most at risk due to future precipitation.
  - Performed Hazus model simulations for 500-yr and 1000-yr precipitation events to identify bridges, highways, and other transportation at risk for the counties of concern.
  - Utilized FHWA’s Vulnerability Assessment Scoring Tool (VAST) to develop vulnerability scores for transportation infrastructure assets at risk (only for demonstration purposes of how it could be utilized due to lack of detailed information about individual infrastructure assets’ condition, etc.)
    - Originally focused on bridges, but we are now looking at roadways.

**Specific objectives:**

- Estimate the direct and indirect economic impacts of various flooding scenarios on truck, rail and barge transportation by developing economic loss/damage functions based on the extent and level of flood inundation.
- Use models for a case study region to gain insights into the magnitude of economic impact that flooding has on truck, rail and barge operations.
- Identify those portions of the network that are considered most at economic risk due to their vulnerability to flooding and the strategic importance of the route segment relative to local, regional and national freight mobility.

- No significant results. We did find that much more information is required to use VAST for developing vulnerability scores. We may have developed a new approach/methodology for screening-level identification of transportation infrastructure assets at risk for future high precipitation events.

***Dissemination:***

- The undergraduate student that worked on the project in summer 2015 presented his work at a Vanderbilt University School of Engineering faculty meeting poster session in September where all undergraduate students involved in summer research presented their work.
- Janey Camp presented research findings at Hazus National User Conference in Atlanta in December 2015 and again at a TRB Subcommittee meeting in January 2016 as a result of that presentation.

***Collaborating organizations:***

- University of Memphis
- We have involved the Tennessee Department of Transportation and other local transportation agencies to assist with distribution of the survey, etc.

***Changes:***

- We were unable to obtain a graduate student to work on the project full time and have thus utilized an undergraduate student worker.
- Janey Camp, PI, was out on maternity leave for 3 months of the fall semester of 2015 which prevented much progress during this time. This resulted in no charges to this for her salary for 3 months in the fall.
- Due to not having a fully dedicated graduate student, we have not spent out the funds as quickly as anticipated.

**CFIRE 09-20: Estimating the Future Agriculture Freight Transportation Network Needs due to Climate Change using Remote Sensing and Regional Climate Models**

Performing Institution: Vanderbilt University

Start Date: July 1, 2014

***Major activities:***

- Held project meetings/conference calls.
- Continued evaluating crop data (acreage by crop type and year at the county level) from the National Agricultural Statistics Service.
- Continued identifying “extreme” weather events that may impact crops from the National Weather Service data repository.
- MTSU has processed additional data and created shapefiles from that including crop production estimates for corn in the upper Midwest – provided to VU recently
- We’re considering what “ideal” growing conditions are required for corn production for consideration under future climate projected conditions.

**Specific objectives:**

- Evaluate recent trends in crop yields and shifts using remote sensing technology.
- Develop any correlations between historic regional climate and crop yield/growing patterns for use in future projections.
- Approximate future locations of crops that will be grown in upper Midwest in 2050 using extrapolation of historic crop data from remote sensing, correlations that have been developed between climate and crop yield, and future climate predictions from the regional climate models.
- Use projected crop areas and climatic projections to estimate yield at appropriate harvesting times as input into freight routing and demand tools.
- Provide an estimate of the multi-modal demands and routes for freight to move agriculture from Midwest to lower Mississippi for export.
- Defined region of focus and gathered crop data for corn (we decided to focus on one crop to keep it manageable as an initial study)
- Choosing corn as the focus was based upon availability of data. However, many other factors would come into play on future projections such as global demand, ethanol production trends, etc. Therefore, we will likely include a range of scenarios for consideration and qualifying statements about our focus and any assumptions made.
- Evaluating potential for agent-based modeling (e.g., AnyLogic software) to look at freight network interactions, etc.

**Dissemination:**

- Report on Wisconsin stakeholder interviews has been shared/presented with (1) the Mayors of the Mississippi River, (2) USDA Northcentral Climate Hub, and (3) Cereals and Climate Change Conference.

**Products:**

- Report on Wisconsin stakeholder interviews has been shared/presented with (1) the Mayors of the Mississippi River, (2) USDA Northcentral Climate Hub, and (3) Cereals and Climate Change Conference.

**Collaborating organizations:**

- Middle Tennessee State University
- University of Wisconsin-Madison

**Changes:**

- Shifted focus region back to Upper Midwest from Tennessee due to newly obtained funding for Wisconsin partners.
- MTSU's effort was reduced due to lack of graduate student availability to work on the project.
- Janey Camp, PI, was out on maternity leave for 3 months of the fall semester of 2015 which prevented much progress during this time.

## CFIRE 09-22: Implementation and Field Evaluation of Pretensioned Concrete Girder End Crack Control Methods

Performing Institution: University of Wisconsin–Madison

Start Date: July 1, 2014

### **Major activities:**

- Project Final Report was completed and submitted to sponsors.

### **Key outcomes:**

- Debonding designs for precast prestressed girders was recommended to WisDOT to control girder end cracking.

