NATIONAL CENTER FOR FREIGHT & INFRASTRUCTURE RESEARCH & EDUCATION

# CFIRE

**Research 2010–2011**

## CFIRE Research

CFIRE engages in innovative research with the aim of advancing freight knowledge to better meet current and future needs. CFIRE awards research projects across a wide range of freight-related topics, focused under four Signature Technical Areas of Research (STARs):

**Design, Materials, and Construction Processes for Highway, Harbor, and Rail Infrastructure**

**Multimodal Systems Optimization and Planning**

**Traffic Operations and Safety**

**Energy and Environment**

Research at CFIRE is undertaken by an experienced and professional team of researchers from various disciplines and multiple institutions working in a collaborative manner in order to address our nation's issues in sustainable freight transportation infrastructure and systems.

### MAFC Research
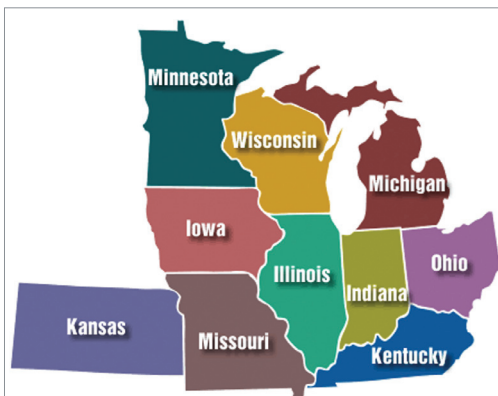


The Mid-America Freight Coalition (MAFC) is a regional effort for cooperation in the planning, operation, preservation, and improvement of transportation infrastructure in the Midwest. This region includes ten states (Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin) that share key Interstate corridors, rail infrastructure, and inland and Great Lakes waterways.

### MAFC 2010–2012 Plan

In the Summer of 2010, the MAFC Executive Committee authorized the Coalition for an additional two years, through 2012.

The 2011-2012 MAFC program includes changes to the governance structure of the Coalition, to streamline the committees and involve more MPO representatives. During these two years, the MAFC will focus its research and outreach efforts in several areas:

- Commercial Vehicle Operations Training
- Economic Analysis Training
- Regional Freight Plan

Two thirds of the $750,000 funding for the 2011-2012 MAFC program is provided by the ten member states; one third is provided by CFIRE.

CFIRE will continue to provide coordination and member support for the Coalition.

For more extensive descriptions of each of the CFIRE and MAFC projects, visit cfire.wistrans.org.

## Completed Research Projects

These projects were completed in Grant Year 5:

- CFIRE 02-04: Reconstruction of Railroads and Highways with In-Situ Reclamation Materials
- CFIRE 03-05: Evaluation of Wisconsin Bridges for Truck Loads
- CFIRE 03-06: Low Carbon Logistics though Supply Chain Design and Coordination
- CFIRE 03-07: Developing a Local Roads Website Compendium of Best Practices
- CFIRE 03-11: Applying Lean Techniques in Delivery of Transportation Infrastructure Projects
- CFIRE 03-15: Assessing the Value of Delay to Rank Order Congestion Cost in Freight Movement Performance Evaluation
- CFIRE 03-18: Understanding the Economic, Environmental, and Energy Consequences of the Panama Canal Expansion on Midwest Grain and Agricultural Exports
- CFIRE 04-01: Compass 2009 Data Analysis and Reporting
- CFIRE 04-03: Best Practices Guidance for Workforce Transition and Succession Planning
- CFIRE 04-23: Maximizing Freight in Local Food Movements
- CFIRE 04-24: System-Wide Large Truck Safety Analysis in Wisconsin
- MVFC 08: MVFC Outreach Materials
- MVFC 10: Transportation Profiles for MVFC Commodities
- MVFC 11: Performance Measures for Evaluating Multi-state Projects

These projects were completed prior to Grant Year 5:

- CFIRE 01-09: Operational Resilience of the I-90/94 Corridor

- CFIRE 02-05: 3D Design Terrain Models for Construction Plans and GPS Control of Highway Construction Equipment
- CFIRE 02-10: Assessment of Near-Term Strategies for Freight Transport Emission Reduction
- CFIRE 03-01: Consumer Adoption and Grid Impact Models for Plug-in Hybrid Electric Vehicles in Wisconsin
- CFIRE 03-02: Managing Challenges of Import Safety in a Global Market
- CFIRE 03-03: Compass 2008 Data Analysis and Reporting
- CFIRE 03-09: North/West Passage Corridor-Wide Commercial Vehicle Permitting
- CFIRE 03-23: Freight Corridor Performance in the Mississippi Valley Region
- CFIRE 04-02: Great Lakes Maritime Education for K-12 Teachers
- MVFC 05: Assessment of Multimodal Freight Bottlenecks and Alleviation for Upper Midwest Region
- MVFC 09: Develop Regional Recommendations for Reauthorization CFIRE 01-01: Trucker's Guide to Wisconsin: Regulations and Requirements for Wisconsin Motor Carriers
- CFIRE 01-02: Analysis of Permit Vehicle Loads in Wisconsin
- CFIRE 01-04: Low Cost Strategies to Increase Truck Parking in Wisconsin
- CFIRE 01-05: Costs and Benefits of Increasing Load Size for Certain Circumstances of Freight in Wisconsin
- CFIRE 01-06: Compass 2007 Data Analysis and Reporting
- CFIRE 01-07: Asset Management for Environmental Mitigation Projects
- CFIRE 01-10: 21st Century Workforce Development Summit
- CFIRE 02-01: Wisconsin Truck Size and Weight Study
- CFIRE 02-12: Implementation of GPS Controlled Highway Construction Equipment: Phase II
- CFIRE 02-13: Implementation of GPS Machine Controlled Grading: Phase III
- CFIRE 02-15: Innovative Bridge Research and Construction 2005
- CFIRE 03-21: Training on Automated Machine Guidance
- MVFC 01: Regional Freight Transportation Workshop and Meetings
- MVFC 02: Logistics for the Public Sector Training Course
- MVFC 03: Model Freight Planning Approaches
- MVFC 04: Mississippi Valley Freight Coalition Expanded Truck Parking
- MVFC 06: Mississippi Valley Freight Information Clearinghouse

## Trucker's Guide to Wisconsin: Regulations and Requirements for Wisconsin Motor Carriers

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project created the *Trucker's Guide to Wisconsin: Regulations and Requirements for Motor Carriers* at the request of the Wisconsin DOT. This handbook serves as a reference for commonly requested information for dispatch operators and owner-operators.

CFIRE 01-01

## Analysis of Permit Vehicle Loads in Wisconsin

Principal Investigator: Jian Zhoa, University of Wisconsin–Milwaukee

This project gathered and evaluated representative oversize and overweight (OSOW) vehicle configurations in Wisconsin, created a database with detailed vehicle configurations, and identified the configurations that best envelop the permit vehicles in Wisconsin. This information was used to propose modifications to Standard Permit Vehicles based on moment and shear in representative bridge spans caused by these vehicles; provide modifications to the Wisconsin Bridge Manual; establish guidelines for future evaluation and adaptation of permits to evolving OSOW vehicle configurations; and, document the existing state-of-practice of OSOW permit issuance.

CFIRE 01-02

## Low Cost Strategies to Increase Truck Parking in Wisconsin

Principal Investigators: Teresa Adams; Bruce (Xiubin) Wang, Texas A&M University

This project provided a detailed examination of overnight parking options for trucks in Wisconsin (outside of all Wisconsin Interstate highways) and identified optimal locations and low-cost strategies for providing truck parking. This project produced an inventory of designated truck parking facilities along state highways and provided the information that allowed the state of Wisconsin to increase short-term truck parking where it is needed most.

CFIRE 01-04

## Costs and Benefits of Increasing Load Size for Certain Circumstances of Freight in Wisconsin

Principal Investigator: Jason Bittner, University of Wisconsin–Madison

This project identified and quantified the impacts of increasing the gross vehicle load limit for international containers to above 80,000 pounds in Wisconsin.

Researchers examined container vehicle load limit regulations in Wisconsin and its neighboring states, identified the key barriers and motives that determine vehicle load limits, and conducted case studies on select freight corridors and select commodities of local and regional interest.

CFIRE 01-05

## Compass 2007 Data Analysis and Reporting

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project provided data analysis and reporting for the 2007 Compass Report. Specifically, researchers provided data reduction and prepared data tables and figures for two reports: 1) Compass Wisconsin State Highway 2007 Maintenance, Traffic, and Operations Conditions Executive Overview Report and 2) Compass Wisconsin State Highway 2007 Maintenance, Traffic, and Operations Conditions Operational Report.

