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Behavioral Freight Model for the United States

Innovations in Travel Modeling Conference
June 25, 2018

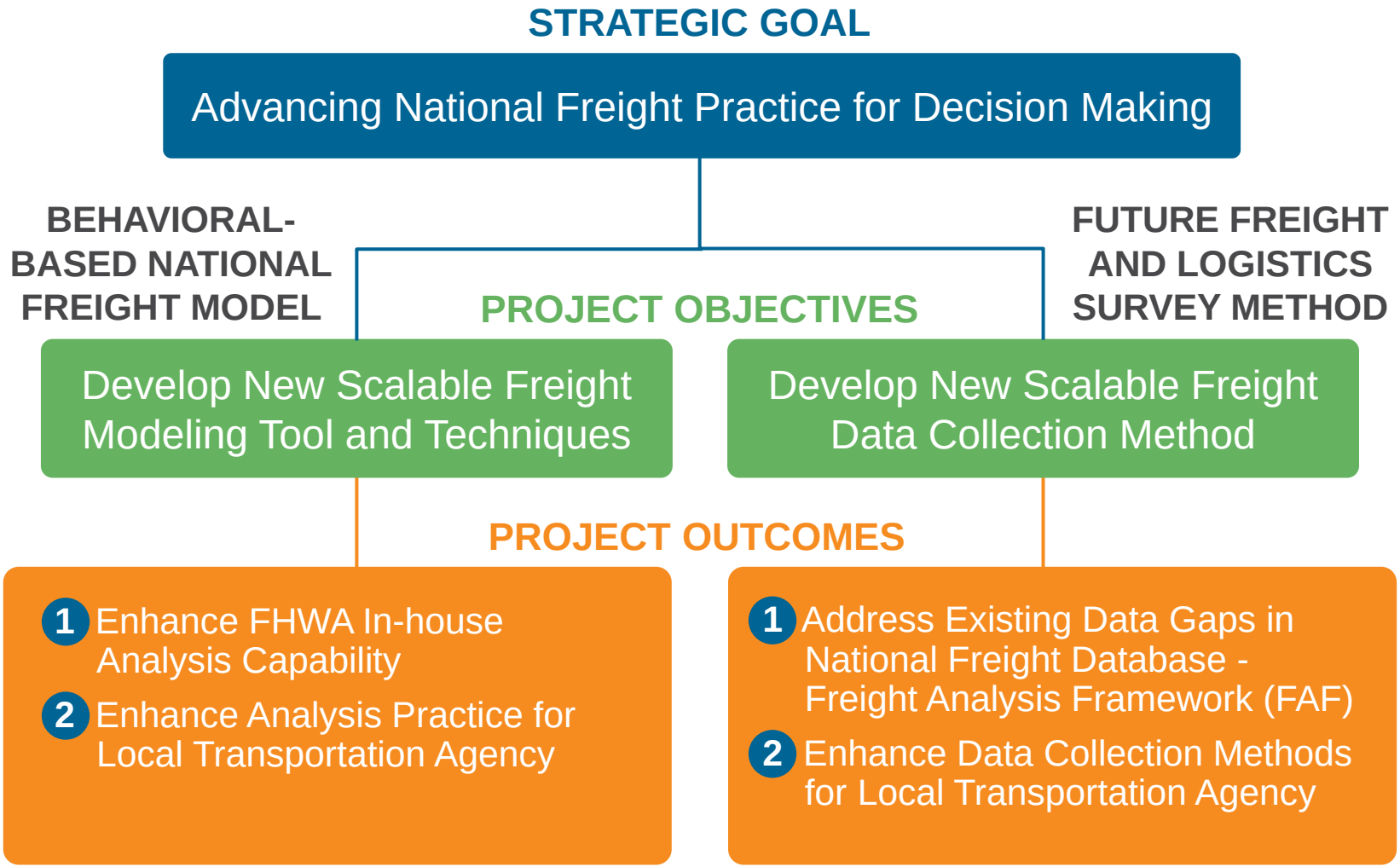
U.S. Department of Transportation
Federal Highway Administration

