

CFIRE

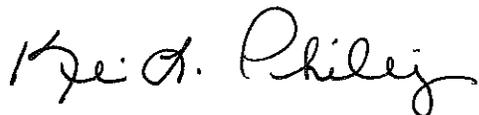
Program Progress Performance Report: July 1, 2016 to December 31, 2016

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National Center for Freight & Infrastructure Research & Education
Department of Civil and Environmental Engineering
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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 July 1, 2016 to December 31, 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:

Nearing completion of web version of the routing tool

Specific objectives:

Make web version of routing tool available for transportation stakeholder use.

Significant results:

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.
- Technologies or techniques (Identify the technologies or techniques that have resulted from the research activity and how they are being shared).
- 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.

Impact:

- Leverages latest databases and spatial analysis techniques to improve transportation decision-maker knowledge and awareness.
- Will provide access to a tool that will improve workforce productivity, efficiency and effectiveness.
- Can help improve understanding of transportation efficiency, safety, security and environmental impacts relative to the provision of freight to serve societal needs.

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:

Final report submitted.

Dissemination:

Information related to this project was disseminated through traditional presentations and publications but also through community meetings, stakeholder survey events, and high school summer outreach programs in Memphis.

Products:

- Publications:
Ivey, S. (2016) "Assessing Livability of Freight Centric Communities." 2016 SSCET Symposium and Jackson State University Engineering Forum. August 26.

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:

Both high school and college students have been engaged as part of this project and exposed to transportation career pathways related to livable communities.

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:

Finalize final report.

Specific objectives:

Submit final report.

Products

A web-based tool is developed for this project. The tool has two components:

1. A "Knowledge Center" that contains summaries of all of the data and information collected during this project on non-destructive methods applicable to infrastructure systems and materials.

2. A decision-making expert system for selecting appropriate methods for diagnose and assessment of structural distress.

Collaborating Organizations

- University of Wisconsin-Madison
- University of Wisconsin-Milwaukee

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.

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

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

Performing Institution: University of Wisconsin–Madison

Start Date: October 1, 2014

Major activities:

- Submitted a paper to TRB on the methodology for the Summit
- Developed demographic projections for Region V
- Completed an inventory of K-12 transportation awareness resources
- Completed an inventory of major transportation stakeholder resources
- Completed an inventory of transportation educational resources

Specific objectives:

- The paper's objective was to disseminate "Collective Impact" framework as a new approach for collaborative work
- The demographic projections were broken into age groups to understand for under 21 availability of workers for the transportation industry, especially trucking
- The inventories of Region V will populate the Midwest Transportation Workforce Clearinghouse
- There are some high school activities that are free for students, for examples programs funded under the National Summer Transportation Institute. In these programs, students are generally from the local area. However, there are many programs focused on Grades 5-12 that are offered within Region V with students coming from all over the country, including abroad. While these may be more general STEM or focused on many types of Engineering, geography is not a barrier

Key outcomes:

- Paper to TRB was accepted as a committee presentation
- A Midwest Transportation Workforce Center Clearinghouse debuted in November 2016

Collaborating Organizations:

- The projections were developed by the Applied Population Laboratory at the University of Wisconsin-Madison. The grant supported this work.
- Nexttrans

Impact:

- The Collective Impact Frame as described in the paper is different than current models of collaboration used by the transportation sector. One salient feature is that the framework requires partners to commit to establishing common metrics which assist in quantifying the progress of an initiative.
- The Clearinghouse data can serve as a baseline of transportation workforce activities in the Region as well as provide some analysis on gaps.
- The Clearinghouse resources will help establish the MTWC as a One-stop for Transportation Workforce development.

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:

Reporting nearly finalized reflecting updated air quality modeling platform to coincide with U.S. EPA's most current Annual Emissions Inventory.

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 1 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 NO₂ and ozone.

Dissemination:

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.

P.I. Meier is no longer with UW-Madison and, with apologies, this is creating a slight delay in finalizing the reporting - anticipated in Q1 2017.

Changes:

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

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

Performing Institution: University of Wisconsin–Madison

Start Date: September 1, 2014

Major activities:

Submitted two papers to TRB. One selected for lectern session and the other for poster.

Dissemination:

The report has been shared with Wisconsin legislators, and a meeting is currently being scheduled to discuss the results and conclusions and the implications for the state as it currently is debating what to do with the transportation budget with arguments for and against finding ways to raise revenues for the budget. We will be making the case that the legislature should pass legislation giving county and municipal governments the ability to form “Port Authorities” and give those counties and municipal governments the ability to support the newly formed port authorities with up to a 0.005% sales tax. Wisconsin currently manages its marine ports via a “harbor commission” structure, and has no structure for rail/inland ports- this makes Wisconsin the exception to the rule when compared to its neighboring states. By passing this legislation, it would increase ownership and associated leverage to the counties and municipal governments to invest in their local infrastructure and reduce the stress on WisDOT's non-highway programs- the Harbor Assistance Program, Transportation Economic Assistance program, Freight Rail Preservation Program, and the Freight Rail Infrastructure Improvement Program.

Collaborating organizations:

The Wisconsin Counties Association is facilitating the meetings with the legislature.

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:

Conduct the field application of polyurethane injection to improve rail substructure.

Key outcomes:

This project documents the results of a field study on the use of expanding rigid polyurethane (PUR) foam to remediate substructure deficiencies in a railroad track. The field site in Madison, Wisconsin consists of railway sidings owned by Wisconsin and Southern Railroad (WSOR). The necessary permits were processed and the geophysical investigation was completed. A

geotechnical and geophysical investigation was conducted including: Dynamic Cone Penetrometer, Sampling (for laboratory testing), Ground Penetrating Radar, and Electrical Resistivity. Soil profiles were developed as well as their in situ strength. This information was shared with URETEK CRI, who designed the polyurethane injection strategy for the field site using the given data. The field project was completed. PUR injected areas showed a higher track modulus with average track rating, i.e., 15 or more based on u-values; whereas, non-injected areas exhibit a poor track rating, i.e., mostly less than 10. Furthermore, the control point P.4 shows a 90% increase in track modulus (increase from 8 MPa to 15.2 MPa) after PUR injection.

