# FHWA FREIGHT FLUIDITY PROGRAM

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U.S. Department of Transportation

**Federal Highway Administration**

# FREIGHT FLUIDITY PROGRAM

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Federal Highway Administration

- Fluidity is a monitoring program for freight transportation performance in support of the competitiveness and vitality of the nation's supply chains
- Captures for the first time the key performance indicators of travel time, travel time reliability, and customer price for multimodal freight transportation by stage and end-to-end across representative travel lanes in a cross-section of American industry
- Combines two types of data in a robust software platform:
  - Supply chain staging patterns by location and mode (from industry partners)
  - Quarterly performance metrics by lane (from public and commercial sources)
- Lane-level metrics by logistical stage and mode sum to total end-to-end supply chain outcomes, which are the bottom line for competitive industrial performance: actual data, not a model

# FLUIDITY BRIDGES AND LEVERAGES EXISTING DATA PROGRAMS

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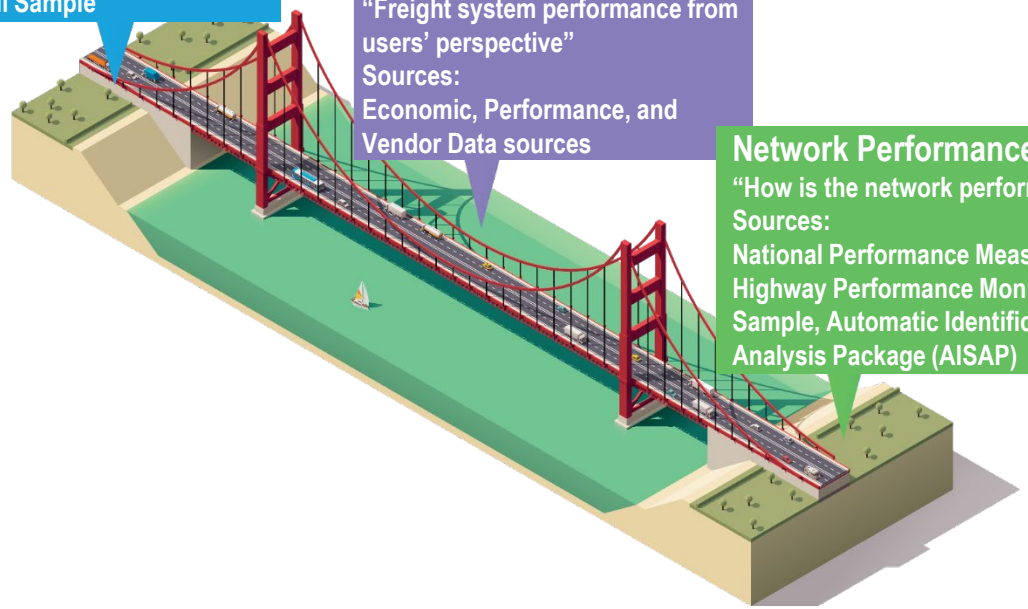
**Economic Data**
"What and how much freight is moving, and where?"
Sources:
Freight Analysis Framework, Bureau of Economic Analysis, Carload Waybill Sample

**Freight Fluidity Program**
"Freight system performance from users' perspective"
Sources:
Economic, Performance, and Vendor Data sources

**Network Performance Data**
"How is the network performing?"
Sources:
National Performance Measures Research Dataset (NPMRDS), Highway Performance Monitoring System, Carload Waybill Sample, Automatic Identification System Analysis Package (AISAP)



**Fluidity is a bridge between economic and network data, showing how freight flows and facility measures merge into effects on multi-stage, multimodal industrial performance**