significance
quantitative research

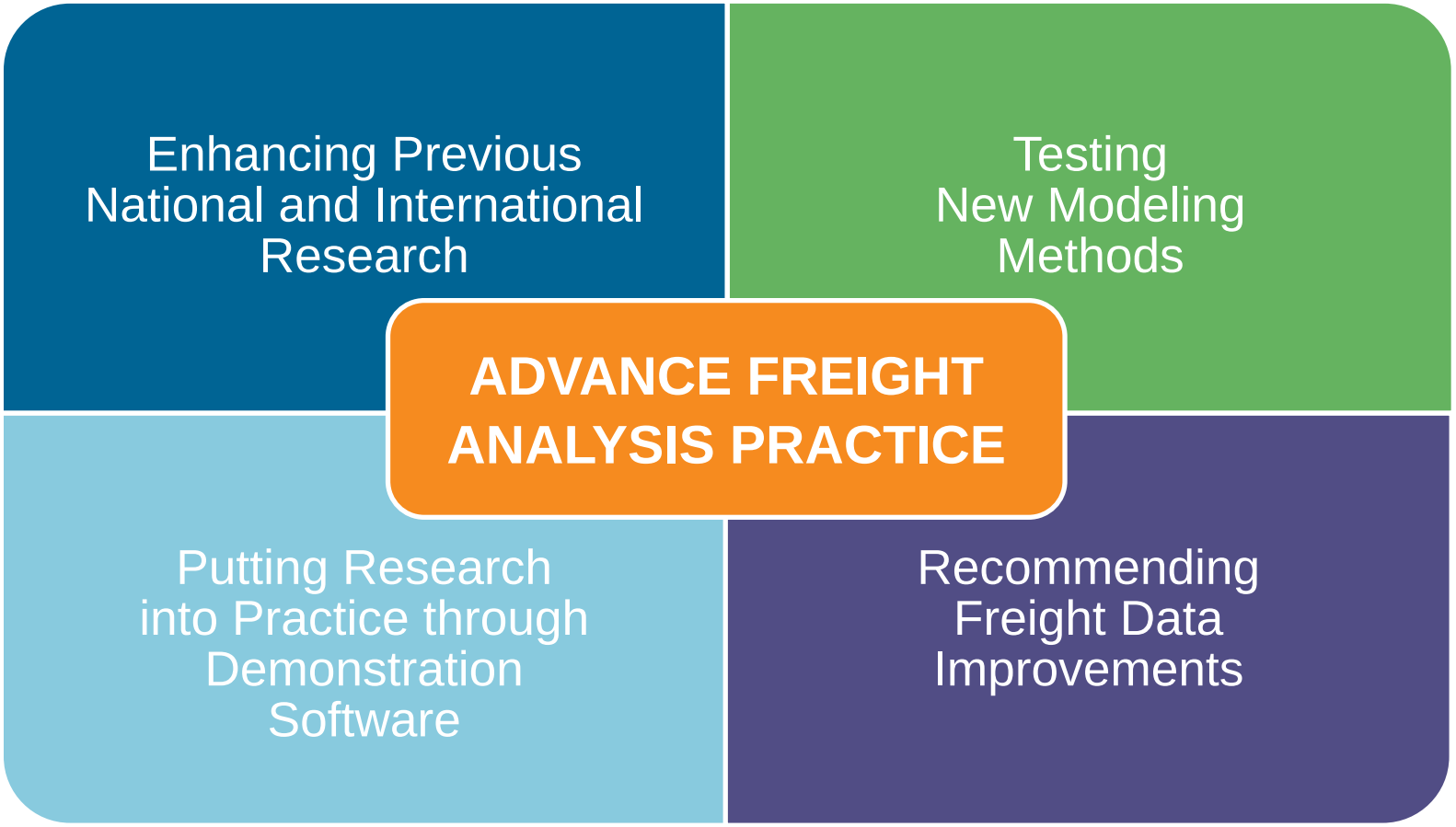
University of Washington 1861

University of Toronto