The key products and achievements include:

1. A full geophysical and geotechnical report of the selected field site
2. Fully designed polyurethane injection location and pattern
3. Installation of selected instrumentation
4. PUR injection
5. Determination of the improvement by PUR injection in the field

Dissemination:

CFIRE 09-14, Field Validation of Polyurethane Technology in Remediating Rail Substructure and Enhancing Rail Freight Capacity, involves multiple entities. UW-Madison is working in conjunction with URETEK CRI, Wisconsin & Southern Railroad LLC to ensure success of the project. Information gained from the site investigation is shared with all parties. A news briefing with photos was prepared and released. Additionally there was a presentation in WisDOT Rail Conference and a technical paper is in preparation for an ASTM Symposium on railways.

Products:

The project is complete and it introduces a new technology for substructure improvement and remediation by polyurethane injection. Now it is completed, the technology will be widely shared.

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.

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

Performing Institution: Vanderbilt University

Start Date: August 1, 2014

Major activities:

- Completed development of a framework for helping municipalities determine equitable arrangement for having fracking companies provide compensation to maintain affected transportation infrastructure.
- Applied knowledge gained to locations in the 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.

Significant results:

In recent years, advances in technologies associated with hydraulic fracturing and horizontal drilling have provided access to vast reserves of oil and gas that were previously uneconomical to produce. Certain states have seen the largest increases in drilling activities over short time periods, and local townships and counties without sufficient financial resources have faced new challenges to maintain transportation infrastructure in the face of an unprecedented volume of heavy truck traffic on already aging roads not designed for such use. Many studies have now evaluated the impact of oil and gas development on roads, but small, local communities – where road impacts are felt the most – do not have the resources to utilize much of this information or conduct advanced local data-gathering and analysis. Using the Tuscaloosa Marine Shale (TMS) oil play in Mississippi as a case study, a methodology was developed for local planners to identify at-risk infrastructure and develop mitigation strategies. By using publicly available data, we were able to demonstrate how to determine which areas and routes are likely to be impacted and how to obtain and use data on water volume use per well, which correlates directly to road impacts and can serve as an important component for future planning.

Key outcomes:

Developed a practical approach to addressing road damage from oil and gas development tailored for small counties and townships.

Dissemination:

Publication in transportation research journal and presentation at national transportation research conference.

Products:

- Dundon, L., M. Abkowitz, J. Camp and C. Philip. "Assessing Impacts to Transportation Infrastructure from Oil and Gas Extraction in Rural Communities: A Case Study in the Mississippi Tuscaloosa Marine Shale Oil Play." Accepted for presentation in the Annual Meeting of the Transportation Research Board, and publication in Transportation Research Compendium.
- Framework for small counties and townships to estimate road damage from oil and gas development. Being shared through technical papers/presentations and website

Collaborating organizations:

- University of Southern Mississippi
- Mississippi Oil and Gas Board
- FracFocus
- U.S. Energy Information Administration

Impact:

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:

Final report was compiled and peer reviewed by advisory board members.

Dissemination:

- Results are disseminated by posting in the following websites:
 - Basecamp
 - CLTT website: <https://www.usm.edu/logistics-trade-transportation/reshoring-index-backup>
- Sarder, MD. presented research findings on "Reshoribility and its Impacts on US Transportation Infrastructure and Economy" to the Congressional Guides, visited to USM Gulf Park Campus on October 27, 2016.

- Sarder, MD. presented the research finding of Reshoring and Its impact on US transportation to the Transportation Group at Mississippi State University on November 11, 2016.

Products:

- Jaehoon Kim, Dr. Michael D. Anderson, Dr. MD Sarder (2017), Impact of Reshoring Phenomenon on Freight Flow in the U.S., 2017 TRB Annual Meeting (submitted).

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:

- Reshoring is not a myth and its happening. The impact of rapid shift of business dynamics between Asian countries (like China) and USA is going to be profound and challenging in coming years. Companies that have not done yet, should reassess their global sourcing foot-print. This does not mean China/Asian countries will disappear. China is still the highest exporter and second highest importer of the globe. But as the benefit at China is shrinking, companies must approach this potential paradigm shift carefully. There is no established rule of thumb to define this opportunity of reshoring. This research is a way forward to define this opportunity by applying macro-economic indicators. Moreover, it also opening opportunity for future research. Countries have their own strategy and tools to promote a particular industry. Import duties, tax waiver, economic and political alliance (like NAFTA) play important role for encouraging domestics manufacturing. Those factors were touched on border horizon but deserve more direct impact on reshoring decision. Long-lead time from Asian countries has an impact on inventory cost. If actual data of these factors can be incorporated for a specific industry and from a particular country, then the result (Reshorability Index) will be more close to reality. However, Reshorability Index, logistics cost and current business trend (Export/Import) will provide a complete picture of reshoring opportunity of a specific industry from a particular Asian country. Furthermore, the location quotient presented in this research provides the details of the regions which have skill manpower to support the relocation of the reshored manufacturing industries. The decision of reshoring is not that straight forward as US and China have very different socio-economic reality. We have accumulated those economic indicators to assess the reshoring potential for different US 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.
- The publications and web tool developed by this project can be used by any students, faculty, and researchers of any institutions for reference.