# BACKGROUND

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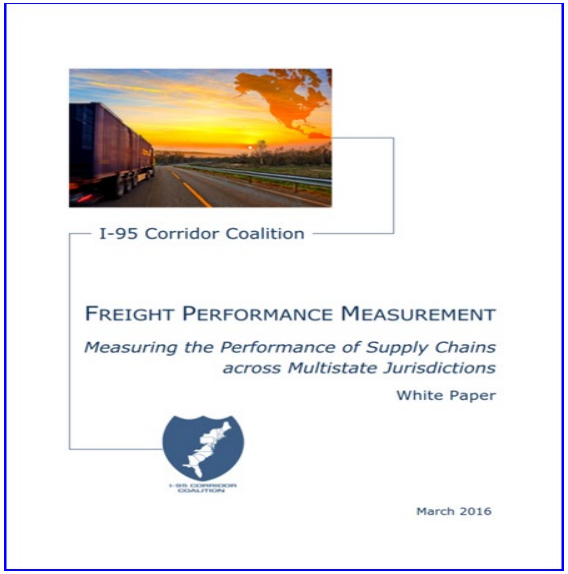
- Builds on prior FHWA funded research conducted with I-95 Corridor Coalition
  - Question: can we measure supply chain performance across modes and across jurisdictions?
  - Outcome: established that measures and metrics are common across supply chains and can be scaled for national, multistate and metropolitan analysis
- The Fluidity Program is a full feasibility test across multiple modes, 30 industries, and over 400 origin-destination moves by truck, water, rail carload and rail intermodal, over four quarters of data



# THE PRODUCT

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- A new USDOT-owned database of information, with a visualization and mapping tool to record and report three types of performance metrics across multiple modes, scalable to future expansion and enhancement
- A major advance beyond highway-only metrics, allowing us to measure performance from the supply chain perspective and identify critical flows/connections, bottlenecks and improvement opportunities over the larger multimodal system

| Current System Performance Capture (Typical) | Freight Fluidity Performance Capture |
|---|---|
| Travel Time | Travel Time (Industry/Supply Chain) |
| Travel Time Reliability | Travel Time Reliability (Industry/Supply Chain) |
| Cost of Wasted Time and Fuel | Transportation Cost (Market Price, Industry/Supply Chain) |
| Highway Only | Multimodal: Highway, Rail (IMX & Carload), Water |

# DATA – SUPPLY CHAIN DEFINITION

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- 30 major US companies identified to represent a broad cross-spectrum of industry sectors, commodities, modes
  - 24 at national level, 6 regionally focused on NY/NJ and Chicago areas
  - Through interviews, industries shared "wiring diagrams" of their most critical supply chains, without revealing other business-sensitive information

Contribution to national GDP and projected growth among freight-dependent industries

Geographic coverage of US: regions, urban centers, rural areas, gateways, corridors, direction of travel

Contribution to regional GDP and projected growth among freight-dependent industries

Industry importance to resilience of other supply chains and of population

Industry importance in US trade

Modal and travel distance diversity

# DATA – PERFORMANCE METRICS

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- Customer prices
  - Truck and Rail Intermodal price data purchased from commercial aggregator
  - Rail Carload price data estimated by consultant team from STB Waybill
- Travel time (with Reliability measured as variations in travel time)
  - Water data provided by US Army Corps of Engineers AIS, with detailed analysis by the Bureau of Transportation Statistics – 25%, 50%, 75% percentiles
  - Rail carload and intermodal travel time data purchased from commercial aggregator – 50% and 95% percentiles -- some routes not available
  - Truck data developed through analysis of FHWA's NPMRDS
    - FHWA acquired first NPMRDS in July 2013, second version in April 2017; see https://ops.fhwa.dot.gov/perf_measurement/index.htm
    - Aggregates observed travel times from vehicle-based probes on Traffic Message Channels (TMCs) over five minute intervals, continuously, for freight and passenger vehicles