### **Dissemination:**

- Dissemination through WHRP research report, conference proceedings and submitted journal paper.

### **Products:**

- Okumus P., E. Kizilarlan, M. Oliva, “Anchorage Zone Cracking Evaluation in Debonded Deep Bulb-Tee Bridge Girders.” Precast/Prestressed Concrete Institute Convention and National Bridge Conference, Nashville, March 1-5, 2016
- Designs for prestressed highway bridge girders have been developed and submitted to WisDOT for adoption as standards.

### **Collaborating organizations:**

- Subcontractor: Prof. P. Okumus, University at Buffalo, Buffalo N.Y.

## CFIRE 09-23: Synthesis of Best Practices for Agency-wide Freight Data and Information Management

Performing Institution: University of Wisconsin–Madison

Start Date: September 1, 2014

### **Major activities:**

- Mr. Wessel conducted a literature review on the state of practice in freight data synthesis and management and evaluated the usability of self-assessment tools in the National Cooperative Highway Research Program (NCHRP) report 814 for this project (found at <http://www.trb.org/Main/Blurbs/173470.aspx>). Mr. Wessel, Ms. Hart, and Professor Adams determined that not all parts of the NCHRP tool were necessarily relevant to data collection. Professor Adams and Mr. Wessel tested a simple data collection method to build matrices of freight activities, data entities, data sets, and business areas with the Wisconsin DOT. Professor Adams and Ms. Rogers evaluated that method and found that it was not entirely comprehensive. Ms. Rogers built a survey that modified the functionality of the NCHRP tool to additionally produce the necessary matrices. Ms. Rogers customized the survey with default responses by state. Professor Adams began the distribution process with the ten Midwestern state planning divisions.

### **Specific objectives:**

- This project will provide a snapshot of the current state of data management at each state Department of Transportation (DOT) in the Mid America Freight Coalition (MAFC).
- Analysis will indicate the maturity of freight data management as well as an analysis of each DOT's freight data architecture.
- A point person in the planning division of each DOT is currently being identified. This person will provide our office a list of data experts. Ms. Rogers will distribute the survey individually to each expert, and assist them if necessary. Upon completion of the survey, we will produce a comparative report of the results. We might also expand distribution of survey beyond planning divisions.

### **Dissemination:**

Professor Adams has emailed the planning directors of all the DOTs.

## **Education and Workforce Development**

### **Michigan Technological University**

- **Family Science & Engineering Nights.** Conducted 3 Family Science & Engineering Nights at elementary schools in the western Upper Peninsula where K-6 students and their parents participate in hands-on STEM activities conducted by MTU students as role models. STEM transportation activities presented included “Stop, Look & Listen” on traffic safety and “Engineering a Life Preserver.” MTU students included both young men and women, and one African American MS graduate student. Events were held at:
  - CJ Sullivan Elementary in L’Anse – Feb. 8 (has a high Native American student population; located on the Keweenaw Bay Indian Reservation in Baraga County)
  - Chassell Elementary in Chassell – March 1
  - Houghton Elementary in Houghton – March 15
- **Teacher Institutes for Detroit Teachers.** Successfully wrote a grant to the Michigan Space Grant Consortium to provide five, \$500 travel stipends for Detroit teachers to attend two 5-day teacher institutes at Michigan Tech University in Summer 2016. Five Detroit K-12 teachers were recruited, a 500% increase over past years! Applicants included several teachers who attended the three transportation education workshops offered in Detroit in Spring 2015, illustrating that we are building a positive relationship with urban Detroit teachers. Institutes were:
  - Engaging Your Students in Authentic Science Research June 27-July 1, 2016
  - Designing a Sustainable Future July 11-15, 2016
- Continued work on the transportation education activity kit which was piloted by one teachers.
- Continued work on the transportation web module for middle/high school students and the public.
- Conducted 6-week After School Science class for fifteen students in grades 2-5 on the Physics of Motion from April 7 – May 16. Students explored motion in our world through investigations involving the principles of physics. They designed rockets, roller coasters, aqueducts, and catapults to discover the relationship between energy and motion through engaging, hands-on activities.