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

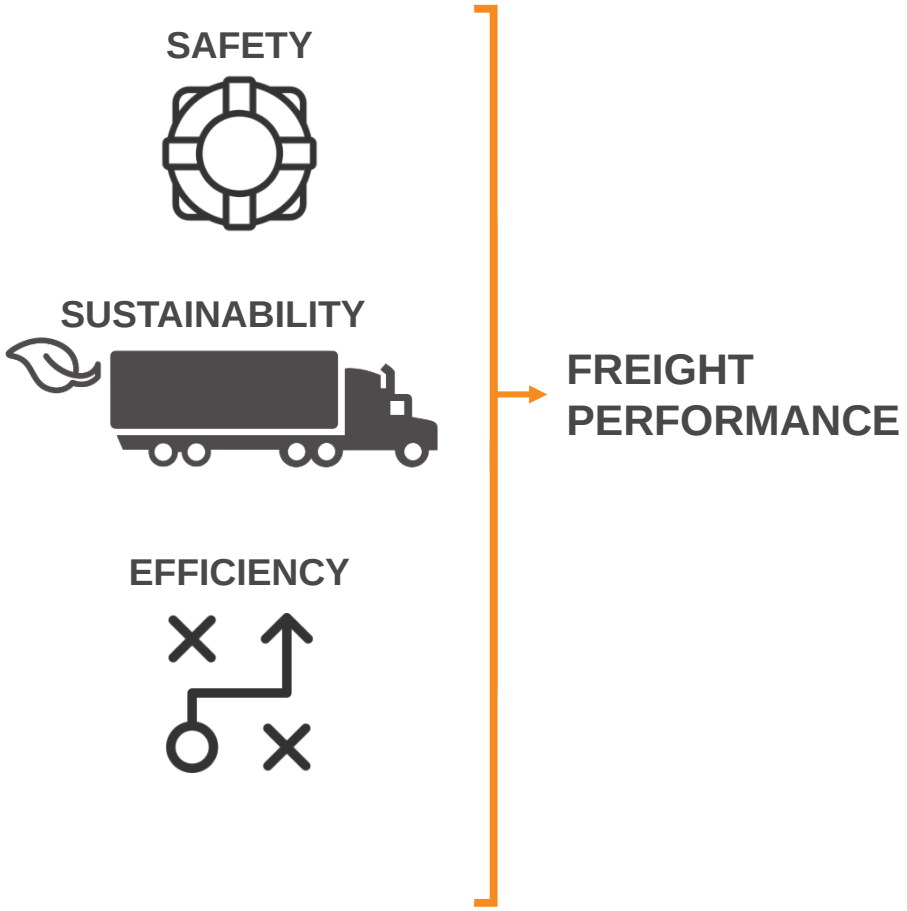


These 4 key elements support the overall goals.