# DATA – NPMRDS ANALYSIS

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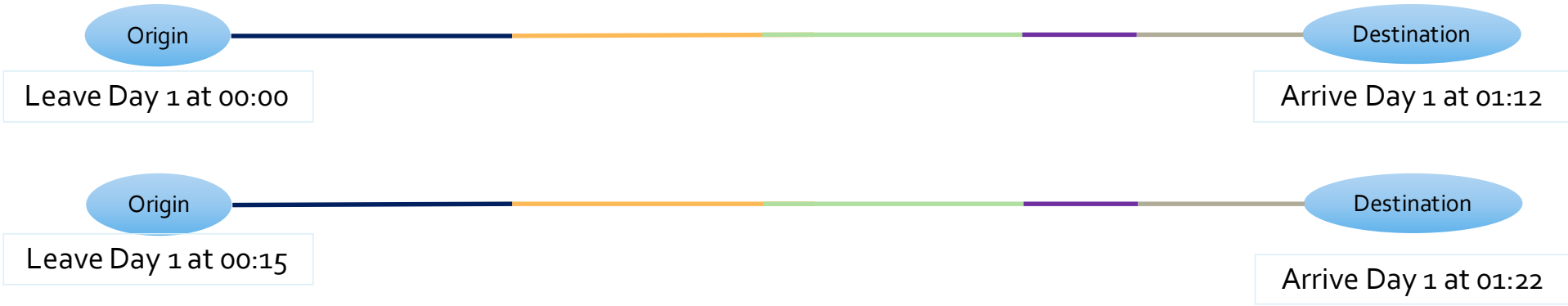
1. Line up road segments (TMCs) from origin to destination zip codes using NPMRDS roadway inventory and fastest paths
2. Using this virtual routing, calculate travel times for a trip starting every 15 minutes throughout a quarter ("traces") based on TMC speed data
3. Record the time it takes to travel the route for each starting time and day in the quarter; calculate free flow, mean, 50%, 95%, and 99% travel times averaged over the full quarter
4. Limitations: not all routes or segments of interest covered by NPMRDS, other sources of speed data would be needed to fill in gaps; but the great majority of truck route mileage is covered



# SOFTWARE PLATFORMS

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- Two integrated platforms, both from existing suite of FHWA freight measurement tools:
  - Excel database and Tableau data analysis/visualization
  - FHWA/HOFM GIS data visualization tools, fed from database

- The software platforms meet key criteria:
  - Ability to hold and process large data sets in time series
  - Accessibility of data to internal and external users, via export into common formats such as spreadsheet software, and directly on the platform without purchase of special tools.
  - Ability to restrict access to certain types or levels of data
  - Varied and high quality graphical and cartographical displays
  - Stability as dependable, tested tools
- Open-ended to support additional industries, travel lanes, modal details, data periods, performance calculations – maintainable, expandable