- This research methodology can be used to identify potential impact of any freight (containerized or bulk) volume increase or decrease due to reshoring in any level (State, Nation, Region, outside CFIRE region) on transportation infrastructure. Manufacturing quotient analysis and economic impact and identification of potential relocation sites can be done using the same methodology used in this study.
- The reshoring index and calculation tool will help US manufacturers to assess and evaluate their offshoring strategies.

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

Performing Institution: University of Alabama–Huntsville

Start Date: September 1, 2014

Major activities:

Nothing to report.

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 report.

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

Performing Institution: Vanderbilt University

Start Date: July 1, 2014

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.

Significant results:

- 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 at the Society for Risk Analysis Annual Meeting December 2016, in San Diego, CA.

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.

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:

- Continued evaluating crop data (acreage by crop type and year at the county level) from the National Agricultural Statistics Service (NASS)
- 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.
- We have performed principal component analysis on the crop data to identify what “factors” or drivers may have contributed to the shift in production seen over the past 35 years including to what extent policy-driven changes and/or climate (i.e. drought) may have played a role in production shifts. This has led to some really interesting findings!

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.

Significant results:

- 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.

Key outcomes:

It is highly likely that policy or other factors may play a larger role in shifts in agricultural production than climate change and therefore it is nearly impossible to correlate future climate projections to anticipated crop yield changes and possible shifts in the need for freight transport in the region.

Dissemination:

Two papers are in progress.

Products:

- Two papers are in progress.
- Python code has been developed to convert NASS data into useable GIS format
- The principal components analysis approach used has not previously been applied in this way in the past (as far as we know).
- Once we finalize our methodology and the results, we will try to publish the information.

Collaborating organizations:

- Middle Tennessee State University
- University of Wisconsin-Madison

Impact:

- Unfortunately, what we set out to examine related to demands on future freight infrastructure was thwarted by some of the initial literature review and investigation into prior shifts in crop yield leading to the realization that it may be nearly impossible to predict future demands based upon one or two single driving factors such as climate change.
- There are potential impacts on agriculture and other disciplines in knowing that policy and other factors may play critical roles in crop yield projections (or inability to predict long-range significant shifts) as opposed to the previous assumptions that climate would be a key driver in shifts.

Changes:

- We realized that a paper describing essentially the same idea was published right after this project was awarded and thus shifted our focus a bit to better understanding the drivers of agricultural shifts to know whether or not one could “predict” the correlation between climate change and shifts in agriculture to then discern the impacts on future freight demands. We wanted to prove or disprove their underlying assumptions on climate forcing a large shift in agriculture production in the future.
- Principal components analysis and other techniques used to identify the driving factors in the shifts in corn production were not considered early in the project, but have proved highly useful.
- The Wisconsin portion of the team was not notified of the project receiving funding (i.e., they did not receive funding until summer of 2015) and the budget was much less than requested for their portion of the work; therefore, they were not able to participate and contribute as much as previously desired
- MTSU’s effort was reduced due to lack of available graduate students.
- Janey Camp, PI, was out on maternity leave for 3 months of the fall semester of 2015 which prevented much progress during this time.

Education and Workforce Development

Michigan Technological University

- **Transportation Engineering After School Classes.** Conducted five 8-Week Transportation Engineering After School classes taught at South Range Elementary, CJ Sullivan Elementary (L’Anse), Barkell Elementary (Hancock), Dollar Bay Elementary, and Michigan Tech Great Lakes Research Center by MTU engineering students. Classes averaged 15 students per class = 75 elementary students.
- **Family Science & Engineering Nights.** Conducted a Family Science & Engineering Night on Nov. 2nd at Dollar Bay Elementary.
- **TRAC Workshops for Teachers.** Held TRAC workshop for teachers on Dec. 5, 2016. Transportation and civil engineering (TRAC) is a FREE program that provides teachers with curriculum-enhancing, hands-on lessons and tools for their math, science, engineering, and social science classes. TRAC provides teachers with hands-on tools for STEM (science, technology, engineering, and science) education and social studies.
- **Teacher Institutes.** Conducted a 5-day teacher institute on Designing a Sustainable Future that included a day focused on sustainable transportation.

Key Outcomes:

- 75 students attended the after-school classes on transportation engineering.
- 10 teachers attended the Design A Sustainable Future teacher institute. These teachers reach an average of 50 students per year for a total of 500 students reached per year for 10-20 years of a teacher's career.
- 52 students and their families participated in transportation engineering activities at Family Science & Engineering Night at Dollar Bay Elementary School. Adults = 19 and Students = 33.
- Thirteen middle and high school teachers from rural Upper Peninsula schools attended the TRAC workshop who will reach an average of 50 students per year for a total of 500 students reached per year for 10-20 years of a teacher's career.

Created an 8-week after-school curriculum for the transportation engineering after school class that can now be replicated.

Dissemination:

- An article was posted on Michigan Tech's website about the transportation engineering activity conducted by the engineers from Michigan Tech's Center for Technology & Training as part of the Family Science & Engineering Night at Dollar Bay Elementary School here:

<http://www.mtu.edu/unscripted/stories/2016/november/daisy-engineers.html>

- The above was also included in the MTU Department of Civil & Environmental Engineering's annual newsletter December 2016.

Impact

21 teachers who reach an average of 50 students per year for 10-20 years were introduced to transportation engineering via the TRAC teacher workshop and the Design Sustainable Future Teacher Institute which helps promote development of the transportation workforce.

An after-school curriculum focused on transportation engineering for elementary school-aged students was developed that can continue to be presented each year, and posted on the UW-CFIRE website as well as in the MTWC Clearinghouse for others across the country to also use.