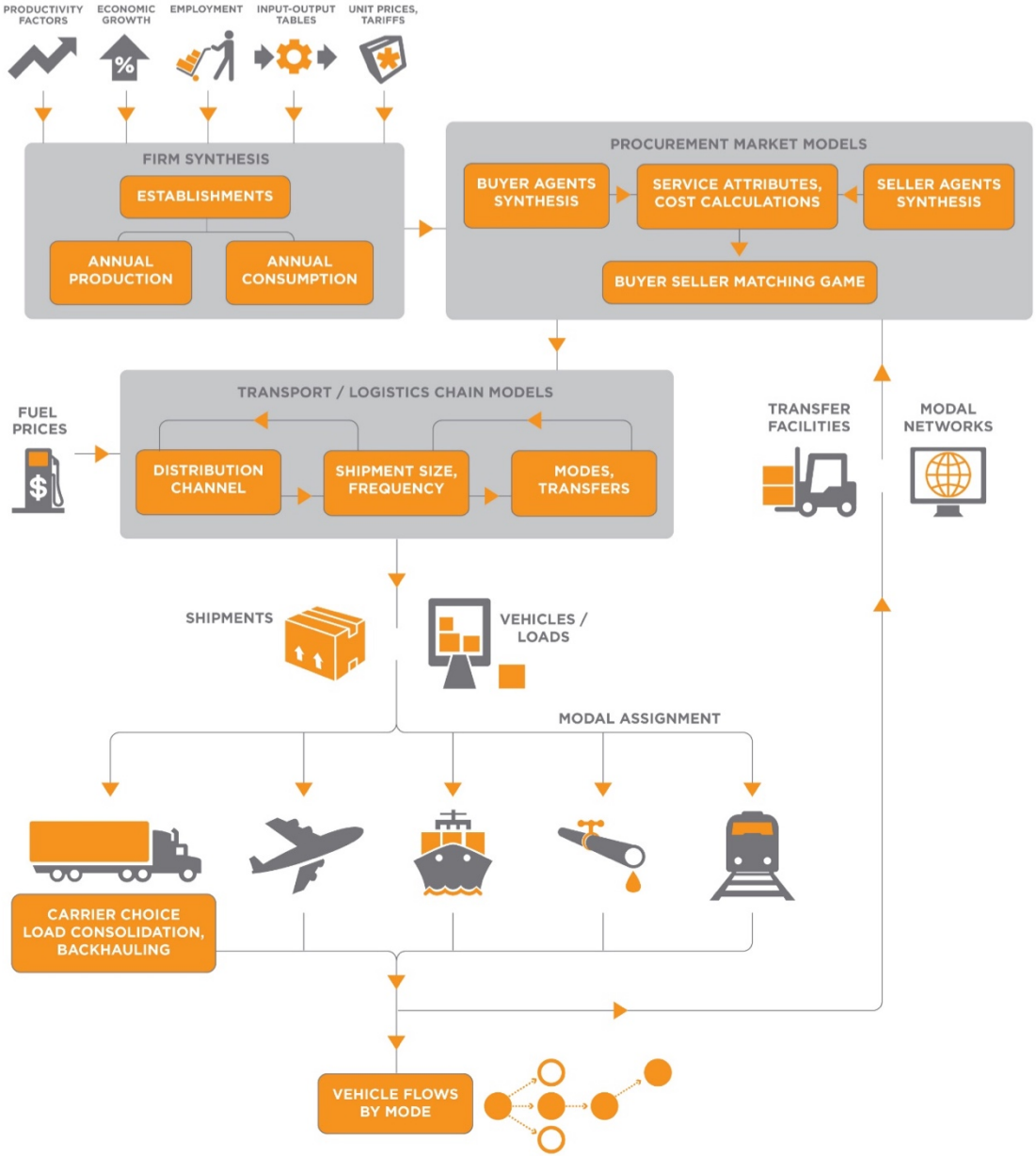


The national freight model enhances our ability to forecast goods movement.

- 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

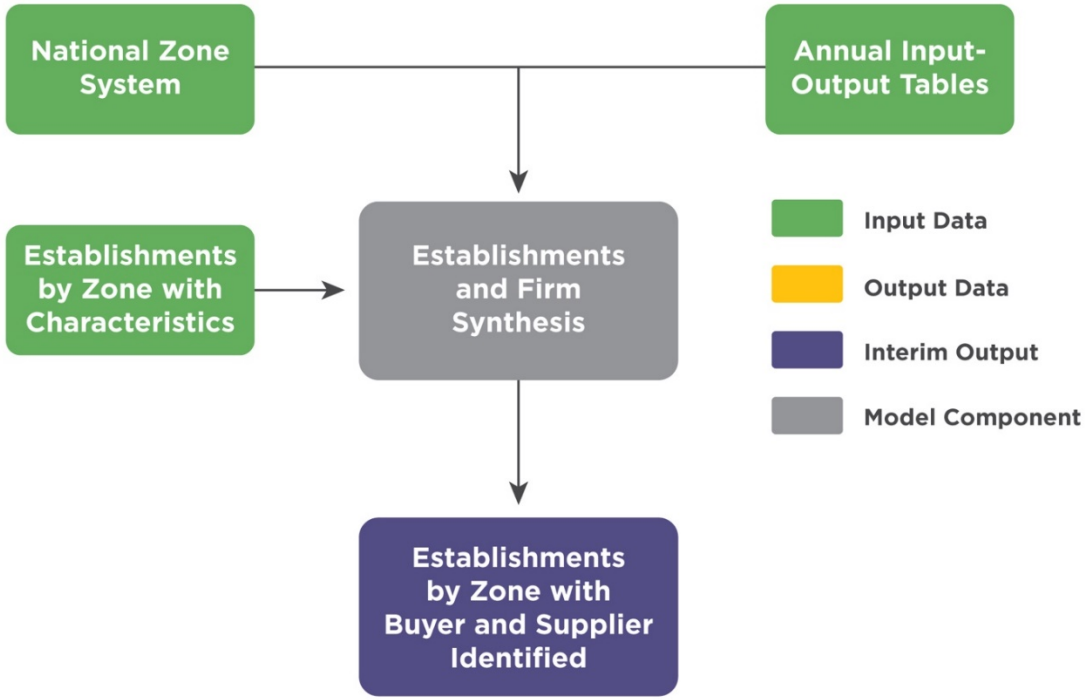
- Simulating the backhauling required to reposition trucks for their next shipment

Firm synthesis simulates firms and establishments.