# MODE/ GEOGRAPHY COVERAGE

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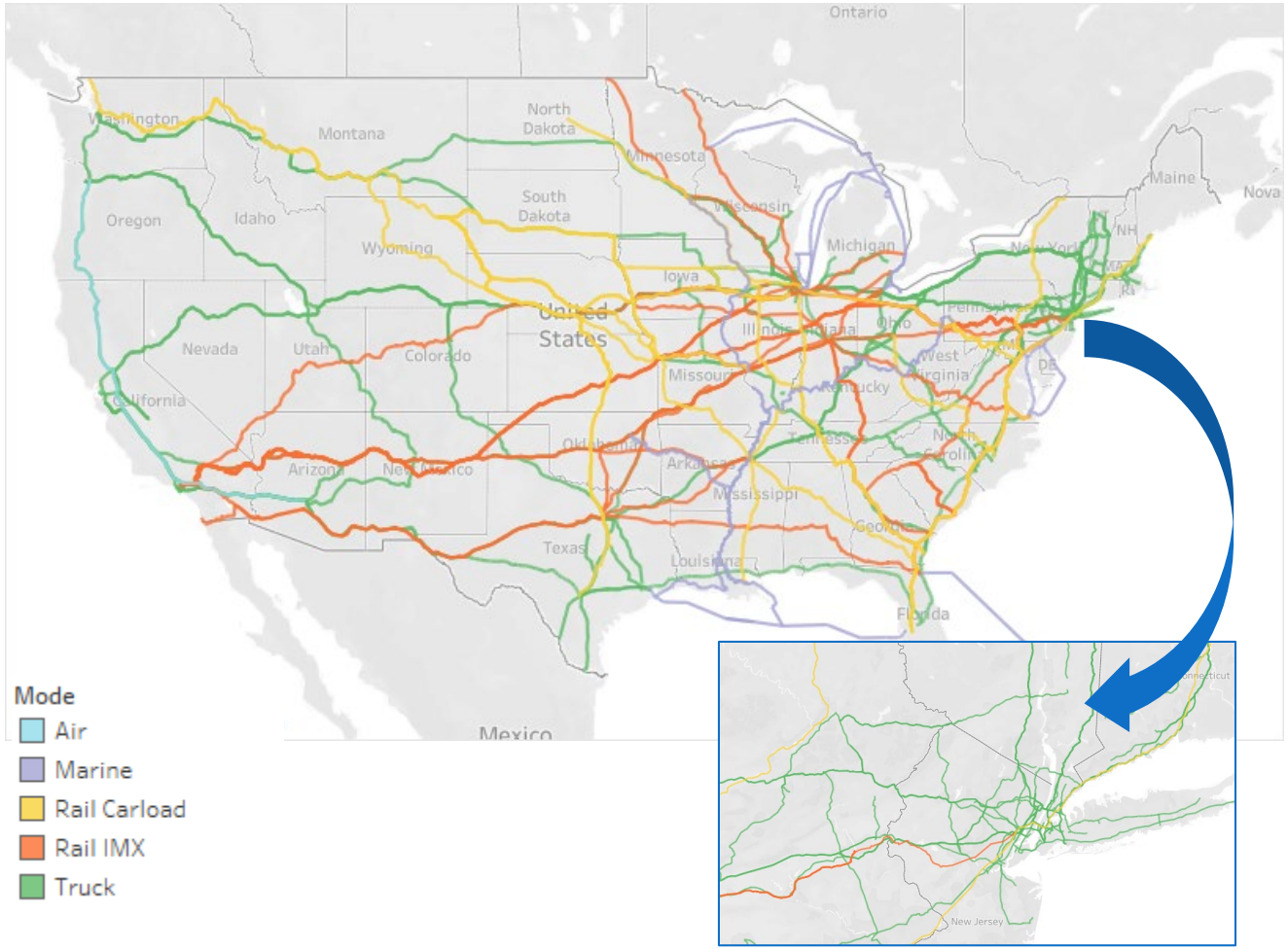


- Each data record has an assigned path – NHS segment, rail network, waterway network -- allows any data attribute or value to be displayed at a path level
- Captures moves in almost every state, most major metro areas, much of the national highway freight network -- even from the limited 30 industry sample

➡ 417 Mapped Moves: Truck (336), Rail IMX (28), Rail Carload (20), Water (28), Air (1)

# INDUSTRY COVERAGE

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➡ 30 Industries: 14 Manufacturing, 8 Retail, 4 Mining, 2 Agricultural Production (in addition to food manufacturing), 2 Transportation/Logistics

