Freight Mobility Research Institute (FMRI)
A USDOT Transportation Research Center

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Freight Mobility Research Institute (FMRI)

- Market Demand
- Competition

75% Freight Transportation

- Operating Efficiency
- Cost Efficiency

Automation Capabilities
Adoption of CPS
Challenges
Meeting Urban Access Needs for Container Growth
Challenges
Maintaining Good Access to Warehousing and Distribution Centers
Challenges
For Most Urban Areas Capacity Increases Represent a Hurdle
A consortium of HU, PSU, UF, UM, UMN, and TAMU
• **Freight Mobility Research Institute (FMRI)** mission is to address critical issues affecting the planning, design, operation, and safety of the nation’s intermodal freight transportation system, in order to strengthen our nation’s economic competitiveness.

• FMRI aims to study, build and deploy *an integrated suite of complementary technologies and policies* to promote smart cities, make surface transportation safer and more efficient, improve multimodal connections, system integration, and security.
Freight Mobility Research Institute (FMRI)
• Economic Competitiveness
  • Improve transportation operations and management
  • Improve freight mobility
• Congestion Mitigation
  • Evolving new technology
  • Improve last mile
  • Support multi-modal corridors
  • Improve security, and infrastructure resilience
• Smart Mobility, efficiency, economic productivity
Objective Function

Maximize $\sum_{b=1}^{B} \beta_{b,z} \phi_{b,z} \quad \forall z$

Subject to:

Benefit Function

$$\beta_{b} = w_{m} \sum_{m=1}^{M} \left( \frac{1}{d_{b,m} \psi_{b,m}} \right) + w_{v} \sum_{v=1}^{V} \left( p_{v} \ast \frac{1}{d_{b,v} \psi_{b,v}} \right) + w_{l} \sum_{l=1}^{L} \left( p_{l} \ast \frac{1}{d_{b,l} \psi_{b,l}} \right) + w_{e} \sum_{e=1}^{E} \left( p_{e} \ast \frac{1}{d_{b,e} \psi_{b,e}} \right) + w_{o} \sum_{o=1}^{O} \left( p_{o} \ast \frac{1}{d_{b,o} \psi_{b,o}} \right) + w_{s} \sum_{s=1}^{S} \left( p_{s} \ast \frac{1}{d_{b,s} \psi_{b,s}} \right) \quad \forall b, z$$

Binary Variable

$$\phi_{b,z} = \{0,1\}$$

Max. Bus Stops in Network

$$\sum_{z=1}^{Z} \phi_{b,z} \leq \eta \quad \forall b$$
Port Resilience—Department of Homeland Security
Problem Statement: A rapid explosion of new technologies and data sources have created opportunities and challenges in freight transportation. The question remains as to who are the agencies likely to adopt the innovative technologies (e.g. CAVs, truck platooning, etc.). Adoption methods available from consumer behavior research are mostly based on individuals, with limited focus on organizational innovation adoption.

Novelty/contribution: We have proposed a disaggregated diffusion of innovation based approach that incorporates behavioral shifts within and between organizations when they look forward to adopt a new and disruptive technology.

Current state-of-the-art: Application of agent-based diffusion of innovation approach to model adoption of technological innovations by freight organizations.

Impact: Researchers and practitioners can utilize the adoption models to determine the when, where and how much of new technology of adoption by freight organizations. The results will help practitioners to have a better understanding of new technology influence in the four step, and activity based model planning process, and enhanced short and long term transportation plan. The approach will provide a foundation of behavioral adoption research as the concept of smart and connected cities emerge in the near future, and more automated technologies are introduced for the freight industry.
Problem Statement: Truck parking has been a national concern for many years. Within any consecutive 24 hours of time, trucker driving and on duty hours are regulated by the federal law for the sake of traffic safety. Truckers, especially those for inter-city travel, must find a rest spot when the driving hours reaches its federally enforced limit. Due to unavailability of truck parking space at locations it is needed, truckers are often found to park illegally on highway ramps or other unsafe spots. Or some truckers are caught driving beyond the hours limit, which significantly contribute to the highway fatal rate.

Novelty/contribution: Are trucking capacity along highways sufficient for truckers given the current and potentially growing economic activities? Are truckers scapegoats due to shortage of parking capacity? This research aims to find the relationship between parking capacity and truck volumes.

Current state-of-the-art: Numerous truck parking studies have been conducted at the federal and state levels due to the significant policy and practical implications. There has not been a study in the best knowledge of the investigators that explores the relationship between truck volume (e.g. economic activities) and the need for truck parking capacities.

Impact: This relationship to unveil will allow policy makers and stakeholders to assess the need for truck parking along highways and to identify locations with shortage of parking capacity.
Problem Statement: Eco-driving reduces fuel consumption and greenhouse gas emissions. The strategies to optimally control a signalized arterial normally only consider mobility measures such as delay and travel time, and mainly only take into account passenger cars. This project develops optimal signal control strategies that improve mobility while reducing fuel consumption and environmental impacts.

Novelty/contribution: we are developing a dynamic control strategy for individual vehicles of different types with eco-driving objectives (individual trajectory control). At the same time we are assessing the impacts of signal control strategies on traffic flow performance (at the aggregated level).

Current state-of-the-art: Current corridor signal control mainly considers passenger cars. Because of the significant truck traffic along the corridor, the speed variation of the traffic flow will be drastically elevated. The much slower deceleration/acceleration process of the trucks will further increase the delay and travel time along the corridor. These special characteristics and impacts associated with trucks are not considered for corridor signal coordination.

Impact: Outcomes of this research will help practitioners design optimized corridor signal timing plans that will work for different levels of traffic and truck percentage. With connect vehicle technologies, the vehicles will also drive in optimized trajectories. The developed models and control strategies will improve the mobility, save fuel consumption, and reduce emissions for a corridor with heavy truck traffic.
Problem Statement: Ports are extremely vulnerable to numerous types of hazards. The geographical location of the port makes its perfect targets for terrorist attacks, it also increases susceptibility to all kind of natural hazards such as hurricanes, tornadoes, etc. Vessel collisions can also hinder a port's operation. Implementing resilience in the system will reduce the negative economic impact of disruption and prepare the system in the face of potential threats.

Novelty/contribution: We have developed a contingency planning tool methods in order to get the port back into normal operating conditions, instead of port being entirely shut down whenever there is some kind of hazard.

Current state-of-the-art: Contingency plans are either not developed or only limited and has various constraints. Due to lack of data & methods, practitioners do not develop multiple contingency plans and very little information is available on this subject.

Impact: Outcomes of this research will help practitioners with a developed simulation-and-modeling, mathematical modeling based contingency plans port resiliency assessment and planning tool that can be adapted, through a choice of interchangeable event modules, to predict consequences of an event based disruption to a port and its waterside and landside distribution capacities. Furthermore, it supports avoidance and mitigation of damage and capacity reduction, and aid rapid recovery from any type of hazards.
Education and Technology Transfer

- Faculty Seminar Series Webinars
- Internships
- Summer Camps, High School Teachers Workshops, etc.
- Partner with different centers: Volpe, Maritime Center/DHS, etc.
- Non-traditional, interdisciplinary approach to educating tomorrow’s transportation professionals
- Publications and professional presentations

Domains
- Civil & Environmental
- Electrical & Computer Engineering
- Information Technology
- Transportation Logistics
- Operational Management
- Public Policy
THANK YOU FOR YOUR ATTENTION

QUESTIONS?