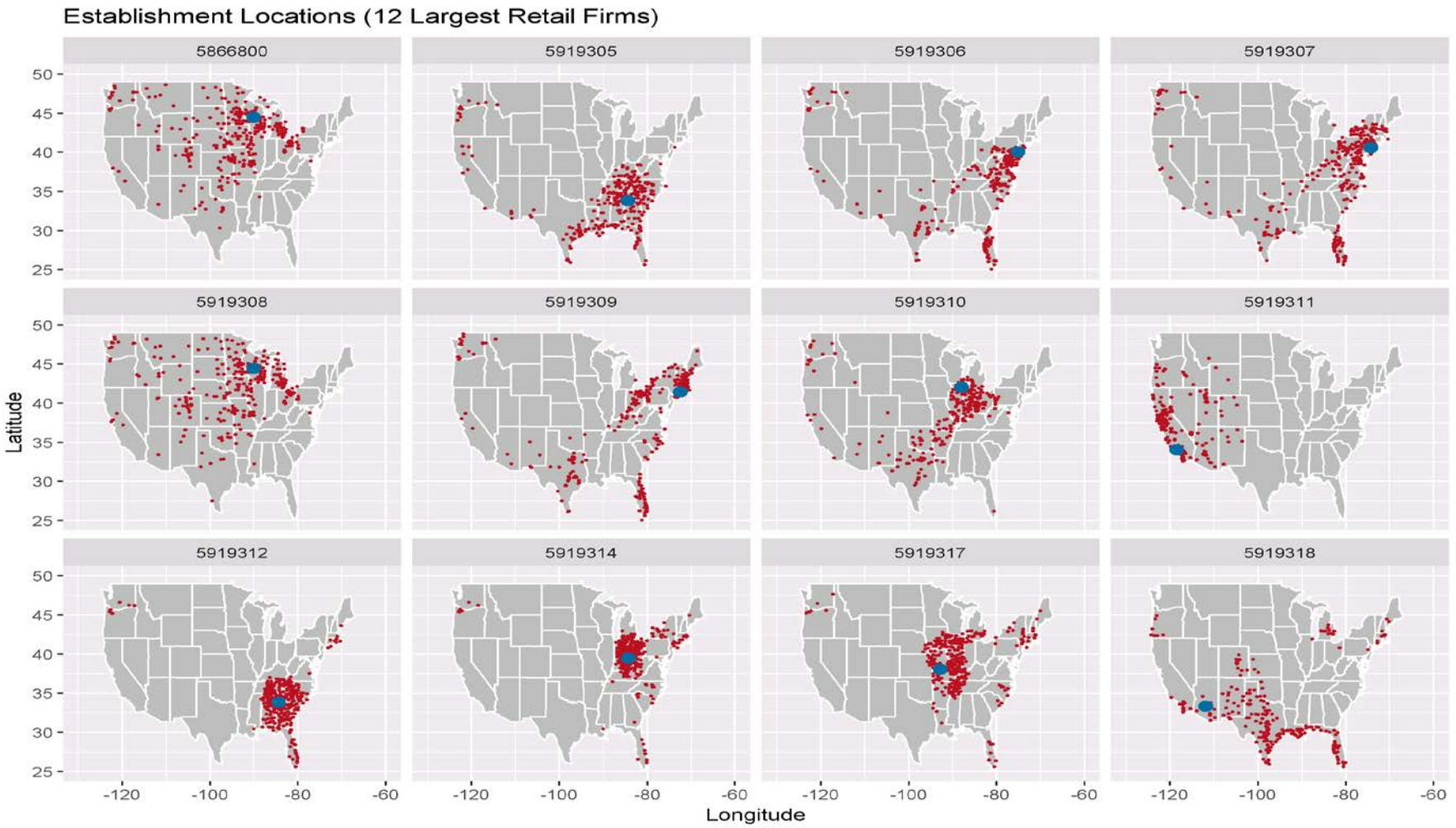
5.9 million firms
7.5 million establishments