# SYSTEM-LEVEL ANALYSIS

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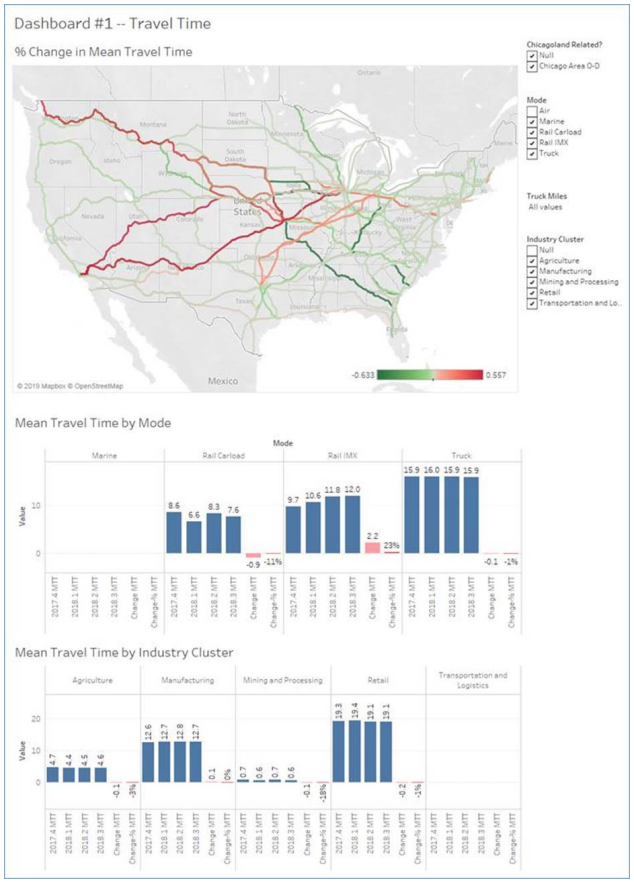