CFIRE 01-06

## Asset Management for Environmental Mitigation Projects: Tool for Tracking Environmental Commitments

Principal Investigator: Jason Bittner, University of Wisconsin–Madison

This project created an inventory of and a tool for tracking environmental mitigation projects constructed in conjunction with transportation projects in Wisconsin. Researchers collected documentation on existing cultural resources, hazardous materials, wetlands, and wildlife accommodation commitments throughout Wisconsin; reviewed the state of the practice in other states and municipalities for collecting and tracking environmental commitments; investigated the reports contained in the WisDOT Transportation Synthesis Report; developed an electronic inventory and asset management tool to assist WisDOT managers in collecting this information; and, provided recommendations for additional inventory features.

CFIRE 01-07

## Operational Resilience of the I-90/94 Corridor

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project evaluates the resiliency of the I-90/94 corridor from Beloit to Hudson, Wisconsin. Researchers will provide information to help the Wisconsin DOT ensure reliable function of this major corridor while maintaining the corridor's normal pass-through capacity. They will also provide recommendations for areas in need of enhancement and strategies for shifting traffic to alternate routes in times of need.

CFIRE 01-09

## 21st Century Workforce Development Summit

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project coordinated the 21st Century Transportation Workforce Summit, which focused on the needs of the next generation of transportation professionals and how to maintain high quality employees. Researchers conducted pre-summit surveys of state and Federal Highway Administration (FHWA) divisions, universities, and consultants with respect to workforce challenges; prepared an assessment of current workforce status; sampled best practices for current and future workforce development and recruitment; and coordinated with ongoing activities of the Council of University Transportation Centers (CUTC) and the FHWA.

CFIRE 01-10

## Wisconsin Truck Size and Weight Study

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project conducted a comprehensive review of Wisconsin's truck size and weight regulations in the light of changing patterns of economic growth and logistics, continued increases in truck traffic, and numerous requests for changes to the regulations. Researchers participated in the Stakeholder Outreach and Advisory Committee activities of the Size and Weight Study, coordinated the peer review process, and developed a performance-based process for evaluating and administering Wisconsin truck size and weight laws.

CFIRE 02-01

## Reconstruction of Railroads and Highways with In-Situ Reclamation Materials

Principal Investigator: Tuncer Edil, University of Wisconsin–Madison

This project develops methods for in-situ strengthening of transportation roadbeds and rail corridors by reclaiming existing materials in a manner that will be able to sustain heavier loads, have a long life, be economical, minimize energy consumption, minimize greenhouse gas generation during production and transportation, and not introduce new toxic materials into the environment.

CFIRE 02-04

## 3D Design Terrain Models for Construction Plans and GPS Control of Highway Construction Equipment

Principal Investigator: Awad Hanna, University of Wisconsin–Madison

This project aided transportation organizations in developing strategies to overcome institutional, cultural, and legal impediments to the adoption of 3D design terrain models and creation of more seamless data and work flows from design through construction. Researchers described the state of the art in adoption of 3D transportation design and construction technologies; described potential benefits and productivity gains from using 3D technologies in transportation design and construction; identified and characterized technological, institutional, cultural, and legal impediments to adoption of 3D design and construction technologies; suggested strategies to overcome identified impediments; and incorporated aspects of this research in the educational program of the Department of Civil and Environmental Engineering at the University of Wisconsin–Madison.

CFIRE 02-05

## Assessment of Near-Term Strategies for Freight Transport Emission Reduction

Principal Investigator: Paul Meier, University of Wisconsin–Madison

This project evaluated the costs and benefits of limited biodiesel blending and speed-of-travel reductions of heavy duty diesel vehicles to reduce emissions from Midwest freight transportation. Researchers used MARKAL to simulate proposed models and quantify the system-wide effects of these changes in order to consider potential adverse impacts, infrastructure requirements, barriers to implementation, and opportunities to maximize air quality and human health benefits. This analysis provided spatially explicit quantification of the net changes in ozone precursor, particulate matter, and greenhouse gas emissions.

CFIRE 02-10

## Implementation of GPS Controlled Highway Construction Equipment: Phase II

Principal Investigator: Awad Hanna, University of Wisconsin–Madison

This project built on the specification and procedures developed in 2006 by the Wisconsin DOT and the Construction and Materials Support Center (CMSC) for GPS machine guidance on highway grading operations. In this phase, researchers planned and conducted five pilot projects that used GPS machine control for grading on Wisconsin DOT highway projects; collected and analyzed

structured data of the pilot projects' experiences; and, applied these results to the refinement of the specification and field procedures for future phases.

CFIRE 02-12

## Implementation of GPS Machine Controlled Grading: Phase III

Principal Investigator: Awad Hanna, University of Wisconsin–Madison

This project built on the specification and procedures developed in 2006 by the Wisconsin DOT and the Construction and Materials Support Center (CMSC) for GPS machine guidance on highway grading operations. In this phase, there are five grading contracts that were selected by the regions as good candidates for GPS machine guidance and specifications, and an additional project that will be part of the 2008 pilot program.

CFIRE 02-13

## Innovative Bridge Research and Construction 2005

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

This project aimed to design and construct an effective and efficient system of precast substructure elements and precast superstructure elements. Researchers assessed the overall costs and risks of these structures in the state of Wisconsin by comparing the proposed system to existing slab bridge systems. The results are applicable to future bridge systems. The cost benefit analysis included traffic and freight impacts.

CFIRE 02-15

## Consumer Adoption and Grid Impact Models for Plug-in Hybrid Electric Vehicles in Wisconsin

Principal Investigator: Giri Venkataramanan, University of Wisconsin–Madison

This project assessed the demand for plug-in hybrid electric vehicles (PHEV) in Wisconsin and its economic impacts on the state's energy market and the electric grid. Researchers assessed the market potential for PHEVs and estimated the associated vehicle charging patterns, electricity consumption, and infrastructure needs.

CFIRE 03-01

## Managing Challenges of Import Safety in a Global Market

Principal Investigator: Vicki Bier, University of Wisconsin–Madison

This project examined market, regulatory, and hybrid approaches to managing risk from deliberate or intentional contamination of imported commodity projects, including mass-produced, unspecialized products, such as foods, bulk chemicals, spices, and nutritional supplements, which are often produced at substantially lower prices abroad, by small suppliers who can enter and exit the market easily.

CFIRE 03-02

## Compass 2008 Data Analysis and Reporting

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project provided data analysis and reporting for the 2008 Compass Report. Specifically, researchers provided data reduction and prepared data tables and figures for two reports: 1) Compass Wisconsin State Highway 2008 Maintenance, Traffic, and Operations Conditions Executive Overview Report and 2) Compass Wisconsin State Highway 2008 Maintenance, Traffic, and Operations Conditions Operational Report.

CFIRE 03-03

## Evaluation of Wisconsin Bridges for Truck Loads

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

This project evaluates the impact that existing regulations and possible new size and weight limits will have on freight transportation, particularly in the timber industry, over local and state trunk roads in Wisconsin. This project is part of ongoing work to evaluate whether highway bridges need to have truck load limits and what limits are appropriate.

CFIRE 03-05

## Low Carbon Logistics though Supply Chain Design and Coordination

Principal Investigator: Saif Benjaafar, University of Minnesota

This project develops a supply chain-wide view of reducing carbon emissions in logistics operations. Researchers will draw on methods from a wide range of disciplines, including supply chain management, transportation science, environmental studies, public policy, and economics, among others.

CFIRE 03-06

## Developing a Local Roads Website Compendium of Best Practices

Principal Investigator: Jason Bittner, University of Wisconsin–Madison

This project creates the Local Roads website, an Internet clearinghouse and compendium of best practices for selected local road issues important to the interests of local transportation stakeholders. This compendium will provide efficient access to existing manuals, reports, articles, best practices, and projects pertaining to local roadway issues. It will also provide a collection of known experts in each topic area to encourage interaction between local roads managers and those with applicable specialized knowledge.

CFIRE 03-07

## North/West Passage Corridor-Wide Commercial Vehicle Permitting

Principal Investigators: Ernie Wittwer and Bob Gollnik, University of Wisconsin–Madison

This project aimed to identify how the states of the North/West Passage Corridor coalition might pursue a regional permitting agreement, what such an agreement would mean for each state's Department of Transportation, and the level of industry demand in the eight states for regional permitting services.

CFIRE 03-09

## Applying Lean Techniques in Delivery of Transportation Infrastructure Projects

Principal Investigator: Awad Hanna, University of Wisconsin–Madison

This project examines the benefits of the use of Lean Techniques in the delivery of transportation projects, potential impediments to the adoption of these techniques, and implementation strategies for using Lean Techniques at State Highway Agencies (SHAs). Researchers will develop a management plan for SHAs to use when adopting and implementing Lean Techniques for transportation projects.

CFIRE 03-11

## Assessing the Value of Delay to Rank Order Congestion Cost in Freight Movement Performance Evaluation

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project develops models to derive the value of delay for freight movements and apply the estimated value of delay to evaluate congestion and rank order bottlenecks and congestion areas for improvement. Researchers will survey truckers, carriers, and shippers for their stated preference, and conduct interviews, case studies, and simulations to corroborate the survey findings.