## University of Memphis

- **Graduate Certificate in Freight Transportation established at U of M.** This certificate will enable individuals with science or engineering bachelor's degrees to expand their analytical, practical, and problem-solving skills in the area of freight transportation (e.g., supply chain and logistics, maritime transportation, rail transportation). The certificate will also enable them to transition and pursue advanced degrees (Master's or Ph.D.).
- **Girls Experiencing Engineering.** This is a fast-paced, interactive summer program for middle school and high school girls. The goal of the GEE program is to increase the number of girls pursuing careers in STEM fields (and particularly transportation and engineering) by offering them an opportunity to increase their awareness and interest in these disciplines. The program involves daily guest speakers, design challenges, and a tiered mentoring system of high school and college students and faculty. The students who participate in the program are diverse, and participant demographics are approximately 85% African-American, 10% Caucasian, and 5% Hispanic. The 2016 program was conducted the weeks of June 6-17 and 82 middle and high school girls participated along with 13 high school and 8 college student mentors. The GEE program has served 926 distinct students as of 2016 (1415 total students including repeat participants). Of the 520 former tracked participants that have now graduated high school, 32% are now enrolled in STEM majors in college, 26% are enrolled at the U of M, and 79% are in college. Even more exciting, of the students that have served as mentors who have graduated from high school, 86% are enrolled in STEM majors and 100% are in college.
- **The Choosing Transportation Summit.** This is an annual conference hosted by the Southeast Transportation Workforce Center and the Intermodal Freight Transportation Institute. The conference engages regional transportation professionals in sessions related to innovative workforce practices, exciting industry trends and technology advances, and allows them to interact with transportation leaders from across the country. For 2016, sponsors CN, Peer Power, and Vaco Logistics provided the opportunity for over 200 high school students to participate in the event and to network with transportation professionals and learn about potential career pathways. Additionally, all IFTI undergraduate and graduate student assistants served as event guides and mentors to the high school students in attendance, and multiple CFIRE consortium members from the southern hub participated as speakers or panelists. An outgrowth of the Choosing Transportation Summit is a new Transportation Academy program launched in July 2016. Shannon Campbell participated as a panelist

## University of Southern Mississippi

- Presented USM LTT program with Mississippi Gulf coast Community College teachers, April 20, 2016
- Presented USM LTT program and CFIRE projects findings to local SOLE members, June 7, 2016
- Provided technical support to create a Logistics associate degree program at the Hinds Community College, Jackson, Mississippi
- USM was contracted to write four local workforce plans for the Mississippi Association of Workforce Development Areas of which the outlook of transportation, warehousing, and distribution jobs were included in the comprehensive plan.

- USM presented its findings of a Land Re-Use Feasibility Study for Marshall County Industrial Development Association. The study was requested to assist with planning decisions where transportation infrastructure changes are making Marshall County a prime location for growth in warehousing, distribution, and manufacturing jobs.
- The University of Southern Mississippi and Naval Air Command (NAVAIR) co-hosted a planning meeting for the South MS Military Corridor whose members are seeking to strengthen the military logistics presence in the region and promote economic development. The planning meeting included leaders from Camp Shelby, Gulfport Readiness Training Center, Mississippi Development Authority (MDA), Mississippi Power, Port of Gulfport, Theater Aviation Sustainment Maintenance Group, and local economic developers. The meeting included briefings from the various organizations and development of action steps to move the effort forward. The recent Port of Gulfport strategic port designation was identified as an opportunity to make the region a national focal point for foreign military sales. The group identified a need for an inventory of assets including workforce capabilities. MDA will be assisting the effort with branding and marketing. A joint summit is planned for the spring to bring military leaders, defense suppliers, and international military buyers to the Mississippi Gulf Coast to better understand the many opportunities for them for expanded business and operations in the region.

#### ***UTC-Funded Graduate Assistant Major Activities***

1. Grenada Short Line Outreach Assistance
  - a. Researched the history of the Grenada Railway.
  - b. Researched commercial possibilities for the railway.
  - c. Researched the supply chain of large scale suppliers in the region surrounding the railway.
  - d. Create economic overview report of region in EMSI
  - e. Created a report detailing the results of the research.
  - f. Created a presentation to accompany report.
  - g. Use the Freight Analysis Framework Data tool to research amount of freight moving through the rail region.
2. Assisted with Pike County I-55 Convention Center Project
  - a. Researched convention centers and large scale meeting spaces in regions similar to Pike County MS.
  - b. Compared demographic and transportation information of Pike County to other counties with convention centers similar to the one proposed.
3. Assisted with Port of Gulfport study
  - a. Researched tourism related businesses in MS coastal region and compile a summary of findings.
4. Tennessee–Tombigbee Waterway Proposal Assistance
  - a. Research history of the Tenn-Tom waterway
  - b. Research commercial possibilities in the region affected by the waterway.
  - c. Compile information from the Appalachian Regional Commission to be put into grant proposal.
  - d. Write grant proposal for the Tenn-Tom Waterway.
5. C-Spire Supply Chain Analysis

- a. Create an economic model of C-SPIRE using IMPLAN.
- b. Conduct an impact analysis using IMPLAN
- c. Create report detailing findings from the impact analysis.

### **Education**

- USM has awarded 4 Masters Degrees in logistics, trade and transportation in Spring 2016
- USM has delivered 3 logistics & supply chain courses on \_\_\_\_\_ -line in the Spring 2016
- At least 8 MS-LTT students performed research projects on logistics transportation areas as part of their course requirement in the Spring 2016.