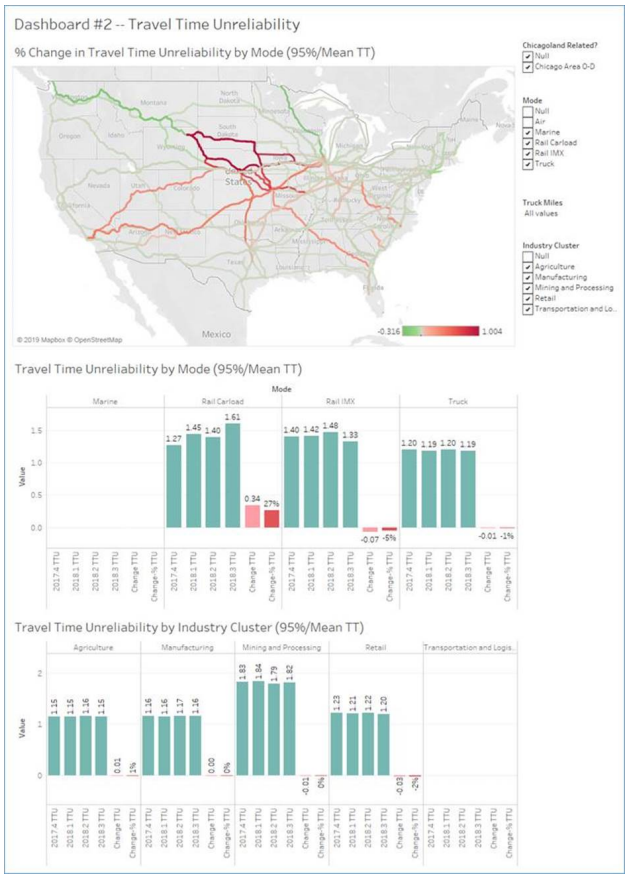


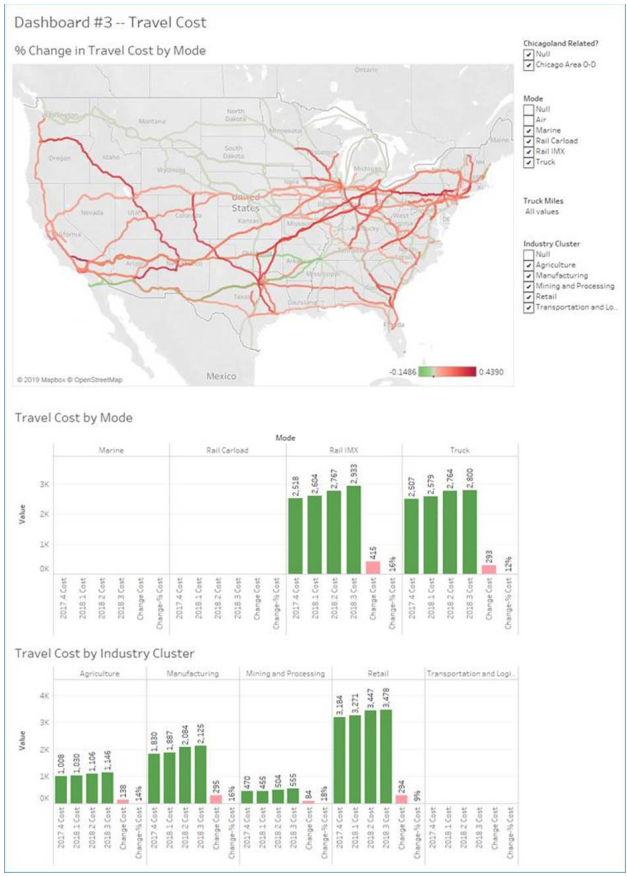


Dashboards for Travel Time, Unreliability, and Price by path, mode, and industry cluster; maps showing each quarter or changes; charts showing quarterly data; can filter by mode, industry, geography, etc.

# SUPPLY CHAIN-LEVEL ANALYSIS

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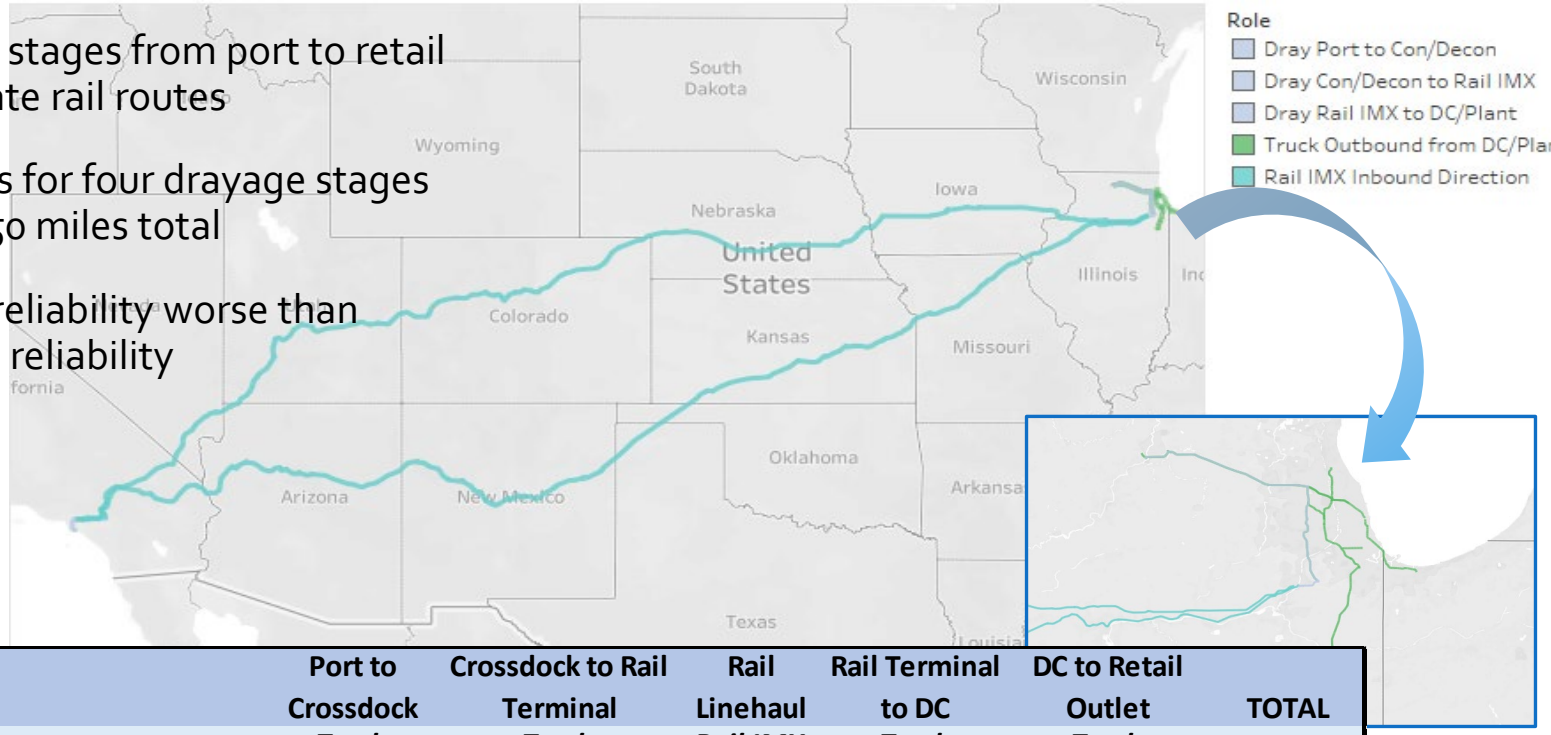
## Industry Example: Home Improvement