CFIRE 03-15

## Understanding the Economic, Environmental, and Energy Consequences of the Panama Canal Expansion on Midwest Grain and Agricultural Exports

Principal Investigator: Jason Bittner, University of Wisconsin–Madison

This project develops up-to-date assessments and recommendations for Midwest grain and agricultural export industries based on the economic, environmental, and energy consequences of the forthcoming expansion of the Panama Canal. Researchers will analyze data from a variety of sources, summarize industry and public sector interviews, and conduct surveys to develop an understanding of the changing transport decisions that the expansion could cause.

CFIRE 03-18

## Training on Automated Machine Guidance

Principal Investigator: Awad Hanna, University of Wisconsin–Madison

This project built on the specification and procedures developed in 2006 by the Wisconsin DOT and the Construction and Materials Support Center (CMSC) for GPS machine guidance on highway grading operations. These new specifications and procedures created the need for training field staff to administer contracts involving GPS machine guidance. These training materials introduced operating principles of the Global Navigation Satellite System (GNSS), the Global Positioning System (GPS), and Automated Machine Guidance (AMG); conveyed the practical experiences of AMG pilot project engineers; and provided field demonstrations and hands-on use of GPS and AMG technology.

CFIRE 03-21

## Freight Corridor Performance in the Mississippi Valley Region

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project uses data from the Freight Performance Measurement (FPM) system to assess the performance of significant freight corridors in the ten states of the Mid-America Freight Coalition (formerly the Mississippi Valley Freight Coalition).

CFIRE 03-23

## Compass 2009 Data Analysis and Reporting

Primary Investigator: Teresa Adams, University of Wisconsin–Madison

This project provided data analysis and reporting for the 2009 Compass Report. Specifically, researchers provided data reduction and prepared data tables and figures for two reports: 1) Compass Wisconsin State Highway 2009 Maintenance, Traffic, and Operations Conditions Executive Overview Report and 2) Compass Wisconsin State Highway 2009 Maintenance, Traffic, and Operations Conditions Operational Report.

CFIRE 04-01

## Great Lakes Maritime Education for K-12 Teachers

Primary Investigator: Joan Chadde, Michigan Technological University

This project aims to increase K-12 teachers' understanding of shipping on the Great Lakes, and increase their ability to teach their students about Great Lakes Maritime Transportation in the core subjects of science, math, language arts, and social studies.

CFIRE 04-02

## Best Practices Guidance for Workforce Transition and Succession Planning

Primary Investigators: Teresa Adams and Ernie Wittwer, University of Wisconsin–Madison

This project aims to develop tools and techniques that will help ease the workforce transition at the Wisconsin DOT as the baby boomer generation departs and younger professionals take roles of responsibility.

CFIRE 04-03

## Maximizing Freight in Local Food Movements

Primary Investigators: Bob Gollnik and Michelle Miller, University of Wisconsin–Madison

This project will identify how the local food supply and distribution system functions in Upper Midwest States and the means by which local food transportation movements can become more efficient.

CFIRE 04-23

## System-Wide Large Truck Safety Analysis in Wisconsin

Primary Investigator: David Noyce, University of Wisconsin–Madison

This project will perform a system-wide review of existing large truck safety concerns and address current problematic areas using truck crash data. Researchers will identify vulnerable locations for large truck crashes and recommend engineering countermeasures.

CFIRE 04-24

# Research

## Regional Freight Transportation Workshop and Meetings

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project examined the role of the federal government in freight activities, the need for freight-specific funding, and a multi-modal approach to freight investment in preparation for testimony at the 2007 field hearings of the National Surface Transportation Policy and Revenue Study Commission. This effort also further defined the strategic direction of the Mississippi Valley Freight Coalition and helped prioritize near-term projects for the MVFC Pooled Fund.

MVFC 01

## Logistics for the Public Sector Training Course

Principal Investigators: Ernie Wittwer, University of Wisconsin–Madison; Bruce Wang, Texas A & M University

This project developed a two-day course to teach public agency staff members the concepts of logistics that are common to private sector shippers and carriers so that they can better understand the needs of the freight community. The course is now available on the CFIRE website.

MVFC 02

## Model Freight Planning Approaches

Principal Investigator: Jessica Guo, University of Wisconsin–Madison

This project gathered best practices related to the task of freight planning for medium- and large-size Metropolitan Planning Organizations (MPOs) and their affiliated state DOTs to provide better tools to the public sector staff who work with freight providers or in freight planning. Researchers produced a guidebook that state and MPO planners can use to assist them in preparing the freight components of their long-range plans. The guidebook is also available as a series of audio-enhanced PowerPoint presentations.

MVFC 03

## Mississippi Valley Freight Coalition Expanded Truck Parking

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project provided a detailed examination of overnight parking options for trucks on Interstate highways in the ten states of the Mississippi Valley Freight Coalition. Researchers supplied states with information about whether parking facility improvements are most needed and why, along with important characteristics for new facilities.

MVFC 04

## Mississippi Valley Freight Information Clearinghouse

Principal Investigator: David Noyce, University of Wisconsin–Madison

This project designed and implemented the basic structure of a reliable traveler information clearinghouse for the ten-state Mississippi Valley region that provides information that commercial vehicle operators and associated industries can use to improve region-wide mobility and safety.

MVFC 06

## Assessment of Multimodal Freight Bottlenecks and Alleviation for Upper Midwest Region

Principal Investigator: Jessica Guo, University of Wisconsin–Madison

This project developed an inventory of freight bottlenecks on regionally significant routes and modes, including highway, rail, and water. Researchers identified these bottlenecks, rank them within each mode, assessed bottleneck rankings across the multiple transportation modes, developed an inventory of planned projects for addressing these bottlenecks, and recommended additional solutions for the region.

MVFC 05

## Develop and Disseminate Outreach Materials to Enhance Freight Investments in the Mississippi Valley Region

Principal Investigator: Ernie Wittwer, University of Wisconsin–Madison

This project developed creditable, illustrative, understandable materials to assist the general public across the region and policy makers of the region better understand freight and communicate the importance

of freight investments in the Region's economic competitiveness and well-being.

MVFC 08

## Develop Regional Recommendations for Reauthorization

Principal Investigators: Teresa Adams and Ernie Wittwer, University of Wisconsin–Madison

This project evaluated, documented, and obtained consent from the ten member states for freight-specific positions of the MVFC on reauthorization. Researchers considered the needs for adequate investment in the freight transportation system, for freight-specific revenue sources, for strong national leadership in freight policy development, for new institutional arrangements, for an integrated, multi-modal freight system, for a national rail policy, for increased maritime investment, and for the creation and implementation of performance measures. Supporting materials outlined these positions and their rationale.

MVFC 09

## Transportation Profiles for MVFC Commodities

Principal Investigators: Teresa Adams and Ernie Wittwer, University of Wisconsin–Madison

This project develops commodity flow profiles for a selected number of agricultural and industrial products generated in the Mississippi Valley region. Researchers will create narratives and illustrations for each commodity, establish each commodity's routes, and develop micro-simulations of commodities based on freight volume, economic activity, and probabilities. The results of this project will demonstrate methods that can be applied to future work.

MVFC 10

## Performance Measures for Evaluating Multi-state Projects

Principal Investigators: Teresa Adams and Ernie Wittwer, University of Wisconsin–Madison

This project develops freight-focused performance measures for multi-state alliances and interstate corridor projects. Researchers will explore the transferability of performance indicators across different multi-state efforts and provide recommendations for establishing performance measures for multi-state freight projects.

MVFC 11

# Research

## Ongoing Research Projects

These projects were ongoing at the end of Grant Year 5:

- CFIRE 01-03: Assessing Environmental Impacts Associated with Bases and Subgrades Stabilized with Coal Combustion Products (CCPs)
- CFIRE 01-08: Effective Depth of Soil Compaction in Relation to Applied Contactive Energy
- CFIRE 02-02: Rapid Replacement and Construction of Bridges
- CFIRE 02-03: Bridge Analysis and Evaluation of Effects under Overload Vehicles
- CFIRE 02-06: Understanding and Modeling Freight Stakeholder Behavior
- CFIRE 02-07: Understanding Freight Land Use Interrelationships
- CFIRE 02-09: Sustainable Freight Infrastructure to Meet Climate and Air Quality Goals
- CFIRE 02-11: Implementing DTMs for Construction Plans and Earthwork Quantities
- CFIRE 02-14: Great Lakes Timber Professionals
- CFIRE 02-16: Rapid Repair and Replacement Techniques for Transportation Infrastructures Damaged From Natural and Man-made Disasters
- CFIRE 02-17: Deck Truss Monitoring
- CFIRE 02-18: Analytical Model Development and Analysis of the McCleary Bridge
- CFIRE 02-19: Structure B-37-364: McCleary Bridge
- CFIRE 02-20: Rational System for Rating Wisconsin Bridges for Truck Loads
- CFIRE 02-21: Policy Issues in Cruise Line Operations on the Great Lakes
- CFIRE 02-22: Optimization of Log Truck Operations and Regional Log Superyards
- CFIRE 02-23: Establishing Intermodal Service on the Prince Rupert Gateway
- CFIRE 02-24: Evaluation of Air Emission Modal Models
- CFIRE 02-25: Using the Supply Chain Operations Reference (SCOR) in Supply Chain Education
- CFIRE 02-26: Using a Rail Simulator in Teaching Land Transportation
- CFIRE 02-27: Writing a Land Transportation Textbook
- CFIRE 02-28: Making Truck-Rail Intermodal Competitive
- CFIRE 02-29: Freight Planning Support System for Northeast Illinois
- CFIRE 02-30: The Cost of Shipping Commodities
- CFIRE 02-31: Freight Origin-Destination Patterns
- CFIRE 02-32: The Transshipment Problem
- CFIRE 02-33: Midwest FreightView
- CFIRE 03-04: Recycled Unbound Materials
- CFIRE 03-08: Freight Model Improvement Project for ECWRPC
- CFIRE 03-10: An Innovative Approach on Highway Bridge Approach Slabs
- CFIRE 03-12: A Novel Abutment Construction Technique for Rapid Bridge Construction: Controlled Low Strength Materials (CLSM) with Full-Height Concrete Panels
- CFIRE 03-13: Nanoporous Thin-Film Additives to Improve Precast Concrete Construction of Transportation Facilities
- CFIRE 03-14: Broad Economic Benefits of Freight Transportation Infrastructure Improvement
- CFIRE 03-16: Enhancing Behavioral Realism of Urban Freight Demand Forecasting Models
- CFIRE 03-17: Aligning Oversize and Overweight Truck (OSOW) Permit Fees and Policies with Agency Costs
- CFIRE 03-19: Environmental and Energy Benefits of Freight Delivery Consolidation in Urban Areas
- CFIRE 03-20: WisDOT Major Highway Cost Estimating Workgroup
- CFIRE 03-22: WisDOT Geotechnical Manual Development
- CFIRE 03-24: AASHTO Mechanistic-Empirical Pavement Design Guide Parametric Study
- CFIRE 04-02: Great Lakes Maritime Education for K-12 Teachers
- CFIRE 04-04: Southeast Wisconsin Freight Access and Mobility Study
- CFIRE 04-05: Addressing Elderly Mobility Issues in Wisconsin
- CFIRE 04-06: Impact of Overweight Vehicles (with Heavy Axle Loads) on Bridge Deck Deterioration
- CFIRE 04-07: A Novel Approach to Mitigating Ballast Fouling and Enhancing Rail Freight Capacity
- CFIRE 04-08: Feasibility Study for a Freeway Corridor Infrastructure Health Monitoring Instrumentation Testbed
- CFIRE 04-09: Superhydrophobic Engineered Cementitious Composites for Highway Bridge Applications: Phase I
- CFIRE 04-10: Improving Log Transportation with Data Based Monitoring and Analysis in Northern Wisconsin and Upper Peninsula of Michigan
- CFIRE 04-11: Air Cargo in the Mid-America Freight Coalition Region
- CFIRE 04-12: Freight Routing for Efficient, Sustainable and Reliable Travel
- CFIRE 04-13: A GPS-Based Survey of Freight Movements in the Midwest Region
- CFIRE 04-14: Measuring Shippers' Value of Delay on the Freight System
- CFIRE 04-15: Developing Safety Risk Index for Truck Preferred Arterial Corridors
- CFIRE 04-16: Development of an Areawide Estimate of Truck Freight Value in the Urban Mobility Report
- CFIRE 04-17: Heavy Vehicle Performance During Recovery from Forced-flow Urban Freeway Conditions Due to Incidents, Work Zones, and Recurring Congestion

- CFIRE 04-18: Development of Next Generation Intersection Control
- CFIRE 04-19: Evaluation of the Effect of Gate Strategies in Drayage Related Emissions
- CFIRE 04-20: Freight From Space: Evaluating Freight Activity and Emissions Trends from Satellite Data
- CFIRE 04-21: Cone Penetrometer Comparison Testing
- CFIRE 04-22: Does Natural Gas Make Sense for Freight? Environmental and Resource Implications of the "Pickens Plan"
- CFIRE 04-25: Farm Based Bioenergy Infrastructure for Wisconsin
- CFIRE 04-26: HMA Long Joint Deterioration Investigation
- MVFC 07: 2008 Workshop on Responding to National Transportation Initiatives
- MVFC 12: Critical Sections and Resiliency of Freight Corridors in the Mississippi Valley Region

## Assessing Environmental Impacts Associated with Bases and Subgrades Stabilized with Coal Combustion Products (CCPs)

Principal Investigators: Tuncer Edil and Craig Benson, University of Wisconsin–Madison

This project examines the use of coal combustion products (CCPs) to stabilize bases and subgrades and upgrade highway infrastructure while using recycled materials. Researchers are using WiscLEACH to assess groundwater impacts caused by the leaching of trace elements from pavement materials stabilized with CCPs, to analyze how different pH conditions affect leaching from CCP materials, and to prepare a report describing the findings from the leaching tests and the modeling efforts.

CFIRE 01-03

## Effective Depth of Soil Compaction in Relation to Applied Contactive Energy

Principal Investigator: Dante Fratta, University of Wisconsin–Madison

This project re-evaluates the 8-inch lift embankment construction requirement in Wisconsin and develops energy and compaction data to determine if lift thickness limitations can be increased while maintaining construction quality and embankment performance, and while also reducing construction costs. This information will help the Wisconsin DOT officials to propose revisions to the current construction specifications and to improve construction operations by creating more stable and economical subgrade structures.

CFIRE 01-08

## Rapid Replacement and Construction of Bridges

Principal Investigator: P.J. Sriraj, University of Illinois–Chicago

This project develops a bridge replacement and construction decision-making framework using the Analytical Hierarchy Process (AHP) to exploit innovative methods for accelerated construction of highway and railway bridges that explicitly address materials, design, and prefabrication of bridge elements, and construction machinery for assembling the structural components. The results of this research will be integrated into a graduate-level course in transportation asset management at the University of Illinois–Chicago and the Illinois Institute of Technology.

CFIRE 02-02

## Bridge Analysis and Evaluation of Effects under Overload Vehicles

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

This project develops a simplified analysis method to predict the effects of overload vehicles on the bridge system—including deck, girders, bearings, diaphragms, joints, and other major components. This method will provide state and local agencies with an efficient method for evaluating the effect of overload vehicles on these structures.

CFIRE 02-03

## Understanding and Modeling Freight Stakeholder Behavior

Principal Investigator: Jessica Guo, University of Wisconsin–Madison

This project develops a conceptual model of private-sector freight stakeholder decisions and interactions that impact freight demand and that are impacted by policy variables and system conditions. Using East Central Wisconsin as a study area, empirical models will be estimated for selected elements of this conceptual model that are fundamentally significant to the production, attraction, spatial distribution, and modal split of freight movements. The empirical results will be used to formulate recommendations to the East Central Wisconsin Regional Planning Commission (ECWRPC) on freight planning and demand model enhancement.

CFIRE 02-06

## Understanding Freight Land Use Interrelationships

Principal Investigator: Kazuya Kawamura, University of Illinois–Chicago

This project examines the effects of land use on freight transportation and vice-versa to expand the understanding of land use decisions on the efficiency of freight movement and the increased economic competitiveness of a region. Researchers will document the effects of the performance of freight movements on regional economic indicators and location decisions of various types of businesses, as well as the effects of land use on the efficiency of freight movement for different components of most common types of supply chains, and the effects of land use and socioeconomic characteristics of a region on the demand for freight transportation.

CFIRE 02-07

## Sustainable Freight Infrastructure to Meet Climate and Air Quality Goals

Principal Investigator: Tracey Holloway, University of Wisconsin–Madison

This project quantifies the air quality and climate benefits from the expanded use of railroad freight transport by evaluating the potential environmental and freight transport benefits of the Midwest Regional Rail Initiative (MWRRI). Researchers will use current and projected 2020 freight transport data from the Freight Analysis Framework, EPA emissions models including MOBILE6 and GREET, and the CMAQ model to perform this analysis.

CFIRE 02-09

## Implementing DTMs for Construction Plans and Earthwork Quantities

Principal Investigator: Awad Hanna, University of Wisconsin–Madison

This project assists the Wisconsin DOT in the preliminary stages of identifying the relevant design and construction work process for the use of Digital Terrain Models (DTMs) for construction plans and earthwork quantities. This research will help the Wisconsin DOT to answer numerous cultural, legal, and work process questions before beginning to distribute DTMs as contractual documents, eliminate traditional cross sections, use them as a basis for determining final quantities, and allow contractors to construct directly from them.

CFIRE 02-11

## Great Lakes Timber Professionals

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

This project develops guidelines for evaluating whether highway bridges need truck load limits and what limits are appropriate. Removal of non-essential load ratings will save the Wisconsin trucking industry many thousands

of dollars in fuel costs and reduce truck emissions by shortening haul routes. Researchers will collaborate with the Great Lakes Timber Professionals Association (GLTP), the Wisconsin DOT, and county highway officials.