University of Illinois Chicago

Dissemination

Our main dissemination is through conferences and academic journals. These include Transportation Research Board meetings (both research presentations and standing committee meetings), freight-specific conferences such as Meeting of the Institute of City Logistics. We also use the finds in classroom instructions for our graduate-level transportation courses throughout the campus.

University of Memphis

- **First Annual Transportation Academy** for high school students held July 11-15, 2016. The 2016 Transportation Academy included 20 high school students (10 male, 10 female) in a week-long full-day program at the University of Memphis campus that was designed to:
 - Expose students to transportation engineering and planning concepts

- Familiarize them with the US transportation system and its impact on our communities and economy
- Provide students with understanding of educational pathways in transportation
- Introduce students to a variety of transportation career opportunities.

The program included mini-lectures and research projects, hands-on design challenges, industry field trips, campus lab visits, and guest speakers from the local transportation community.

Program entrance (administered on July 11, 2016) and exit surveys (administered on July 15, 2016) assessed student's interests and shifts in perceptions over the course of the week. A parent survey was also emailed to all participants with the program acceptance packets in order to determine parents' perceptions related to the program and goals for their children. Parents were asked to complete and return the survey on the first day of the program. Eighteen parents responded to the survey and indicated that the primary reasons they encouraged their children to attend the program were to help them learn about career opportunities in engineering and science related fields (94%), to keep students engaged in learning activities over the summer (67%) and to expose students to a university environment (56%). Interestingly, only 4 parents (22%) reported that it was their child's idea to attend the program. Parents indicated that they would like their children to pursue an engineering or science career because of career variety (67%), rewarding career opportunities (61%), and because they believed their student would enjoy and has the potential to be successful in a career in engineering or science (55%). Two parents indicated they might not support their child's decision to pursue an engineering or science major because they do not know enough about these disciplines.

Twenty students responded to the program introduction survey and eighteen responded to the exit survey. When asked whether they were interested in majoring in computer/technology, engineering, science or math related majors, response percentages remained the same and generally high between the pre and post surveys, with the exception of computer/technology majors where 50% of students indicated interest prior to the program and 72% expressed interest at the end of the program. Students were also asked to respond to a series of perception questions on both surveys. Students indicated agreement with the following statements (% introduction survey/% exit survey):

- There are good jobs available for people with degrees in STEM (100%/100%)
- Transportation professionals make good money (88%/85%)
- Girls can do just as well as boys in transportation and engineering jobs (75%/89%)
- Being a science or engineering professional in transportation would be a fun job (35%/72%)
- I believe I have the ability to work in a STEM field (75%/89%)

Students also indicated the activities, field trips, and speakers helped them better understand the transportation industry (94%), how to pursue a transportation career (94%) and made them more interested in pursuing a transportation career (72%). These results and shifts in perceptions are important, as 72% of students also reported that programs such as the Transportation Academy are influential factors in determining the college major they will pursue after graduating from high school.

Participants of the 2016 Transportation Academy have continued to be engaged with IFTI throughout the academic year through a high school session held in conjunction with the JOC Inland Distribution Conference in November, 2016, and returning to campus for a college student panel in December 2016. The program will be continued in the summer of 2017 for a new cohort of students, with students from the 2016 program serving as mentors to the new students.

A significant number of participants from this year's conference were first-time attendees, which expanded our reach and engagement with organizations in the Mid-South region.

Students in the Transportation Academy were educated on a variety of transportation topics and industry practices throughout the program.

- **IFTI 10th annual State of Freight and inaugural Biologistics conference** held December 2, 2016. The IFTI State of Freight conference is held each year to bring together academic, community, public, and private sector stakeholders to learn about technological advances, changes in policy or legislation, and other trends expected to impact the freight industry. Over 150 regional professionals attended the IFTI annual conference. Participants of the 2016 State of Freight conference were educated on the state of practice and trends (both technology and policy/practice) changing the landscape of the freight industry.
- **Press:**
 - <https://www.logisticsforthelifesciences.com/logistics/gdps/fedex-institute-technology-and-ifti-hold-biologistics-event-week>
 - <http://www.commercialappeal.com/story/money/industries/logistics/2016/12/02/dot-chief-says-driverless-technology-poses-challenges/94826686/>
 - <http://www.ttnews.com/articles/basetemplate.aspx?storyid=44139&page=2>
- A partnership was developed with the University of Memphis Department of Physics through this program to help connect physics study to transportation application.
- The partnership with the FedEx Institute of Technology to deliver a Biologistics focused afternoon session brought together professionals from a variety of industries outside of traditional transportation agencies and companies, including those from the healthcare and security sectors.
- Twenty high school students and six undergraduate college mentors gained greater understanding on transportation career opportunities and education and training requirements.
- Our partnership with the Greater Memphis Alliance for a Competitive Workforce allowed us to make the industry professionals attending the conference aware of a new online and app-based program for recruiting potential employees to the transportation industry in the Memphis area.

University of Southern Mississippi

Outreach

- Attended Reshoring Summit at Mississippi State Extension Center in Biloxi, Mississippi to share CFIRE project with attendees on September, 2016
- Conducted a study to determine Mississippi Economic Developers transportation issues and information needs

- Supported the Port of Gulfport and NAVAIRS effort to promote the port's strategic port designation at a center for foreign military sales
- 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>

Education

- USM has awarded 5 Masters Degrees in logistics, trade and transportation in Fall 2016
- USM has delivered 4 logistics & supply chain courses on-line in the Fall 2016
- At least 10 MS-LTT students performed research projects on logistics transportation areas as part of their course requirement in the Fall 2016