### **University of Wisconsin–Superior**

- **Girls Scout Transportation Day.** The 20 Girl Scouts who participated in the Girl Scout Transportation Day on June 23, 2016 took away the knowledge about the five modes of transportation by climbing aboard a semi-truck cab, putting together a pipeline (PVC pipe) and learning how it works, making paper airplanes and learning why things fly, touring the William A. Irvin, and taking a train ride. This was the first event of its kind in the Twin Ports Area.
- Seventh successful year providing industry seminars. April 19-20, 2016 hosted a two-day Import Export Seminar for regional business that employ over 500 individuals.
- Offering an on-line certification program for industry
- Increased enrollment in the transportation and logistics management major

### **Vanderbilt University**

- Held GIS workshop for metro Nashville middle school teachers
- Supported graduate student information needs and resource requirements
- Sponsored travel to relevant transportation, GIS and risk assessment forums and training sessions
- Supported student and faculty research and educational needs

## **Technology Transfer**

### **University of Southern Mississippi**

#### ***TRB annual meeting participation by USM Faculty***

Drs. Sarder and Miller attended this meeting. Dr. Sarder served in the following TRB committees. 1) Transportation Research Board (TRB) - Intermodal Freight Terminal Design and Operations (AT050) Committee, 2013-2019 -Member

2) Transportation Research Board (TRB) - Intermodal Freight Transport (AT045) Committee, 2011-2017 - – Research Coordinator

#### ***MODEX 2016 Conference Participation by USM Faculty and Students***

Recently, a group of seven Logistics, Trade and Transportation graduate students and Industrial Engineering Technology undergrad students led by Dr. Sarder participated MODEX 2016

conference in Atlanta, GA. About 200 students from different US universities including MIT, Virginia Tech, Auburn University, etc. participated this event from April 5-7. MODEX 2016 conference provided unique opportunities for these students to hear from one of the greatest entrepreneur Mr. Kevin O'Reilly who plays Mr. Wonderful in TV show "Shark Tank", logistics & material handling solutions in action, and tours of several facilities including Mazda, Interroll, Norfolk Southern, and Sealed Air/Packforum Americas. The trip was funded by Materials Handling Institute (MHI).

#### ***IISE 2016 Conference Participation by USM Faculty & Students***

Dr. Sarder, an associate professor and program coordinator of LTT program, served as chair of the Institute of Industrial & Systems Engineering Research Conference (ISERC) 2016 in Anaheim, California, May 21-24. The ISERC is the premier conference within the Industrial and Systems Engineering discipline. This conference attracted about 2,000 industrial and Systems Engineering students and professionals from more than 30 countries. The conference offered more than 250 research sessions, 40 applied sessions, 60 joint sessions, and 31 panel sessions concurrently in 21 rooms for three full days. The keynote speakers included Mr. Brian Betts, Vice president of operations planning and insights, Walt Disney Parks & Resorts and Dr. Phil Kaminsky, Professor and Chair of Industrial Engineering and Operations Research, University of California, Berkeley. Please find more information in the following link. <http://www.iienet2.org/annual2/>. Two LTT graduate students also participated and presented CFIRE research findings in this conference.

#### ***TRB midyear meeting participation by USM Faculty***

The midyear meeting of the TRB Intermodal Freight Transport Committee (AT045) was held on April 11th 2016 in conjunction with the 2016 Freight in the Southeast Meeting (New Orleans LA). Several speakers covered freight transportation topics from different perspectives. The Port of New Orleans presented its history and importance for the regional and national economy, especially for grain exports and coffee imports. CLTT IAC member Stuart McAvoy (UPS) presented about the main activities of the UPS operating model (packages, freight, and contract logistics), and several new initiatives taking place at UPS: Access Point Network, Field Stocking Locations, UPS-USPS partnership, and customized solutions. Drs. Sarder and Miller attended this meeting.

#### ***USM's Logistics, Trade & Transportation Advisory Council***

The Advisory Council met on February 19, 2016 to provide guidance on outreach services and insights on industry trends. Members of the council include:

- Todd Davis, ABF Freight
- Jennifer Steele, UPS
- Jeff Ely, MS Dept of Transportation
- Robby Burt, MS Dept of Transportation
- Mike Salvetti, Ingalls Shipbuilding
- Cole Trosclair, The Irwin Brown Company
- Stuart McAvoy, UPS
- Lee Wagner, Wester Express
- Eyler Coates, Ingalls
- Clint Walker, Dept of Defense
- Barry Wilkie, Ingalls

### ***USM College of Business Recognized Entrepreneurs of the Year***

Tommy Duff, CEO of TL Wallace Construction and KLM Trucking—USM College of Business recognized Tommy and his brother, Jim, as Entrepreneurs of the Year.