CFIRE 02-14

## Rapid Repair and Replacement Techniques for Transportation Infrastructures Damaged From Natural and Man-made Disasters

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

This project will identify very rapid construction and contracting techniques used by other State Highway Agencies (SHAs), the railway industry, and internationally to repair and replace damaged bridges and other structures; evaluate the identified procedures for applicability by the Wisconsin DOT and the Wisconsin construction industry; and, recommend potential construction and procurement processes for future use by the Wisconsin DOT.

CFIRE 02-16

## Deck Truss Monitoring

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

The I-35W Mississippi River bridge was an eight-lane steel truss arch bridge that carried 140,000 vehicles daily across the Mississippi River in Minneapolis, Minnesota. On August 1, 2007, the bridge collapsed. This accident has led to additional emphasis on bridge performance monitoring across the nation. This project helps organize a plan for monitoring the performance of deck truss bridges in Wisconsin.

CFIRE 02-17

## Analytical Model Development and Analysis of the McCleary Bridge

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

The I-35W Mississippi River bridge was an eight-lane steel truss arch bridge that carried 140,000 vehicles daily across the Mississippi River in Minneapolis, Minnesota. On August 1, 2007, the bridge collapsed. This accident has led to additional emphasis on bridge performance monitoring across the nation. This project provides the Wisconsin DOT with bridge failure warning signs so that a disaster can be avoided.

CFIRE 02-18

## Structure B-37-364: McCleary Bridge

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

The I-35W Mississippi River bridge was an eight-lane steel truss arch bridge that carried 140,000 vehicles daily across the Mississippi River in Minneapolis, Minnesota. On August 1, 2007, the bridge collapsed. This project develops construction guidelines for use in obtaining the vertical road profile over bridge piers by accounting for deflections during construction.

CFIRE 02-19

## Rational System for Rating Wisconsin Bridges for Truck Loads

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

This project develops guidelines for evaluating whether highway bridges need truck load limits and what limits are appropriate. Removal of non-essential load ratings will save the Wisconsin trucking industry many thousands of dollars in fuel costs and reduce truck emissions by shortening haul routes. Researchers will collaborate with the Great Lakes Timber Professionals Association (GLTP), the Wisconsin DOT, and county highway officials.

CFIRE 02-20

## Policy Issues in Cruise Line Operations on the Great Lakes

Principal Investigator: Richard Stewart, University of Wisconsin–Superior

This project evaluates US and Canadian maritime policies that impact the cruise industry on the Great Lakes and the future expansion of the cruise market. Researchers will publish and present a paper that provides recommendations for how to reduce regulatory constraints on the Great Lakes cruise industry while meeting the goals of both nations' policies.

CFIRE 02-21

## Optimization of Log Truck Operations and Regional Log Superyards

Principal Investigator: Richard Stewart, University of Wisconsin–Superior

This project is a preliminary examination into the potential for optimizing log truck operations and establishing regional log superyards to increase loaded capacity and reduce the production of greenhouse gasses and carbon emissions.

CFIRE 02-22

## Establishing Intermodal Service on the Prince Rupert Gateway

Principal Investigator: Richard Stewart, University of Wisconsin–Superior

This project investigates the potential establishment of new intermodal services to the Twin Cities region from the Prince Rupert Gateway on routes that serve the Twin Cities through Chicago, Illinois and the Twin Ports of Duluth, Minnesota and Superior, Wisconsin. Researchers will examine transit time, terminal availability, drayage, corridor congestion, asset utilization, interest inventory costs, freight rates, growth potential, circuitry, and transloading on both routes.

CFIRE 02-23

## Evaluation of Air Emission Modal Models

Principal Investigator: Mei Cao, University of Wisconsin–Superior

This project evaluates the net benefit in the reduction of greenhouse gasses from optimization of log movements. Researchers will consider factors in the vehicle operating environment that may affect modal emissions such as external conditions, vehicle fleet characteristics, vehicle activities, vehicle gasoline specifications, inspection and maintenance programs, and anti-tampering programs. The EPA MOBILE6 model will be used to predict gram per mile emissions of greenhouse gasses based on average speeds for each fleet type under various conditions.

CFIRE 02-24

## Using the Supply Chain Operations Reference (SCOR) in Supply Chain Education

Principal Investigator: Mei Cao, University of Wisconsin–Superior

This project integrates the Supply Chain Operations Reference (SCOR) into the Supply Chain Management class at the University of Wisconsin–Superior. This will provide students a comprehensive examination of the SCOR model and offer students the methodology for using the SCOR model.

CFIRE 02-25

## Using a Rail Simulator in Teaching Land Transportation

Principal Investigator: Mei Cao, University of Wisconsin–Superior

This project investigates the use of the rail simulator, a train simulation game which brings the railways to life for

students, in a Land Transportation class at the University of Wisconsin–Superior.

CFIRE 02-26

## Writing a Land Transportation Textbook

Principal Investigator: Mei Cao, University of Wisconsin–Superior

This project creates a land transportation textbook that describes the functions and purposes of land transportation systems, and how they relate to the needs of the shipping and traveling public. The textbook will cover the objectives of transportation and how they are managed, freight and passenger transportation on the rail and highway systems, the function of pipeline systems, and how intermodal systems benefit all facets of the transportation system.

CFIRE 02-27

## Making Truck-Rail Intermodal Competitive

Principal Investigator: Kazuya Kawamura, University of Illinois–Chicago

This project identifies the trends and markets for truck-rail intermodal shipping by examining the relationship between the characteristics of commodities and market segments that include: origin-destination, shipping distance, and value.

CFIRE 02-28

## Freight Planning Support System for Northeast Illinois

Principal Investigator: Kazuya Kawamura, University of Illinois–Chicago

This project develops a policy analysis tool to help public agencies formulate effective strategies for the Chicago region and the Midwest to cope with the anticipated changes in both the volume and the flow pattern of freight traffic in the long term. This analysis tool follows that of the traditional commodity-based freight demand forecasting model, consisting of commodity flow generation, mode choice, and route choice modules. However, each module is developed using a novel approach that addresses the shortcomings of the existing methods.

CFIRE 02-29

## The Cost of Shipping Commodities

Principal Investigator: Matthew Petering, University of Wisconsin–Milwaukee

This project develops a cost model to estimate the cost of shipping a quantity of a commodity between two locations, which will aid public sector decision makers in determining the economic benefits of infrastructure improvements or determining the impacts on the private sector of various policies and operational strategies. Researchers will use the inventory cost model to evaluate the data with shipment cost information to build a cost model for one mode and for several varied commodities carried by that mode.

CFIRE 02-30

## Freight Origin-Destination Patterns

Principal Investigator: Alan Horowitz, University of Wisconsin–Milwaukee

This project explores the techniques for disaggregating freight origin-destination tables, including information from toll transponders, weigh station transponders, and single-station origin-destination surveys. Researchers will produce workable methods for disaggregating origin-destination tables and solve computational issues associated with very large tables.

CFIRE 02-31

## The Transshipment Problem

Principal Investigator: Alan Horowitz, University of Wisconsin–Milwaukee

This project develops a model for better macroscopic understanding of transshipment of commodity shipments and its implications for the provision of public infrastructure. Researchers will study transshipment using travel forecasting models that predict the probability that commodities flowing between two points are transshipped at an intermediate point.

CFIRE 02-32

## Midwest FreightView

Principal Investigator: Peter Lindquist, University of Toledo

This project creates and maintains the Midwest FreightView and Great Lakes Maritime Information Delivery System, a detailed data repository consisting of vessel movements and commodity flows, port and dock functions, regional economic activity, regional population and socioeconomic patterns, and environmental impacts. This information is delivered via the Internet to state transportation agencies, regional planning agencies, port authorities, and economic development organizations, as well as other interested decision makers and stakeholders within the region.

CFIRE 02-33

## Recycled Unbound Materials

Principle Investigator: Tuncer Edil, University of Wisconsin–Madison

This project monitors a controlled field experiment at the Minnesota Road Research Facility (MnROAD) using test cells constructed with recycled materials in the granular base layers, including those blended with virgin materials and those with 100 percent recycled materials. Researchers will monitor material properties during construction and throughout the pavement life to verify mechanistic-empirical design inputs, especially their variation with changing seasons and moisture regimes.

CFIRE 03-04

## Freight Model Improvement Project for ECWRPC

Principal Investigators: Jessica Guo and Jason Bittner, University of Wisconsin–Madison

This project provides data and field verification to evaluate and improve the Northeast Region Travel Demand Model so that it can be used for calibrating freight use in the East Central Wisconsin Regional Planning Commission (ECWRPC) region. Researchers will use aerial photography, GIS data, mapping projects, and other data obtained by the ECWRPC to complete a freight-specific land use inventory.