- 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



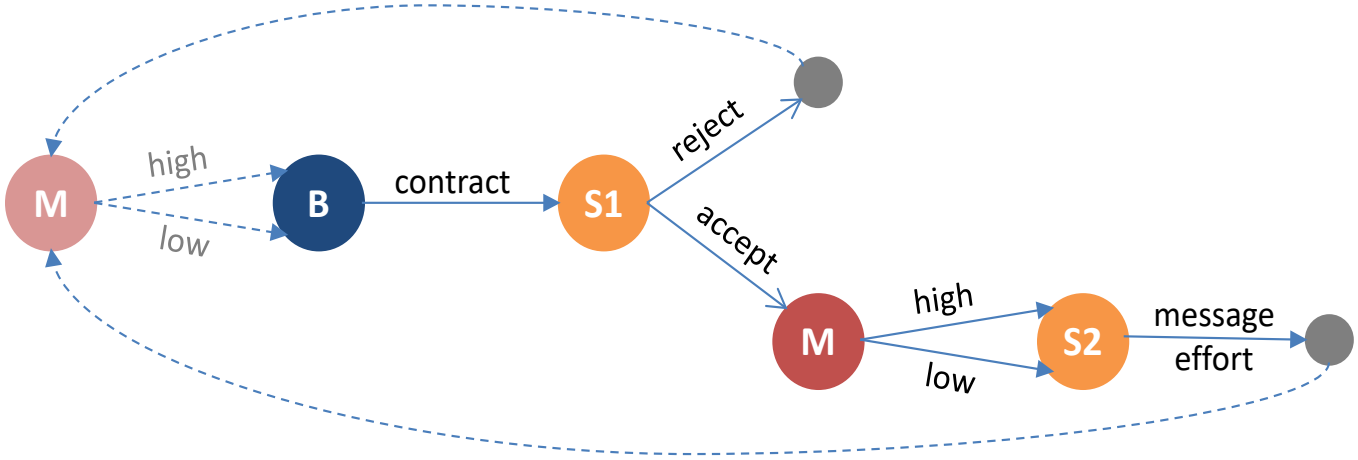
The output for the largest firms show a reasonable distribution.



Procurement market is modeled using game theory.

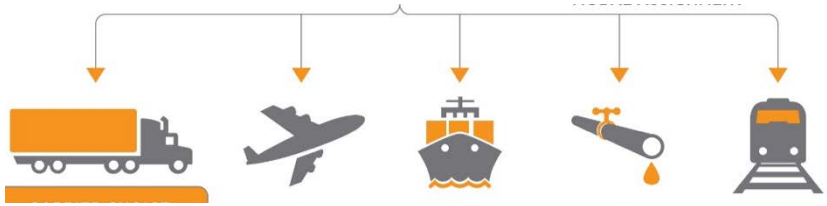
Procurement market game for a single buyer-seller pair.

- 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.