University of Wisconsin–Superior

Outreach

- Mei Cao attended the 10th International Conference on Operations and Supply Chain Management (ICOSCM), Chongqing, China, July, 2016
- Mei Cao attended CSCMP's Supply Chain Management Educators (SCMEC), Orlando, FL September, 2016
- Mei Cao attended CSCMP's Annual Global Conference, Orlando, FL, September, 2016
- Mei Cao attended INFORMS Annual Meeting, Nashville, Tennessee, November, 2016
- Richard Stewart reviewed papers for the Transportation Research Board annual meeting
- Mei Cao reviewed for Journal of Operations Management
- Mei Cao reviewed for Production and Operations Management Journal
- Richard Stewart served on a successful Dissertation Committee for Samir Dhar the University of Toledo in Geography. His dissertation addressed the use of Automatic Identification Systems (AIS) in marine transportation

Education

- Richard Stewart attended the Intermodal Association of North America EXPO in Houston, Texas with 18 students. Three of the students participated in the intercollegiate debate on transportation and won first place. September 2016
- Co-hosted with Michigan Technological University the 7th annual Rail and Intermodal Summer Youth Camp
- Increased enrollment in the transportation and logistics management major reaching a record level of 106 in July 2016
- There were numerous presentations, student research activities and educational activities all addressing transportation
- Dr. Daniel Rust was hired as tenure track transportation faculty member
- Minnesota & CSCMP (Council of Supply Chain Management Professionals) Twin Cities Transportation Freight Symposium, December 02 2016 to meet with industry leaders and participate in educational seminars
- Increased transportation education from K-12 up through the Ph.D. level and also with industry

Dissemination

- Research Associate Cassandra Roemhildt and four students attended the Women in Trucking Association EXPO (November 2016) Cassandra and one of the students were on panels discussing transportation education.
- Contributions to non-academic magazines and journals
- Placed on university website
- Academic publishing
- Discussions with industry representatives

Vanderbilt University

- Enhanced learning about the profession and the opportunities present for career development
- Broadened awareness of ongoing freight transportation education, research and technology transfer at Vanderbilt and among other CFIRE institutions
- Greater awareness of transportation and its influence on economics, safety, security and the ecology

Technology Transfer

University of Illinois Chicago

The two main themes of our research work are:

1. The investigation of strategies that will lead to more efficient and environmentally sustainable last-mile delivery activities
2. Development of behavioral microsimulation model of freight activities

Investigation of Strategies

- Project 1.1. We continued the analysis of detailed freight survey data from Tokyo to understand how land use and land use policies affect the shipment distance in urban area. We found that decentralization of logistics facilities do not necessary increase truck travel because the trucks using newer, larger facilities in the suburbs tend to carry more goods per trip.
- Project 1.2. We have studied the optimum strategy to route electric trucks for urban deliveries. The products of this research are (1) an eco-routing tool that enables real-time on-the-go cargo consolidation service, (2) an electric vehicle routing tool that helps the penetration of EVs in freight industry, and (3) an ad hoc platform that enables collaboration among couriers such that resources are better utilized. These can be applied to future urban goods delivery e-markets, which will bring customers flexible, timely and economical logistics service while maximizing couriers' net gain through shared resources enabled by wireless communication and mobile computing. At the same time, the adverse effects of freight transportation on the environment will also be reduced, which makes the urban delivery service system more sustainable.
- Project 1.3. We investigated the effects of built environment on delivery truck operations in dense urban environment. We found that most (70%) of truck parking time is spent on waiting and conducting truck driver's personal business and rest instead of delivery

activities. Also, well-designed loading zones with sufficient length and enforcement to curb illegal use is the most effective physical treatment for reducing illegal truck parking.

Development of Behavioral Microsimulation Model

- We continue to improve the freight microsimulation model for the US. We have successfully improved the Freight Activity Microsimulation Estimator (FAME) model's ability to forecast the movements of farm products. The accuracy of models improved by; presenting another supplier evaluation model, and adding more data sources to make the models more realistic. The computational problems of the previous model were solved. A specific framework was introduced to capture the effect of cereal grain movements in the U.S. transportation network.
- Freight has been ignored or treated in an ad-hoc manner in urban planning. We are raising awareness for the impacts of freight, especially delivery trucks in dense urban environment, and also produced some preliminary results that can be used by the practitioners to improve their planning practices.
- Freight models lags behind passenger travel demand models. The framework of FAME's supply chain formulation model is being used by consultants and agencies for development of their models.

University of Southern Mississippi

MTI Conference. LTT team participated the 2016 Mississippi Transportation Institute Conference October 17-18, 2016 at the Jackson Convention Complex

Reshoring Project Completed. Reshoring and its impact on US transportation and economy project was completed by September 30, 2016. The final report was peer reviewed and submitted to funding agency

Research Needs Statements for TRB. Drafted two research needs statements for the TRB ADD10 Transportation & Economic Development

University of Wisconsin–Milwaukee

- Enhancement of the oversize overweight truck permit database that contains all overweight single-trip permits from May 16, 2007 through December 31, 2009. Inclusion of the dataset that contains all oversize single-trip permits (legal weight) and overweight single-trip permits issued from January 1, 2010 through December 30, 2016
- Improvements on the portal interface based on a survey that was sent to state DOT engineers/personnel in the freight division
- Improvements of portal search capabilities and out put
- Improvements of the portal base maps to include missing highway segments
- Implementation and use of the OSOW single truck permit database by Wisconsin DOT freight division
- Dissemination through web application: <http://pavement.ceas.uwm.edu/> . (Logon ID and password are required and can be obtained by contacting: Hani Titi (hanititi@uwm.edu) or Bill Wondrachek (Bill.Wondrachek@dot.wi.gov))

University of Wisconsin–Superior

- Richard Stewart served as member of the Freight Advisory Committee for the Wisconsin Department of Transportation. He participated in Committee meetings.