CFIRE 03-08

## An Innovative Approach on Highway Bridge Approach Slabs

Principal Investigator: Michael Oliva, University of Wisconsin–Madison

This project develops design methods for highway bridge approach slabs as beam elements that allow rapid construction, improved durability, and have design procedures that are based on a rational understanding of the characteristics of the embankment backfill acting as a slab foundation system.

CFIRE 03-10

## A Novel Abutment Construction Technique for Rapid Bridge Construction: Controlled Low Strength Materials (CLSM) with Full-Height Concrete Panels

Principal Investigator: Sam Helwany, University of Wisconsin–Milwaukee

This project examines the Controlled Low Strength Materials (CLSM) integrated bridge system by performing an instrumented, large-scale laboratory test on a CLSM bridge abutment to investigate its performance due to the application of a monotonically increasing sill (foundation) pressure. The size of the proposed CLSM abutment test is approximately 9 cubic feet.

CFIRE 03-12

## Nanoporous Thin-Film Additives to Improve Precast Concrete Construction of Transportation Facilities

Principal Investigator: Marc Anderson, University of Wisconsin–Madison

This project examines the benefit and practicality of using nanoporous thin-film coatings to improve the adhesion between grouts and already hardened concrete surfaces in joints between precast pieces of highway and rail bridges; and, the performance of pre-stressed concrete bridge components by decreasing pre-stress loss due to shrinkage and creep, and by minimizing the cement content without compromising mechanical properties.

CFIRE 03-13

## Broad Economic Benefits of Freight Transportation Infrastructure Improvement

Principal Investigator: Kazuya Kawamura, University of Illinois–Chicago

This project develops an analytical framework for quantifying third-order and induced benefits of transportation infrastructure projects. Researchers will use the Field of Influence technique to extend the FHWA Highway Freight Logistics Reorganization Benefits Estimation Tool to estimate the re-organization benefits that are directly caused by changes in the efficiency of truck freight movements.

CFIRE 03-14

## Enhancing Behavioral Realism of Urban Freight Demand Forecasting Models

Principal Investigator: Jessica Guo, University of Wisconsin–Madison

This project develops a behavior-oriented freight demand model with improved sensitivity to policy variables and system conditions. The model will be implemented and applied to metropolitan areas in East Central Wisconsin and be evaluated against the conventional trip-based models used in the same study area.

CFIRE 03-16

## Aligning Oversize and Overweight Truck (OSOW) Permit Fees and Policies with Agency Costs

Principal Investigator: Bob Gollnik, University of Wisconsin–Madison

# Research

This project analyzes the broad impacts of oversize and overweight (OSOW) truck operations on Midwest states and establishes a framework for linking fee structures with the public policy decision-making process. Researchers will review current permitting practices and fee structures and outline preliminary outlooks for OSOW demand in the foreseeable future.

CFIRE 03-17

## Environmental and Energy Benefits of Freight Delivery Consolidation in Urban Areas

Principal Investigator: Jane Lin, University of Illinois–Chicago

This project examines the effectiveness of delivery consolidation in terms of air pollutant emissions, energy use, and costs to businesses. Researchers will consider the benefit/cost of delivery consolidation, the social benefit from reduced emissions and energy consumption, whether delivery consolidation should be eligible for a subsidy, and how the benefit/cost is affected by delivery vehicle size, fleet turnover rate, long-term fuel prices, and the use of biodiesel.

CFIRE 03-19

## WisDOT Major Highway Cost Estimating Workgroup

Principal Investigator: Awad Hanna, University of Wisconsin–Madison

This project provides support for the Major Highway Cost Estimating Workgroup (MHCEW) of the Major Highway Program (MHP) of the Wisconsin DOT as this workgroup works to improve the cost-estimating procedures for projects under consideration for enumeration by the MHP.

CFIRE 03-20

## WisDOT Geotechnical Manual Development

Principal Investigator: Awad Hanna, University of Wisconsin–Madison

This project develops a new edition of the Geotechnical Manual for the Wisconsin DOT. Researchers will develop the new manual based on an existing draft, as well as existing bulletins, memos, past studies, current policy documents, and other departmental information. Charts, tables, maps, checklists, analysis examples, guidelines, and text will be developed as needed to provide a complete and comprehensive manual.

CFIRE 03-22

## AASHTO Mechanistic-Empirical Pavement Design Guide Parametric Study

Principal Investigator: Steven Cramer, University of Wisconsin–Madison

This project helps the Wisconsin DOT implement the Mechanistic-Empirical Pavement Design Guide (MEPDG) for rigid pavements. The MEPDG provides engineers and contractors with advanced tools, improvements in conservation, management, and conditions for users, and significant economic savings.

CFIRE 03-24

## Great Lakes Maritime Education for K-12 Teachers

Primary Investigator: Joan Chadde, Michigan Technological University

This project aims to increase K-12 teachers' understanding of shipping on the Great Lakes, and increase their ability to teach their students about Great Lakes Maritime Transportation.

CFIRE 04-02

## Southeast Wisconsin Freight Access and Mobility Study

Primary Investigator: Jason Bittner, University of Wisconsin–Madison

This project will conduct a feasibility assessment to determine what infrastructure enhancements are needed to improve multimodal freight access and mobility in the Greater Milwaukee area. Researchers will inventory infrastructure in the greater Milwaukee area, compile inventory of commodities that are being shipped via the Great Lakes, identify factors impeding movement of goods and assess the need for improvements, identify cost thresholds, and then use this information to recommend, prioritize, and locate needed geometric improvements and to provide an analysis of existing regulatory and operational barriers.

CFIRE 04-04

## Addressing Elderly Mobility Issues in Wisconsin

Primary Investigator: Jason Bittner, University of Wisconsin–Madison

This project aims to help the Wisconsin Department of Transportation increase the efficiency and improve the performance of elderly transit services in Wisconsin. Researchers will review current practices, conduct a demographic analysis, collect input from elderly residents,

compile an inventory of best practices, and publish a set of recommendations.

CFIRE 04-05

## Impact of Overweight Vehicles (with Heavy Axle Loads) on Bridge Deck Deterioration

Primary Investigators: Jian Zhao and Habib Tabatabai, University of Wisconsin–Milwaukee

This project will investigate the impact of overweight vehicles, especially those with heavy axle loads on the deterioration of concrete bridge decks. Researchers will conduct durability tests on concrete specimens that have undergone compressive stress and establish the effects of on typical bridges under overweight vehicles with high axle loads.

CFIRE 04-06

## A Novel Approach to Mitigating Ballast Fouling and Enhancing Rail Freight Capacity

Primary Investigator: Tuncer Edil and James Tinjum, University of Wisconsin–Madison

This project will assess the feasibility of strategically placed urethane reinforced layers within the ballast structure used for the structural support of railway beds in order to mitigate ballast fouling and fines intrusion, thus reducing maintenance life cycle costs and increasing load capacity of these beds.

CFIRE 04-07

## Feasibility Study for a Freeway Corridor Infrastructure Health Monitoring Instrumentation Testbed

Primary Investigator: Hani Titi, University of Wisconsin–Milwaukee

This project will evaluate the feasibility of initiating a health monitoring network for highway infrastructure. Researchers will develop health monitoring data elements, identify construction project restraints, and develop an acquisition/installation plan for this network.

CFIRE 04-08

## Superhydrophobic Engineered Cementitious Composites for Highway Bridge Applications: Phase I

Primary Investigator: Konstantin Sobolev, Habib Tabatabai and Jin Zhao, University of Wisconsin–Milwaukee; Michael Oliva, University of Wisconsin–Madison

This project aims to develop superhydrophobic engineered cementitious composite (ECC) material to replace normal concrete and achieve a service life of 120+ years. The proposed concept will produce a new

generation of concrete with significantly improved ductility, durability, and sustainability through a longer life and less maintenance.

CFIRE 04-09

## Improving Log Transportation with Data Based Monitoring and Analysis in Northern Wisconsin and Upper Peninsula of Michigan

Primary Investigator: Richard Stewart, University of Wisconsin–Superior; Pasi Lautala, Michigan Technological University

This project examines the use of inexpensive GPS tracking devices to further the understanding of inefficiencies in current log truck movements and to use the data to improve the performance of log transportation system in northern Wisconsin and the Upper Peninsula of Michigan.

CFIRE 04-10

## Air Cargo in the Mid-America Freight Coalition Region

Primary Investigator: Jason Bittner, University of Wisconsin–Madison; Jeffrey Warner and Jeffrey Borowiec, Texas A&M University

This project aims to better understand the operations and current activity levels of the air cargo industry in the Mid-America Freight Coalition (MAFC) region in order to better accommodate state and local needs, provide for a more efficient transportation network, better utilize general aviation facilities, and provide for economic development across the region.

CFIRE 04-11

## Freight Routing for Efficient, Sustainable and Reliable Travel

Primary Investigator: Tito Hollem-de-Mello, University of Illinois at Chicago; Marco Nie, Northwestern University

This project aims to develop, implement, and evaluate novel methods for optimal freight routing, which will allow for more efficient, reliable and sustainable travel by taking into consideration the disruptions and emissions that are an inherent part of road travel.