### **University of Wisconsin—Milwaukee**

- Continued work on the Oversize Overweight (OSOW) truck data from Wisconsin, Iowa, and Illinois.
- Continued enhancement of the OSOW portal to increase reliability of data access and matching that currently reached 98% level
- Added component to the OSOW tool portal to allow the inclusion of new and future permit data to the historical database
- Designed and conducted survey to evaluate the OSOW tool portal by DOTs in the Midwest region of the US to obtain feedback about the product
- Developed computer application to estimate/predict the resilient modulus of aggregate base layers for use in the mechanistic empirical pavement design
- Completed analysis to compare computed tomography analysis with laboratory tests from mercury porosimetry
- Enhance the OSOW tool to reach high reliability to help WisDOT freight engineers in performing analysis on historical data needed for their evaluation/planning of freight movement on highway network
- Build an interactive and easy to use tool that allows WisDOT to incorporate current freight truck permit data into the database. The data is added on a quarterly basis.
- Presented the OSOW research results to the freight unit as well as OSOW permit unit at WisDOT
- Presented research results at TRB
- Published paper on OSOW research at ASCE Transportation Engineering Journal
- Deployed enhanced OSOW tool portal at UWM server and made it available to WisDOT

### **University of Wisconsin—Superior**

- Outreach to local industry (visits to manufacturers and transporters and participation in monthly trade organization meetings).
- Transportation Day for Girl Scouts (June 23, 2016)
- Mei Cao attended TRB Annual Conference, January, 2016
- Mei Cao reviewed for Journal of Operations Management
- Mei Cao reviewed for Production and Operations Management Journal
- Richard Stewart attended TRB Annual Conference, January, 2016
- Richard Stewart attended the Council of University Transportation Centers (CUTC) annual meeting January, 2016
- Richard Stewart reviewed for the Transportation Journal
- Richard Stewart attended the Transportation Research Forum Conference in Toronto Canada and presented two papers. (CFIRE funding was not used for this trip)
- Richard Stewart reviewed papers for the Transportation Research Board annual meeting

- Dr. Mei Cao was on a Sabbatical during this reporting period engaged in research.
- Richard Stewart served as member of the Freight Advisory Committee for the Wisconsin Department of Transportation. He participated in Committee meetings.
- Zamira Simkins participated in a bi-state economic analysis of the counties of Douglas, WI and St. Louis, MN.
- Collaborative research with CFIRE partner universities – participation in conference calls, serve on executive committee
- Richard Stewart serves as a member of the Board of Directors of the North Shore Scenic Railroad.
- Richard Stewart was served as member of the Freight Advisory Committee for the Wisconsin Department of Transportation. He participated in Committee meetings
- Richard Stewart 2014-Present Member Duluth International Airport Board of Commissioners
- 2014-Present Member Council of Great Lakes Governors Marine Task Force Advisory Panel
- Richard Stewart 2013-Present Member U.S. EPA Great Lakes Restoration Advisory Board
- Richard Stewart 2006-Present Member, Green Marine Environmental Committee
- Richard Stewart 2014-Present Member Transportation Research Board Committee: Logistics of Disaster Response and Business Continuity, AT065T.
- Richard Stewart 2004-Present Member, Transportation Research Board, Marine Environmental Committee AW030
- Richard Stewart taught online modules for Certified in Transportation and Logistics (CTL) program at University of Wisconsin-Superior on transportation economics and general management.
- Richard Stewart taught courses on campus on transportation economics, international & intermodal logistics, port & terminal management and land transportation (pipelines, railroad and trucking).
- Richard Stewart conducted a tour of Intermodal hubs in Chicago IL March 15- 19, 2016 with 12 students Transportation and Logistics students of the University of Wisconsin-Superior.
- To involve undergraduate students in research activities. Seven students were employed as undergraduate research assistants.
- Partnering with Girl Scouts to create awareness of the transportation industry and STEM opportunities with the younger female generation.
- To encourage students to participate in activities in preparation for professional and academic life beyond graduation. Forty students attended seven professional society meetings, symposiums and national conferences.
- Hosted the Institute of Supply Management (ISM) - Lake Superior Chapter General Meeting, February, 18, 2016, 45 students and industry representatives participated.
- Mei Cao brought seventeen Transportation and Logistics (T&L) students to Transportation Expo & Seminar, March 2015.
- Richard Stewart brought twelve Transportation and Logistics (T&L) students to CSCMP (Council of Supply Chain Management Professionals) Twin Cities Roundtable Spring

Seminar, April 15, 2016 to meet with industry leaders and participate in educational seminars.

### Vanderbilt University

- Participated in meetings involving TDOT freight research program
- Worked with Vanderbilt administration related to contract management and accounting
- Disseminated relevant CFIRE information to internal Vanderbilt community and externally to others
- Maintained transportation center website
- Kept abreast of and transfer knowledge related to CFIRE activities
- Implemented responsible project management practices
- Facilitated greater awareness of Center activities
- Promoted learning capabilities of Center personnel
- Enhanced communication, leading to a productive and well-recognized enterprise
- Resources utilized to provide enhanced research opportunities
- New decision-support methodologies and databases described on website and in presentations/publications