- Collaborative research with CFIRE partner universities – participation in conference calls, serve on executive committee.
- Collaboration with Michigan Technological University, University of Minnesota
- 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 serves as a member of the Board of Directors of the North Shore Scenic Railroad

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
- Supported graduate student information needs and resource requirements
- Sponsored travel to relevant transportation, GIS and risk assessment forums and training sessions
- Kept abreast of and transferred knowledge related to CFIRE activities
- Implemented project management practices
- Supported student and faculty research and educational needs
- 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
- Oral and written communication, including participation and presentation of relevant activities at professional meetings and educational training sessions
- Preparation of manuscripts for publication consideration
- New decision-support methodologies and databases described on website and in presentations/publications
- Ability to extend the state of the art related to freight transportation, risk assessment, and applications of geographic information systems (GIS)
- Greater recognition of the importance of the socio-technical interface in solving today's problems

Products

Publications

1. Abkowitz, M. and E. Bickford. Application of a Decision-Support Tool for Evaluating Radioactive Material Transportation Routing Options and Emergency Preparedness. Proceedings of the 18th International Symposium on the Packaging and Transportation of Radioactive Materials. 2016.
2. Abkowitz, M. and E. Bickford. Development of Rail Accident Rates for Spent Nuclear Fuel Rail Shipments. Forthcoming in Proceedings of Waste Management.
3. Abkowitz, M. and J. Camp. Structuring an Enterprise Risk Assessment Protocol: Traditional Practice and New Methods. Forthcoming in Risk Management and Insurance Review.
4. Abkowitz, M., A. Jones, L. Dundon, and J. Camp. Performing a Regional Transportation Asset Extreme Weather Vulnerability Assessment. Forthcoming in Transportation Research Procedia.
5. Adams, T.M. and M. Hart. From Self to Community: The Use of Powerful Questions at the Midwest Transportation Workforce Summit. Paper # 17-06865. TRB Annual Meeting. Washington, D.C. 2017
6. Ayuby, M. and M. Sarder. Assessing Reshorability of US Manufacturing Industries. Proceeding of the Annual Industrial & Systems Engineering Research Conference (ISERC). Anaheim, California. 2016.
7. Coley, N., H. H. Titi, and V. Latifi. (2016). Mapping Overweight Vehicle Permits for Pavement Engineering Applications. Journal of Transportation Engineering, American Society of Civil Engineers. DOI: 10.1061/(ASCE)TE.1943-5436.0000875. pp. 04016044-1– 04016044-13.
8. Dundon, L., M. Abkowitz, and J. Camp. Assessing the Impacts of Extreme Weather on Critical Transportation Assets: An Expert Elicitation Approach. Forthcoming in Climate Change and Transport: Making Mobility More Sustainable.
9. Dundon, L., M. Abkowitz, J. Camp, and C. Philip. Assessing Impacts to Transportation Infrastructure from Oil and Gas Extraction in Rural Communities: A Case Study in the Mississippi Tuscaloosa Marine Shale Oil Play. Forthcoming in Transportation Research Compendium.
10. Dundon, L., M. Abkowitz, J. Camp, and C. Philip. Assessing Impacts to Transportation Infrastructure from Oil and Gas Extraction in Rural Communities: A Case Study in the Mississippi Tuscaloosa Marine Shale Oil Play. Accepted for publication in Transportation Research Compendium.
11. Haque, K., S. Mishra, R. Paleti, M. Gkolias, and A. Sarker. (2016) 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.
12. Haque, K., S. Mishra, R. Paleti, M. Gkolias, 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.
13. Khaled, A., M. Hosseini, and M. Sarder. A General Framework for Resilience Assessment of Systems Using Bayesian Networks: A Case Study of Sulfuric Acid Manufacturer. Journal of Manufacturing Systems. Vol. 41: 211-227. 2016.

14. Kim, J., S. Ko, M. D. Anderson, and A. K. Mohammadian. Distribution Changes of Containerized Freights into the US by Maritime Network Capacity Increase. *International Journal of Traffic and Transportation Engineering*. 5(3), 73-81. 2016.
15. Li, Q., Y.M. Nie, S. Vallamsundar, J. Lin, and T. Homem-de-Mello. Finding Efficient and Environmentally Friendly Paths for Risk-Averse Freight Carriers. *Networks and Spatial Economics*. 16(1), 255-275. 2016.
16. Lin, J., Q. Chen, and K. Kawamura. Sustainability SI: Logistics Cost and Environmental Impact Analyses of Urban Delivery Consolidation Strategies. *Networks and Spatial Economics*. 16(1), 227-253. 2016.
17. Lin, J., W. Zhou, and O. Wolfson. Electric Vehicle Routing Problem. *Transportation Research Procedia*. 12, 508-521. 2016.
18. Miller, C. and J. Bolton. Economic Development Strategies for Fracking: The Case of the Tuscaloosa Marine Shale Play. *Journal of Energy and Development*. 41(2): 201-222. 2016.
19. Mills, A. Daisy and the Engineers. Michigan Tech. Michigan Technical University. November 24, 2016. Web. Accessed January 23, 2017.
<http://www.mtu.edu/unscripted/stories/2016/november/daisy-engineers.html>
20. Pourabdollahi, Z., B. Karimi, A. Mohammadian, and K. Kawamura. An Agent-based Supply Chain and Freight Transportation Model: Case Study For Chicago Metropolitan Area. *Transportation Research Board 95th Annual Meeting (No. 16-6517)*. 2016.
21. Rust, D. L. *The Aerial Crossroads of America: St. Louis's Lambert Airport*. St. Louis: Missouri History Museum Press, November 15, 2016 (ISBN 978-1-883982-89-8).
22. Sakai, T., K. Kawamura, and T. Hyodo. Logistics facility distribution in Tokyo Metropolitan area: Experiences and policy lessons. *Transportation Research Procedia*. 12, 263-277. 2016.
23. Sakai, T., Kawamura, K., and Hyodo, T. Location Choice Models of Urban Logistics Facilities and the Impact of Zoning on their Spatial Distribution and Efficiency 2. *Transportation Research Board 95th Annual Meeting (No. 16-6445)*. 2016.
24. Shurraba, M., N. Mandahawib, M. Sarder, and H. Takamatsua. The Assessment of a Two-Handed Pinch Force: Quantifying Different Anthropometric Pinch Grasp Patterns for Males and Females. *Applied Ergonomics* (accepted for publication). 2016.
25. Van Dyke, S., H. H. Titi, and R. ElHajjar. (2016). Comparison of CBR and Pin Puncture Strength Testing used in the Evaluation of Woven Geotextiles. *GeoAmericas 2016 Proceedings*. Volume 2, pp. 1287-1297.
26. Zietlow, B. R. E., E.B. Perry, T.M. Adams, S. Walljasper. Assessing Wisconsin Shippers' Proximity to Rail. Paper # 17-04807. *TRB Annual Meeting*. Washington, D.C. 2017
27. Zietlow, B.R. E., E.B. Perry, T.M. Adams, T. Sivappa, and S. Walljasper. Modal Diversion Estimates Using USDOT's ITIC-IM Model. Paper # 17-05187. *TRB Annual Meeting*. Washington D. C. 2017.
28. Zietlow, B.R.E., E.B. Perry, T.M. Adams, T. Sivappa, and S. Walljasper. (2017). Modal Diversion Estimates Using USDOT's ITIC-IM Model. Paper # 17-05187. To appear, *TRR. J. of the Transportation Research Board*. 2017.