CFIRE 04-12

## A GPS-Based Survey of Freight Movements in the Midwest Region

Primary Investigators: Kouros Mohammadian and Kazuya Kawamura, University of Illinois–Chicago

This project will conduct a new disaggregate GPS survey with specific focus on the Midwest region that can

facilitate analysis of the freight shippers in the region, their decision making process, route choice, and their interactions with the rest of the country.

CFIRE 04-13

## Measuring Shippers' Value of Delay on the Freight System

Primary Investigators: Teresa Adams, University of Wisconsin–Madison; Bruce Wang, Texas A&M University

This project will develop a model for estimating the value of delay (VOD) for highway freight shippers. Researchers will conduct a small number of case studies of representative shippers, conduct a survey of shippers, and use Logit to model collected data.

CFIRE 04-14

## Developing Safety Risk Index for Truck Preferred Arterial Corridors

Primary Investigators: Xiao Qin, South Dakota State University; David Noyce, University of Wisconsin–Madison

This project will develop a safety risk index for truck preferred arterial corridors. Researchers will identify truck preferred arterial corridors, prototype an innovative data collection method to enhance safety asset management for trucks, identify heavy vehicle involved crash causal factors, examine and review currently available cutting-edge access management methodologies, and develop an arterial corridor safety risk-based index.

CFIRE 04-15

## Development of an Areawide Estimate of Truck Freight Value in the Urban Mobility Report

Primary Investigators: Jessica Guo, University of Wisconsin–Madison; William Eisele and David Schrank, Texas A&M University

This project will create and test a methodology for generating truck freight values for inclusion in the Urban Mobility Report, with a particular focus on facilitating the transferability between regions so that freight value estimates can be developed for all 100 urban areas in the report.

CFIRE 04-16

## Heavy Vehicle Performance During Recovery from Forced-flow Urban Freeway Conditions Due to Incidents, Work Zones, and Recurring Congestion

Primary Investigators: Yue Liu and Alan Horowitz, University of Wisconsin–Milwaukee; Alex Drakopoulos, Marquette University

This project seeks to establish how heavy trucks influence urban freeway congestion during forced-flow conditions. Researchers will collect a large vehicle classification dataset and calibrate simulation models to establish the influence of truck traffic in these conditions.

CFIRE 04-17

## Development of Next Generation Intersection Control

Primary Investigators: Madhav Chitturi and David Noyce, University of Wisconsin–Madison; Mihalis Golias, University of Memphis

This project will develop a next generation intersection control system called Autonomous Control of Urban TrAffic (ACUTA) for operation of isolated intersections. ACUTA can provide real-time optimal route guidance to the trucks resulting in fewer stops and lesser delay for freight traffic. This would also reduce the delay caused to the other vehicles and result in significant reduction in emissions and fuel consumption.

CFIRE 04-18

## Evaluation of the Effect of Gate Strategies in Drayage Related Emissions

Primary Investigator: Mei Cao, University of Wisconsin–Superior

This project will develop a simulation model capable of implementing different gate strategies at an intermodal marine container terminal and to estimate the amount of the emissions produced by drayage trucks.

CFIRE 04-19

## Freight From Space: Evaluating Freight Activity and Emissions Trends from Satellite Data

Primary Investigator: Tracey Holloway, University of Wisconsin–Madison

This project will use satellite data to analyze and quantify freight activity and emission trends. Researchers will employ a roadway-by-roadway truck emissions inventory and develop a complimentary line-by-line rail inventory in order to model atmospheric concentrations of emitted and chemically formed pollutants using the EPA CMAQ model. This project will produce the first satellite analysis of ground-based transportation emissions.

CFIRE 04-20

## Cone Penetrometer Comparison Testing

Primary Investigator: James Schneider, University of Wisconsin–Madison

This project aims to engineers and geologists in within the Wisconsin Department of Transportation to understand the mechanisms controlling cone penetration test readings so that they can decide when the testing method is appropriate for use, know how to design an appropriate exploration program, and rapidly interpret the results of the tests for more efficient and reliable engineering.

CFIRE 04-21

## Does Natural Gas Make Sense for Freight? Environmental and Resource Implications of the "Pickens Plan"

Primary Investigator: Paul Meier, University of Wisconsin–Madison

This project will evaluate whether natural gas powered freight transport makes sense as a cost-effective strategy to reduce greenhouse gases, meet air quality objectives, and allocate this valuable domestic fossil fuel. Researchers will develop natural gas usage scenarios and calculate the fuel use and emissions for each in order to compare costs and evaluate ground-level air quality changes associated with each model.

CFIRE 04-22

## Farm Based Bioenergy Infrastructure for Wisconsin

Primary Investigator: Carol Barford, University of Wisconsin–Madison

This study will define the optimal scale of bio-based heat and power infrastructure development in Wisconsin, and describe the physical, financial and ecological constraints on the bioenergy life cycle.

CFIRE 04-25

## HMA Long Joint Deterioration Investigation

Primary Investigator: Awad Hanna, University of Wisconsin–Madison

This project will review both good and poor performing notch-wedge longitudinal joints constructed in HMA pavements and make recommendations for changes to the current WisDOT specifications to eliminate or reduce the deterioration.

CFIRE 04-26

**Note:** Prior to October 2010, the Mid-America Freight Coalition (MAFC) operated as the Mississippi Valley Freight Coalition (MVFC). Projects originating in this period refer to the Mississippi Valley Freight Coalition and are designated with the MVFC prefix for the purposes of continuity and historical consistency.

## 2008 Workshop on Responding to National Transportation Initiatives

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project identified key areas of interest for the Mississippi Valley Freight Coalition in the work of the National Commission on Surface Transportation Policy and Revenue and National Surface Transportation Infrastructure Finance Commission, as well as AASHTO's transportation vision, and ARTBA's Critical Commerce Corridors Proposal. Members of the MVFC discussed these issues and conducted needed coalition business.

MVFC 07

## Critical Sections and Resiliency of Freight Corridors in the Mississippi Valley Region

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project aims to identify critical nodes and sections, including intermodal connectors, along the I-35, I-70, I-80, I-90, and I-94 freight corridors within the Mid-America Freight Coalition (MAFC) region that are most vulnerable to disruption and lack adequate alternate route freight capacity. The information provided will be in the form of recommendations of segments in need of enhancement and strategies for navigating traffic on to alternate routes in times of need. This project will identify and create an inventory of critical sections of the network along the proposed Corridors. The critical sections are where the greatest traffic delays would be experienced.

MVFC 12

# Research

## New Research Projects

These projects were initiated during Grant Year 5:

- CFIRE 05-01: Longer Combination Vehicles: Do They Improve Freight Flows and Operational Efficiency and Reduce Highway Congestion?
- CFIRE 05-02: North/West Passage Corridor-Wide Commercial Vehicle Permitting – Phase 2
- CFIRE 05-03: Cost Effective Maintenance Strategies of Managing Pavements in Poor Condition
- CFIRE 05-04: Compass 2010 Data Analysis and Reporting
- CFIRE 05-05: Great Lakes Maritime Education for K-12 Teachers (2011)
- CFIRE 05-06: Guide for Selecting Level-of-Service Targets for Maintaining and Operating Highway Assets
- CFIRE 05-07: Characterization of Aggregates for Sustainable Freight Transportation Infrastructure
- CFIRE 05-08: Evaluating the Methodology and Performance of Jetting and Flooding Granular Backfill Materials
- CFIRE 05-09: Lateral Deflection Contribution to Settlement Estimates
- CFIRE 05-10: Superhydrophobic Engineered Cementitious Composites for Highway Bridge Applications: Phase II
- CFIRE 05-11: Warning System for Safety and Maintenance of Freight Railways
- CFIRE 05-12: Protecting Prestressing Strand in Transportation Structures and Improving Strand-Concrete Bonding
- CFIRE 05-13: Evaluating Export Container Pooling Options in Minnesota, Wisconsin and Michigan's Upper Peninsula
- CFIRE 05-14: Preserving Vital Great Lakes Infrastructure: Assessment of Asset Management Activities in Great Lakes Ports
- CFIRE 05-15: New Framework and Decision Support Tool to Warrant Detour Operations during Freeway Corridor Incident Management
- CFIRE 05-16: Incorporating Greenhouse Gas Emissions and Fuel Consumption Measures into the Texas Transportation Institute's Urban Mobility Report
- CFIRE 05-17: Maximizing Freight Movements in Local Food Markets – Phase Two
- CFIRE 05-18: Toolbox for Strategic Truck Forecasting
- CFIRE 05-19: Characterization of Resilient Modulus of Base Aggregate for Mechanistic-Empirical Pavement Design Guide (MEPDG)
- CFIRE 05-20: Evaluation of Pavement Design using MEPDG
- CFIRE 05-21: Synthesis of Evidence of Truck Diversion through Work Zones
- CFIRE 05-22: Further Investigation on Urban Cooperative Delivery Strategies at the Firm Level
- CFIRE 05-23: Guide for Effective Tribal Crash Reporting

- MAFC 13: Regional Freight Study

## Longer Combination Vehicles: Do They Improve Freight Flows and Operational Efficiency and Reduce Highway Congestion?

Primary Investigators: Teresa Adams, Bob Gollnik, and Jason Bittner, University of Wisconsin–Madison

This research will provide an objective and comprehensive evaluation of how the use of LCVs will impact freight flow, operational efficiency, safety, infrastructure, and highway congestion. The results of this project will contribute to the policy evaluation that will determine whether to continue to restrict or allow for operation of LCVs on state and federal highways.