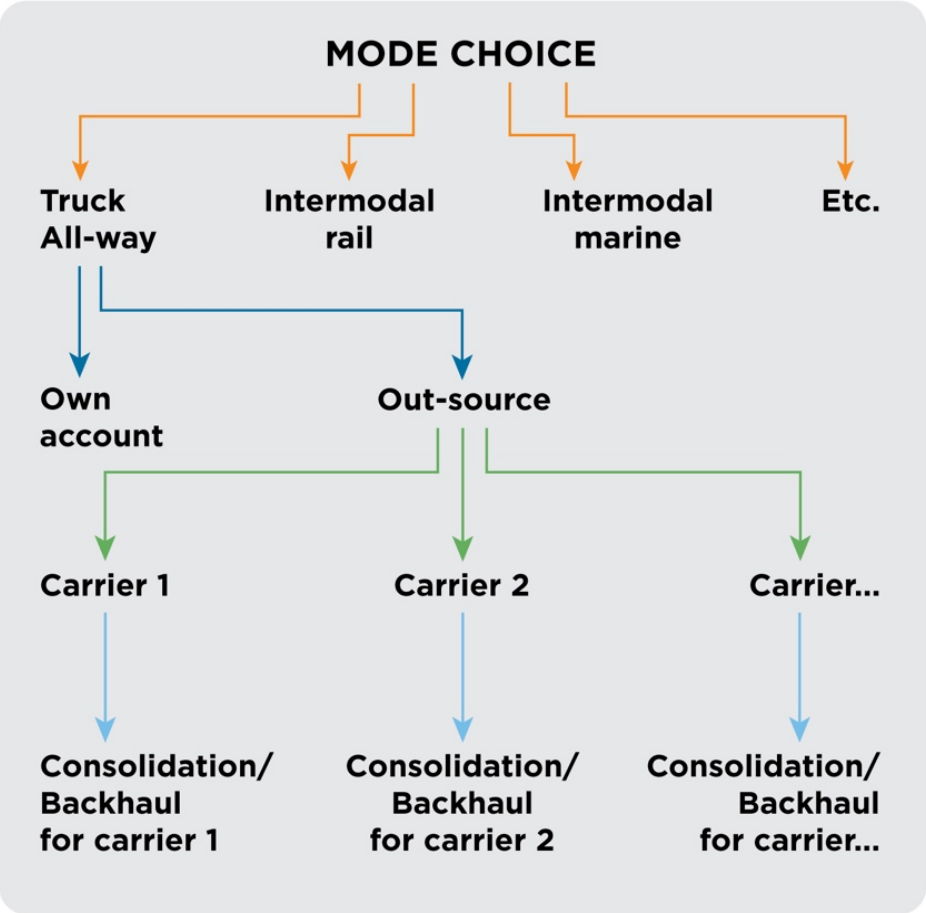
STEP 1

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

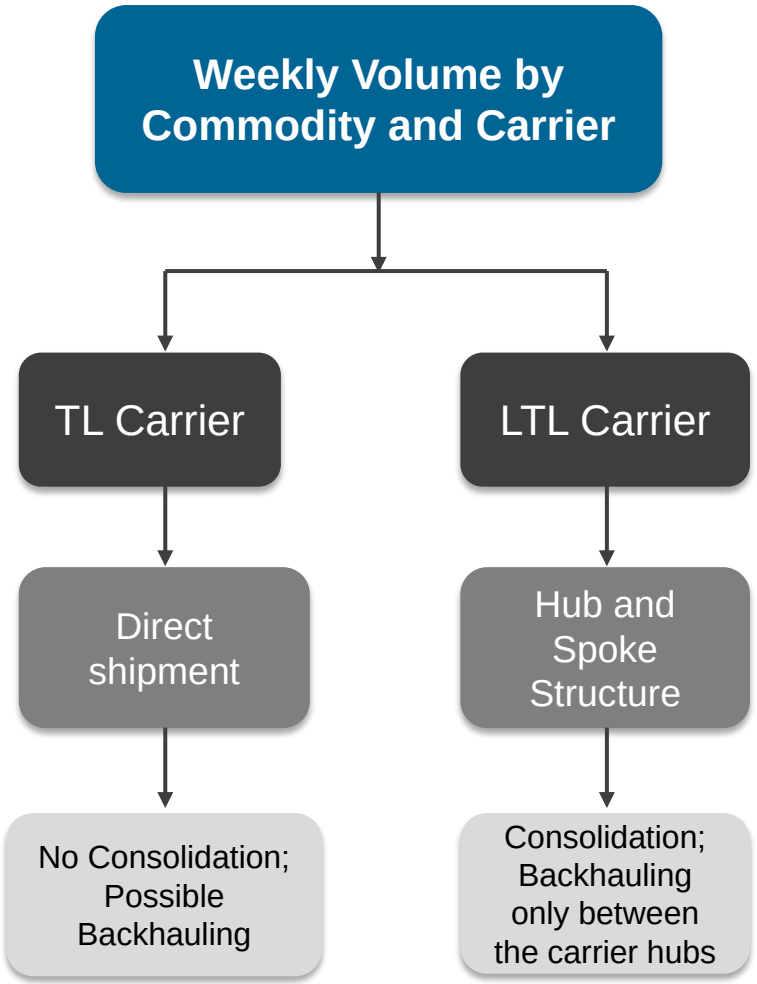
- Allows for explicit matching of loaded trips
- Improves performance by
  - consolidating shipmens
  - maximizing fleet utilization
  - minimizing empty backhauls
- Forecasts the necessary empty truck repositioning trips

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



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

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