Presentations

1. "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.
2. Abkowitz, M. "Application of a Decision-Support Tool for Evaluating Radioactive Material Transportation Routing Options and Emergency Preparedness." PATRAM, Kobe. September 2016.
3. Abkowitz, M., L. Dundon, and J. Camp. "Performing a Regional Transportation Asset Extreme Weather Vulnerability Assessment." World Conference on Transport Research. Shanghai, China. July 2016.
4. Camp, J. Research methodology and findings. Presented at the Society for Risk Analysis Annual Meeting. December 2016. San Diego, CA.
5. Camp, J., A. Shaw, and D. Whyte. "Use of Hazus and Regional Climate Models to Identify Vulnerable Transportation Infrastructure due to Future Extreme Precipitation Events." Society for Risk Analysis. San Diego, CA. December 2016.
6. 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." Presented at the 96th Transportation Research Board Annual Meeting and publication in Transportation Research Record. 2017.
7. Dundon, L., M. Abkowitz, J. Camp, and C. Philip. "Assessing Impacts to Transportation Infrastructure from Oil and Gas Extraction in Rural Communities: A Case Study in the Mississippi Tuscaloosa Marine Shale Oil Play." Accepted for presentation in the Annual Meeting of the Transportation Research Board. 2017.
8. Gong, Q. and T.M. Adams. Strategic Truckload Relay Network Design Considering Travel Time and Reliability. Paper # 17-06597. TRB Annual Meeting. Washington, D.C. 2017.
9. Haque, K., S. Mishra, R. Paleti, M. Mihalik, M. M. Golias, A. A. Sarker, and K. Pujats. "Truck Parking Utilization Analysis Using Truck GPS data." LECTERN session 472 at the 95th TRB Annual Meeting. Washington, D.C. 2016.
10. Haque, K., S. Mishra, R. Paleti; M. M. Golias. A. A. Sarker, and K. Pujats. "Truck Parking Utilization Analysis Using Truck GPS Data." Transportation Research Record: Journal of the Transportation Research Board. Status of publication: Pending. 2016.
11. Ivey, S. "Assessing Livability of Freight Centric Communities." 2016 SSCET Symposium and Jackson State University Engineering Forum. August 26, 2016.
12. Ivey, S. "Creating Opportunities for Women in the Transportation Workforce." TRB Webinar: The Evolving Surface Transportation Operations and Maintenance Workforce: Challenges and Opportunities. August 18, 2016.
13. Ivey, S. "Finding Critical Talent." Roundtable Think Tank. Journal of Commerce Inland Distribution Conference. Memphis, TN. November 8-10, 2016.
14. Ivey, S. "Transportation Job Needs and Priorities in the Southeastern United States." Tennessee Public Transit Association Annual Conference. Memphis, TN. October 26, 2016.
15. Ivey, S. and M. Powers. "Transportation Academy." Memphis-area WTS Chapter meeting. Memphis, TN. July 21, 2016.

