U.S. freight practice will benefit from the new freight model and new data methods.

STRATEGIC GOAL

Advancing National Freight Practice for Decision Making

BEHAVIORAL-BASED NATIONAL FREIGHT MODEL

PROJECT OBJECTIVES

Develop New Scalable Freight Modeling Tool and Techniques

Develop New Scalable Freight Data Collection Method

PROJECT OUTCOMES

1. Enhance FHWA In-house Analysis Capability
2. Enhance Analysis Practice for Local Transportation Agency

1. Address Existing Data Gaps in National Freight Database - Freight Analysis Framework (FAF)
2. Enhance Data Collection Methods for Local Transportation Agency
These 4 key elements support the overall goals.

- Enhancing Previous National and International Research
- Testing New Modeling Methods
- Putting Research into Practice through Demonstration Software
- Recommending Freight Data Improvements
The national freight model enhances our ability to forecast goods movement.

- Evaluate freight investments
- Test effectiveness of national policies
- Support statewide and regional freight planning
- Evaluate private sector and global trade decisions
The national freight model system is multimodal and disaggregate.
There are several key advancements in this research.

• Simulating establishments as a function of the firm to which they belong

• Matching buyers and suppliers in the procurement market using game theory

• Including pipelines as a fifth mode

• Determining carriers for firms shipping goods by truck

• Simulating the backhauling required to reposition trucks for their next shipment
Firm synthesis simulates firms and establishments.

- Covers all 6-digit North American Industry Classification System (NAICS) industries

- Allocates establishments to firms based on:
  - industry
  - input/output
  - commodities
  - employment size
  - geography variables

5.9 million firms
7.5 million establishments
The output for the largest firms show a reasonable distribution.
Procurement market is modeled using game theory.

Procurement market game for a single buyer-seller pair.
• The game begins with an initial market (M) assessment by a buyer (B).
• The seller then moves next (S1), deciding whether to accept or reject the offered contract.
Mode choice models will be estimated with Commodity Flow Survey data.

- Discrete choice of a single mode or mode combination, such as rail-truck, air-truck or water-truck, with 54 alternatives
- New explanatory variables
  - Establishment and firm relationship
  - Shipper characteristics
  - Receiver characteristics
  - Geographic specificity
- Pipeline is added as a new mode
Carrier choice identifies which suppliers will use a carrier and then which one.

**STEP 1**
Supplier decides
- to deliver goods using their own fleet or
- to outsource goods movement to a carrier

**STEP 2**
Then an individual carrier is selected
Carrier Choice

• Allows for explicit matching of loaded trips
• Improves performance by
  – consolidating shipmens
  – maximizing fleet utilization
  – minimizing empty backhauls
• Forecasts the necessary empty truck repositioning trips
Truck deliveries can include backhauling and consolidation.

- Operational model that accounts for vehicle return trips and truck transfers

- Each carrier company primarily operates either Truckload (TL) or Less-than-truckload (LTL)

- Backhauling
  - considered on return from destination to origin zone, with a buffer
  - account for either backhauls or empty return trips
Backhauling and consolidation is segmented by truckload carrier.

- Truckloads (TL) follow a direct transport network from origin to destination.
- Less-than-truckload (LTL) shipments flow through a distribution chain.

Weekly Volume by Commodity and Carrier

- **TL Carrier**: Direct shipment
  - No Consolidation; Possible Backhauling
- **LTL Carrier**: Hub and Spoke Structure
  - Consolidation; Backhauling only between the carrier hubs
The national freight model enhances supply chain methods in several innovative ways.

**MACROECONOMICS**
- Evolution of global business supply chains
- Focus on buyer-supplier relationships in procurement markets

**SEGMENTATION**
- Industries
- Carrier choice
- Establishment and firm relationships

**TRANSPORT CHAINS AND LOGISTICS**
- Including pipelines with air, rail, water and truck
- Operationalizing backhauls

**IMPLEMENTATION**
- Application software to demonstrate
Summary

• Exploratory research allows for testing of new methods

• Expands on previous research to allow scenario testing of global trends, investments, new technologies, and national policies

• Demonstration software moves this research towards practice

• Data recommendations will provide a road map to improving data collection for freight