### Products

#### Publications

1. Ahmed, J., M. Ayuby, and MD Sarder. An inventory Model for a Multi Stage Supply Chain. *Proceedings of the Annual Industrial & Systems Engineering Research Conference (ISERC)*. Anaheim, California. 2016.
2. Ayuby, M. and MD Sarder. Assessing Reshorability of US Manufacturing Industries. *Proceedings of the Annual Industrial & Systems Engineering Research Conference (ISERC)*. Anaheim, California. 2016.
3. Ayuby, M., J. Ahmed and MD Sarder. Integrated Hands-on Experience on Students Learning of Logistics Seniors. *Proceedings of the Annual Industrial & Systems Engineering Research Conference (ISERC)*, Anaheim, California. 2016.
4. Banks, J.C., J. V. Camp and M.D. Abkowitz. A Screening Method for Bridge Scour Estimation and Flood Adaptation Planning Utilizing HAZUS-MH 2.1 and HEC-18. *Natural Hazards*, DOI 10.1007/s11069-016-2390-1. May 8, 2016.
5. Chen, D., S. Ahn, S. Bang, D. Noyce. Car-Following and Lane-Changing Behavior Involving Heavy Vehicles. Accepted in *Transportation Research Record, Journal of the Transportation Research Board*. (DOI: 10.3141/2561-11). 2016.
6. Coley, N., H. H. Titi, and V. Latifi, V. Mapping Overweight Vehicle Permits for Pavement Engineering Applications. *Journal of Transportation Engineering*. American Society of Civil Engineers, 10.1061/(ASCE)TE.1943-5436.0000875, 04016044. 2016.
7. Dulebenets, M., K. Pujats, D. Deligiannis, M. Golias, and S. Mishra. Development of Tools for Processing Truck GPS Data and Analysis of Freight Transportation Facilities. Submitted for publication in *Transportation Research Record*. 2017.

8. Dundon, L.A., K.S. Nelson, J. Camp, M. Abkowitz and A. Jones. Using Climate and Weather Data to Support Regional Vulnerability Screening Assessments of Transportation Infrastructure. *Risks*. 4, 28, doi:10.3390/risks4030028. 2016.
9. Dundon, L.A., M. Abkowitz and J. Camp. The real value of FracFocus as a regulatory tool: A national survey of state regulators. *Energy Policy*. 87 (2015) 496–504.
10. Haque, K., S. Mishra, R. Paleti, M. Gkolia, and A. Sarker. Truck Parking Utilization Analysis Using Truck GPS data. *Compendium of Papers in 95th Annual Meeting of Transportation Research Board*. National Research Council. Washington D.C. 2016.
11. Haque, K.; Sabyasachee Mishra; Rajesh Paleti; Mihalis M. Golia; Afrid A. Sarker; Karlis Pujats. "Truck Parking Utilization Analysis Using Truck GPS data." 2016. Transportation Research Record: Journal of the Transportation Research Board. Status of publication: Pending.
12. J. Chadde. Family Science & Engineering Nights are a "Vehicle" for Transportation Education. Midwest Transportation Workforce Center Website. May 3, 2016. <http://mtwc.org/2016/05/family-science-engineering-nights-are-a-vehicle-for-transportation-education/>
13. Miller, C. and J. Bolton. Economic Development Strategies for Fracking: The Case of the Tuscaloosa Marine Shale Play. Submitted to *Journal of Energy and Development*. 41(1). 2016.
14. Rapalo, V., S. Ivey, M. Hart, K. Schroeckenthaler, and T. Adams. Evaluation of Factors Affecting Livability in a Freight-Centric Community in Memphis, Tennessee. *Proceedings of the Transportation Research Board 95th Annual Meeting*. Washington, DC. January 2016.
15. Sarder, MD. Developing Master's Program in Logistics & Transportation. *Proceedings of the American Society of Engineering Education Conference (ASEE)*. New Orleans, Louisiana. 2016.
16. Stewart, R. and T. Hiroko. Japan Liquefied Natural Gas (LNG) Intermodal Container Operations: Applicability to U.S. Operations. *Proceedings of the Transportation Research Forum 2016 Annual Meeting*. May 2016.

## Presentations

1. Abkowitz, M. and Bickford, E. Stakeholder Tool for Assessing Radioactive Transportation (START): Background and Status. National Transportation Stakeholders Forum, Orlando, FL. June 2016.
2. Abkowitz, M. Enterprise Risk Management: The World According to Humpty Dumpty. Society for Information Management. Nashville, TN. June 2016.
3. Abkowitz, M., Jones, A., Dundon, L., and Camp, J. A Regional Approach to Assess Transportation Infrastructure Vulnerability to Extreme Weather Events. Adaptation Futures 2016. Rotterdam, Netherlands. May 2016.
4. Ayuby, M. Assessing Reshoring of US Manufacturing Industries. Annual Industrial & Systems Engineering Research Conference (ISERC). Anaheim, California. May 21, 2016.