16. Juni, E. and T.M. Adams. Two-stage Data Envelopment Analysis for Transportation Infrastructure Maintenance Management. Paper # 17-02484. Annual Meeting of the TRB. Washington D.C. 2017.
17. Miller, C. "Challenges of Rural River Ports." Mississippi Water Resources Annual Conference. Jackson, MS. October 21, 2016.
18. Miller, C. "Rural Ports: An Important Asset for Development." 2016 IEDC Annual Conference. Cleveland, OH. September 28, 2016.
19. Oberhart, E., E. B. Perry, S. Marion, T.M. Adams, and B. Zietlow. Utilization of Vacant Urban Land for Truck Parking: An Evaluation of Feasibility." Paper # 17-05261. TRB Annual Meeting. Washington, D.C. 2017.
20. Rust, D.L. "History of Commercial Aviation in the Upper Midwest." Presentation. Annual meeting of the Lexington Group. Duluth, Minnesota. September 28, 2016.
21. Rust, D.L. "History of Lambert-St. Louis International Airport." Showcase. Art of Travel event. Concourse B, Lambert-St. Louis International Airport. October 6, 2016.
22. Rust, D.L. "The Aerial Crossroads of America: St. Louis's Lambert Airport." Book launch at monthly meeting of Missouri Aviation Historical Society. St. Louis. November 17, 2016
23. Rust, D.L. "The Aerial Crossroads of America: St. Louis's Lambert Airport." Book launch. Missouri History Museum. St. Louis. November 16, 2016
24. Sarder, MD. "Reshoring and Its Impact on US Transportation." Presented to the Transportation Group. Mississippi State University. November 11, 2016.
25. Sarder, MD. "Reshoribility and its Impacts on US Transportation Infrastructure and Economy." Presented to the Congressional Guides. USM Gulf Park Campus. October 27, 2016.
26. Stewart, R. "Great Lakes Marine Transportation: Past, Present and Future." CTL, Lexington Group Annual Meeting. Duluth MN. September 28, 2016.
27. Stewart, R. D. "Our Transportation and Logistics Cluster: The Region's Great Asset", Richard D. CTL, Regional Economic Indicator Forum. Duluth, MN. November 1, 2016.
28. Titi, H. H. "Falling Weight Deflectometer Testing for Evaluating Aggregate Base Layer," Presented at the FWDUG meeting. Fremont, CA. 2016.
29. Wang, XB., X. Cao, K. Yin and T.M. Adams. Modeling Vehicle Miles Traveled on Local Roads Using Roadway Spatial Structure. to appear. Networks and Spatial Economics. 2017.
30. Zietlow, B. R. E., T. M. Adams, and E. B. Perry. "Modal Diversion Estimates Using USDOT's ITIC-IM Model." Selected for lectern session presentation at TRB Annual Meeting. 2017.
31. Zietlow, B. R. E., T. M. Adams, E. Perry, and S. Walljasper. "Assessing Wisconsin Shippers' Proximity to Rail." Selected for poster session at TRB Annual Meeting. 2017.

Websites

1. <http://pavement.ceas.uwm.edu/>
2. <https://www.usm.edu/logistics-trade-transportation/reshoring-index-backup>
3. <http://www.vanderbilt.edu/vector/>
4. <http://mtwc.org/clearinghouse/>

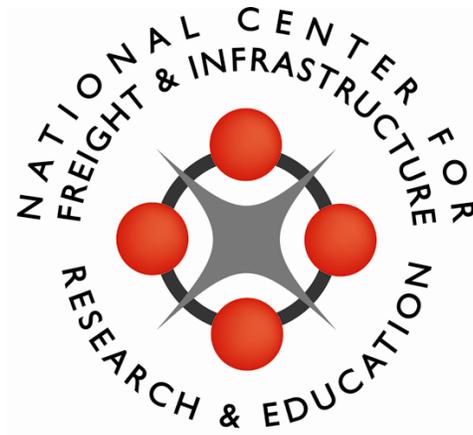
Collaboration

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

1. American Society of Transportation and Logistics
2. American Transportation Research Institute (ATRI)
3. Autozone
4. Baraga-Houghton-Keweenaw (BHK) Child Development Board
5. Barkell Elementary
6. BNSF Railroad
7. Boys and Girls Club Technical Training Center
8. Center for Transportation Studies – University of Minnesota
9. Chartwell's
10. CJ Sullivan Elementary
11. CN Railroad
12. Conway
13. Copper Country Intermediate School District
14. Council of Supply Chain Management Professionals
15. DeHart Family Foundation
16. Dollar Bay Elementary
17. Duluth Superior Transportation Association
18. Enbridge
19. Federal Highway Administration
20. FedEx
21. Franklin Furniture Institute, MSU
22. Fraser Shipyard
23. Great Lakes Fleet
24. Great Lakes Maritime Research Institute
25. Greater Memphis Alliance for a Competitive Workforce
26. Halvor Lines
27. Hub Group Trucking
28. Institute for Trade and Transportation Studies.
29. Intermodal Association of North America
30. Lake Superior Pilot Program
31. Lake Superior Railroad Museum
32. Livable Memphis
33. Mallory Alexander
34. Marten Transport
35. Memphis MPO
36. Metro Nashville Government
37. Metropolitan Interstate Committee
38. Michigan Department of Transportation

39. Michigan Tech Great Lakes Research Center
40. Michigan Technological University Rail Transportation Program
41. Michigan Tech's Center for Technology & Training
42. Middle Tennessee State University
43. MS State Port Authority.
44. National Association of Purchasing Managers (Lake Superior Chapter)
45. National Oceanic and Atmospheric Administration (NOAA)
46. North American Regional Climate Change Assessment Program (NARCCAP)
47. North Shore Scenic Railroad
48. Reshoring Initiative.
49. Rihm-Kenworth Trucking
50. Shelby County Municipal Schools
51. South Range Elementary
52. SSR
53. St. Lawrence Seaway Development Corporation
54. Tennessee Department of Community and Economic Development
55. Tennessee Department of Transportation
56. Tennessee Trucking Association
57. The Wisconsin Counties Association
58. Tokyo University of Marine Science and Technology
59. Transportation Research Board
60. Twin Cities Transportation Club
61. U.S. Army Corps of Engineers
62. University of Memphis Department of Physics
63. University of Memphis FedEx Institute of Technology
64. University of Minnesota Duluth
65. University of Tennessee
66. URETEK ICR (Heartland)
67. URETEK USA
68. Western UP Center for Science, Math & Environmental Outreach
69. William A. Irvin Ship Tours
70. Wisconsin & Southern Railroad LLC
71. Wisconsin Department of Transportation – Freight Division and OSOW Division

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