CFIRE 05-01

## North/West Passage Corridor-Wide Commercial Vehicle Permitting - Phase 2

Principal Investigators: Ernie Wittwer and Bob Gollnik, University of Wisconsin–Madison

This project aims to continue to work with North/West Passage States to pursue a regional permitting agreement. Additionally, the research team intends to develop an XML permit concept to allow users to request permits from multiple jurisdictions from one centralized location.

CFIRE 05-02

## Cost Effective Maintenance Strategies of Managing Pavements in Poor Condition

Principal Investigators: Teresa Adams, University of Wisconsin–Madison

This research project will identify construction treatments and/or materials that can be used to extend the service life of pavements in poor condition. These treatments are intended to be economical and practical stop-gap measures until permanent and affordable solutions are available.

CFIRE 05-03

## Compass 2010 Data Analysis and Reporting

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project provided data analysis and reporting for the 2010 Compass Report. Specifically, researchers provided data reduction and prepared data tables and figures for two reports: 1) Compass Wisconsin State Highway

2009 Maintenance, Traffic, and Operations Conditions Executive Overview Report and 2) Compass Wisconsin State Highway 2009 Maintenance, Traffic, and Operations Conditions Operational Report.

CFIRE 05-04

## Great Lakes Maritime Education for K-12 Teachers (2011)

Principal Investigator: Joan Chadde, Michigan Technological University

This project will support two summer teacher institutes for K-12 teachers that focus on Great Lakes transportation, mathematics, and navigation to increase their ability to teach their students about Great Lakes Maritime Transportation in the core subjects of science, math, language arts, and social studies.

CFIRE 05-05

## Guide for Selecting Level-of-Service Targets for Maintaining and Operating Highway Assets

Principal Investigator: Teresa Adams, University of Wisconsin–Madison

This project aims to develop a guide for selecting level-of-service targets for maintaining and operating highway assets.

CFIRE 05-06

## Characterization of Aggregates for Sustainable Freight Transportation Infrastructure

Principal Investigator: Hani Titi, University of Wisconsin-Milwaukee

This project will investigate aggregate durability using X-ray Computed Tomography (CT) and make comparisons with the results of this method with conventional aggregate durability/strength methods.

CFIRE 05-07

## Evaluating the Methodology and Performance of Jetting and Flooding Granular Backfill Materials

Principal Investigator: Dante Fratta, University of Wisconsin-Madison

This project aims to determine whether backfill jetting or flooding could provide an alternative that may be faster and more economical than the traditional method of placing and compacting coarse-grained materials (e.g., granular materials) by mechanical means.

CFIRE 05-08

## Lateral Deflection Contribution to Settlement Estimates

Principal Investigators: James Schneider and Dante Fratta, University of Wisconsin-Madison

This project aims to address uncertainty in the influence of lateral deflection on the magnitude of measured settlement through numerical and analytical analysis of cross sections related to the STH 29/USH 41 interchange, as well as through parametric studies of other soft soil conditions and embankment geometries.

CFIRE 05-09

## Superhydrophobic Engineered Cementitious Composites for Highway Bridge Applications: Phase II

Principal Investigator: Konstantin Sobolev, University of Wisconsin-Milwaukee

This project will conduct an in-depth evaluation of the durability of developed superhydrophobic engineered cement composite (SECC) materials and their adaptability for use in highway bridge approach slabs.

CFIRE 05-10

## Warning System for Safety and Maintenance of Freight Railways

Principal Investigators: Dante Fratta, University of Wisconsin-Madison

This project will assess the feasibility of using electromagnetic surveying and remote fiber optic sensing for railway track inspection. The proposed methodology is expected to increase track safety by also developing a warning system for track inspection and maintenance.

CFIRE 05-11

## Protecting Prestressing Strand in Transportation Structures and Improving Strand-Concrete Bonding

Principal Investigator: Marc Anderson, University of Wisconsin-Madison

This project aims to develop and prove that a novel inorganic nano-particle coating for strand will greatly increase corrosion resistance and provide the added benefit of improved strand to concrete bonding.

CFIRE 05-12

# Research

## Evaluating Export Container Pooling Options in Minnesota, Wisconsin and Michigan's Upper Peninsula

Principal Investigator: Richard Stewart, University of Wisconsin-Superior

This project aims to investigate the issues that limit containerized exports from Minnesota and Wisconsin. This effort will catalog best practices in other regions and explore adopting those practices for the Upper Plaines States.

CFIRE 05-13

## Preserving Vital Great Lakes Infrastructure: Assessment of Asset Management Activities in Great Lakes Ports

Principal Investigators: Jason Bittner and Teresa Adams, University of Wisconsin-Madison

This project will identify current state of the practice for asset management for Great Lakes Ports, help identify critical barriers to implementing asset management principles, and recommend strategies to implement asset management practices.

CFIRE 05-14

## New Framework and Decision Support Tool to Warrant Detour Operations during Freeway Corridor Incident Management

Principal Investigator: Yue Liu, University of Wisconsin-Milwaukee

This project aims to develop a new multi-criteria framework along with an advanced and computation-friendly tool for traffic managers to decide whether or not and when to implement corridor detour operations.

CFIRE 05-15

## Incorporating Greenhouse Gas Emissions and Fuel Consumption Measures into the Texas Transportation Institute's Urban Mobility Report

Principal Investigators: Paul Meier, University of Wisconsin-Madison

This project aims to create a methodology to incorporate greenhouse gas (GHG) emissions into the 2011 *Urban Mobility Report* (UMR) and to update and test a methodology for fuel consumption into the 2011 UMR.

CFIRE 05-16

## Maximizing Freight Movements in Local Food Markets – Phase Two

Principal Investigator: Teresa Adams, University of Wisconsin-Madison

This project continues to explore the movement of local foods (specifically, beef, potatoes, and apples) in the Driftless and Central Sands regions of Wisconsin, Minnesota, Iowa, and Illinois.

CFIRE 05-17

## Toolbox for Strategic Truck Forecasting

Principal Investigators: Alan Horowitz, University of Wisconsin-Milwaukee

This project aims to develop a set of straight-forward tools for truck forecasting by modifying and enhancing those tools developed for state DOTs for all traffic.

CFIRE 05-18

## Characterization of Resilient Modulus of Base Aggregate for Mechanistic-Empirical Pavement Design Guide (MEPDG)

Principal Investigators: Hani Titi, University of Wisconsin-Milwaukee

This project aims to develop a database of resilient modulus test results and to establish correlations for estimating the resilient modulus of various aggregates from basic properties for use in mechanistic-empirical pavement design guide (MEPDG).

CFIRE 05-19

## Evaluation of Pavement Design using MEPDG

Principal Investigators: Hani Titi, University of Wisconsin-Milwaukee

This project aims to identify all input parameters employed in Wisconsin for application in mechanistic-empirical pavement design.

CFIRE 05-20

## Synthesis of Evidence of Truck Diversion through Work Zones

Principal Investigators: Troy Liu, University of Wisconsin-Milwaukee

This project aims to develop a synthesis of literature and empirical evidence of the level of truck diversion to assist work-zone traffic engineers with decisions about the expected amount of truck traffic that might be diverted from major highways to local streets.

CFIRE 05-21

## Further Investigation on Urban Cooperative Delivery Strategies at the Firm Level

Principal Investigators: Jane Lin, University of Illinois at Chicago

This project aims to understand the urban goods distribution and delivery decisions at the firm level and to incorporate these findings with additional survey data to further the investigation in urban cooperative delivery strategies at the firm level.

CFIRE 05-22

## Guide for Effective Tribal Crash Reporting

Principal Investigators: David Noyce, University of Wisconsin-Madison

This project aims to produce a guide for the development and implementation of effective tribal crash reporting programs in order to improve tribal transportation safety planning and programs.

CFIRE 05-23

## MAFC Regional Freight Study

Principal Investigators: Teresa Adams, University of Wisconsin-Madison

This project will support the Mid-America Freight Coalition Regional Freight Study, which aims to identify state and regionally significant freight corridors and nodes, assess and integrate business climate perspectives on freight development, develop a suite of freight project planning and project evaluation tools, assess regional integration of over size and overweight trucking (OSOW) considerations, establish freight performance measures, and identify and assess timely and cutting edge freight opportunities for the states of the MAFC region.

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