5. Ayuby, M. Presentation on the research finding of Reshoring and its impact on U.S. transportation. 2016 Dr. Susan A. Siltanen Graduate Student Research Symposium. Hattiesburg, MS. March 24, 2016.
6. Camp, J. Presented research findings at a TRB Subcommittee meeting. January 2016.
7. Chen, D., S. Ahn, S. Bang, D. Noyce. Car-Following and Lane-Changing Behavior Involving Heavy Vehicles. The 95th Annual Meeting of the Transportation Research Board. Washington, DC. 2016.
8. Edil, T. Maintaining and Inspecting Railroad Track. Engineering Professional Development course.
9. Gholston, S. Presented at 2016 ASEE Annual Conference & Exposition. New Orleans, LA. June 27, 2016.
10. Haque, K., S. Mishra, R. Paleti, M. Golias, A. Sarker, and K. Pujats. Truck Parking Utilization Analysis Using Truck GPS data. Lectern session 472 at the 95th TRB Annual Meeting, Washington, DC. 2016.
11. Haque, K., S. Mishra, R. Paleti, M. Golias, A. Sarker, and K. Pujats. Truck Parking Utilization Analysis Using Truck GPS data. 2015. Poster presentation at the 9th Annual Intermodal Freight Conference. Memphis, TN.
12. Ivey, S. Creating Opportunities for Women in the Transportation Maintenance and Operations Workforce. Standing Committee on Maintenance and Operations Personnel: 95th Annual Transportation Research Board Annual Meeting, Washington, DC. January 11, 2016.
13. Ivey, S. Assessing Livability of Freight Centric Communities: Memphis Case Study. Invited Presentation at Southern District Institute of Transportation Engineers Annual Meeting, Nashville, TN, April 12, 2016.
14. Ivey, S. Choosing Transportation. PennDOT Secretary's Transportation Tomorrow Speaker Series. Pennsylvania Department of Transportation, Harrisburg, PA. May 4, 2016.
15. Ivey, S. Keynote Address. South Carolina Department of Transportation Annual Engineering Conference, March 22, 2016.
16. Lin, J. and W. Zhou. Is Electric Commercial Vehicle a Cost-effective Alternative to Diesel Commercial Vehicle in Urban Delivery? 28th European Conference on Operational Research, session on Routing in Practice. Poznan, Poland. July 3-6, 2016.
17. Lin, J., W. Zhou, and L. Du. Green Same Day Delivery with Real-time Demand. 28th European Conference on Operational Research, session on Green Vehicle Routing. Poznan, Poland. July 3-6, 2016.
18. Miller, C. Rooftops Versus Jobs: The Case of the Port of Gulfport. Annual American Society for Public Administration (ASPA) Conference. Seattle, WA. March 20, 2016.
19. Nelson, K., J.V. Camp, C.E. Philip, and M.D. Abkowitz. Navigable Inland Waterway Traffic Model for Evaluation of Tow Operation Procedures in the Context of Extreme Weather Events. 4th Biennial TRB-CMTS Research & Development Conference, Washington DC. June, 2016.

20. Okumus, P., E. Kizilarslan, and M. Oliva. Anchorage Zone Cracking Evaluation in Debonded Deep Bulb-Tee Bridge Girders. Precast/Prestressed Concrete Institute Convention and National Bridge Conference. Nashville, TN. March 1-5, 2016
21. Philip, C.E. and P. Johnson. Building Institutional and Social Resilience as a Response to Maritime Infrastructure Fragility. 4th Biennial TRB-CMTS Research and Development Conference. Washington, DC. June, 2016.
22. Philip, C.E. Commercial User Perspective, Resilience and Safety Data. 4th Biennial TRB-CMTS Research and Development Conference, Washington, DC. June, 2016.
23. Sarder, M. Presentation on the research finding of Reshoring and its impact on U.S. transportation. International Society of Logistics (SOLE) event. Ocean Springs, MS. June 7, 2016.
24. Sarker, A., S. Mishra, R. Paleti, and M. Gkolas. Modeling Path Based Reliability Using Truck GPS Data. Presented at the 95th Annual Meeting of Transportation Research Board, National Research Council. Washington D.C. 2016.
25. Stewart, R. Sustainable Development Where Rivers Meet Open Water: A Great Lakes Perspective. Marine Group (AW000) & Marine Environment (AW030): Session 708, Presentation P16-1805, Transportation Research Board Annual Meeting. Washington, DC. January 12, 2016.
26. Stewart, R., N. Burger, E. Hansen, and G. Johnson. An Analysis of the Status of Undergraduate Transportation Management Education in the United States. Transportation Research Forum Annual Meeting. Toronto, Canada. May 5, 2016.
27. Strozier, R. Presented transportation activities at three Family Science & Engineering nights in Spring 2016.
28. Titi, H. Evaluation of Spatial Variability in Compacted Aggregate Bases. Presented at the 2016 TRB meeting, Washington DC.
29. Titi, H.H., N. Coley, and V. Latifi. Evaluation of Pavement Performance due to Overload Single-Trip Permit Truck Traffic in Wisconsin. Presented at the 2016 TRB meeting, Washington DC.
30. Zietlow, B. GIS's Role in a USDOT National University Transportation Center. 2016 UW-Madison Geospatial Summit. Madison, WI. April 19, 2016.

## Websites

1. "A new transportation web module "From Sea to Shining Sea" for K-12 students and teachers has been created as part of this project. The web module provides an interactive way to engage youth (future workforce) in learning about the four primary transportation modes and careers in transportation. The module will be shared via the CFIRE website, Michigan Tech Alive website and will be emailed to all teachers attending past professional development workshops and summer institutes on transportation 2012 to present.
2. <http://k12-transportation.mtu.edu/intermodal/>
3. A video was created to share information about the Choosing Transportation Summit with high school attendees at <http://www.memphis.edu/ifti/>

4. A web-based tool was developed for public to calculate reshoring index for specific industries at <https://www.usm.edu/logistics-trade-transportation/reshoring-index-backup>.
5. [http://www.memphis.edu/gradcatalog/degree\\_planning/engr/civl.php](http://www.memphis.edu/gradcatalog/degree_planning/engr/civl.php) - Information regarding U of M Graduate Certificate in Freight Transportation
6. Information regarding U of M Girls Experiencing Engineering program: [www.memphis.edu/gee](http://www.memphis.edu/gee)
7. Story Map:  
<http://uwmad.maps.arcgis.com/apps/MapJournal/?appid=090c0247e1384fcf8092e664670cb0f5>
8. This online program satisfies the academic requirements to achieve CTL certification, an industry leading certification, through the American Society of Transportation and Logistics (ASTL).  
<http://www.uwsuper.edu/cee/certificates/transportation/index.cfm>
9. USM Center for Logistics, Trade & Transportation <https://www.usm.edu/logistics-trade-transportation>
10. Vanderbilt Center for Transportation Research (VECTOR) web site - <http://www.vanderbilt.edu/vector/>
11. Visualization: <http://www.wistrans.org/livability/MemphisLamarAve.htm>
12. [www.usm.edu/cltt](http://www.usm.edu/cltt) - Waiting to receive all reports to upload in this site.

## Collaboration

CFIRE has collaborated with the following organizations during the reporting period.

1. ABF Freight
2. American Society of Transportation and Logistics
3. American Transportation Research Institute (ATRI)
4. Applied Research Associates
5. Beijing Wuzi University, China
6. BNSF Railroad
7. Boys and Girls Club TTC
8. Business Transportation Solutions
9. Canadian National Railroad
10. Carrier/UTC
11. Center for Transportation Studies – University of Minnesota
12. Chartwell's
13. Choosing Transportation: Southeast Transportation Workforce Center
14. CN Railroad
15. Conway
16. Cornerstone
17. Council of Supply Chain Management Professionals (Twin Cities and Northeast Wisconsin Roundtable)
18. Dept of Defense
19. Duluth Superior Transportation Association

20. Emmanuel Center
21. Enbridge
22. Federal Highway Administration
23. FedEx
24. FracFocus
25. Franklin Furniture Institute, MSU
26. Fraser Shipyard
27. Frito-Lay
28. GKM Incorporated
29. Great Lake Fleet
30. Great Lakes Maritime Research Institute
31. Halvor Lines
32. IANA
33. IFTI
34. Ingalls Shipbuilding
35. Institute for Trade and Transportation Studies
36. Intermodal Association of North America
37. Intermodal Freight Transportation Institute
38. Johnson Controls
39. Kimley Horn
40. KLM Trucking
41. Lake Michigan Air Directors Consortium (LADCO)
42. Lake Superior Pilot Program
43. Lake Superior Railroad Museum
44. Livable Memphis
45. Mallory Alexander
46. Marten Transport
47. Metro Nashville Government
48. Metropolitan Interstate Committee
49. Middle Tennessee State University
50. Mississippi Oil and Gas Board
51. Mississippi State Port Authority
52. MS Dept of Transportation
53. MS State Port Authority
54. Nashville Metro Schools
55. National Association of Purchasing Managers (Lake Superior Chapter)
56. National Oceanic and Atmospheric Administration (NOAA)
57. Neel Schaffer
58. NOAA
59. North American Regional Climate Change Assessment Program (NARCCAP)
60. North Shore Scenic Railroad

61. Peer Power Foundation
62. Pepsi Co.
63. Powers-Hill Design
64. Prime Focus LLC
65. Reshoring Initiative
66. Rihm-Kenworth Trucking
67. Shelby County Schools
68. Southeast Transportation Workforce Center
69. St. Lawrence Seaway Development Corporation
70. Streets Ministries
71. Tennessee Department of Community and Economic Development
72. Tennessee Department of Transportation
73. The Irwin Brown Company
74. TL Wallace
75. TVA
76. Twin Cities Transportation Club
77. U.S. Energy Information Administration
78. University of Le Harve, France
79. University of Minnesota Duluth
80. UPS
81. URETEK ICR
82. URETEK USA
83. US Army Corps of Engineers – Memphis District
84. USDOT
85. Vaco Logistics
86. Wester Express
87. William A. Irvin Ship Tours
88. Wisconsin & Southern Railroad
89. Wisconsin Department of Transportation
90. Wisconsin Economic Development Corporation
91. Wisconsin Manufacturers & Commerce
92. Women’s Foundation for a Greater Memphis

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