- Multimodal; 5 stages from port to retail outlet; alternate rail routes
- Half the cost is for four drayage stages of less than 250 miles total
- Import stage reliability worse than delivery stage reliability




| | Port to Crossdock *Truck* | Crossdock to Rail Terminal *Truck* | Rail Linehaul *Rail IMX* | Rail Terminal to DC *Truck* | DC to Retail Outlet *Truck* | TOTAL |
|---|---|---|---|---|---|---|
| Miles | 6 | 25 | 2200 | 109 | 103 | **2443** |
| 2017.4 Total Cost per Unit ($) | 489 | 526 | 2616 | 699 | 692 | **5022** |
| 2017.4 Linehaul Cost per Unit ($) | 487 | 518 | 2298 | 659 | 653 | **4615** |
| 2017.4 Fuel Cost per Unit ($) | 2 | 8 | 319 | 40 | 38 | **407** |
| 2017.4 Mean Truck Travel Time (hrs) | 0.3 | 0.7 | | 1.9 | 1.8 | **4.7** |
| 2017.4 Cross Modal Reliability (95%/50%) | 1.5 | 1.6 | | 1.1 | 1.3 | |

# STATEWIDE ANALYSIS

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## State Example: Missouri

- Truck, rail intermodal, rail carload, and water flows
- Inbound, outbound, through
- Ability to track multi-state performance metrics for a limited sample of industries
- Opportunity to build on national platform to increase coverage for industries and moves most significant to each state
- Could help states better fulfill FAST-Act mandate to address multi-state freight planning factors

# PRODUCT VALUE

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- **Public Agencies (Federal, State, MPO/Regional)**
  - Monitor Key Performance Indicators (KPIs), comparable to how freight system users monitor themselves, capturing critical factors for industry competitiveness
    - Supports economic development strategies by identifying transportation connections relied on by essential industries
    - Supports timely response to questions about supply chain disruptions, resiliency and redundancy, alternative service options for major industries, last mile connectivity, and other freight transportation issues
    - Provides working tool that complements and combines with others in the public agency toolbox
    - National platform supplies foundation for state and local agencies to build upon

- **Private Sector**
  - Potential resource to provide benchmarking data to smaller/rural industries without access to this information

# NEXT STEPS

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- Complete data validation and documentation
- FHWA launches Freight Fluidity Supply Chain Monitoring tool as part of suite of Freight Data Tools in 2020
  - Provides report on Project and User Guide on Data Tool
- Conduct continued outreach to state DOTs, MPOs and others to create awareness of tool and capabilities
  - Through TRB, AASHTO, AMPO event presentations in 2020
- FHWA HOFM examines adding additional capabilities in tool
  - Additional quarters, industry sectors, applications

# MORE INFORMATION

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- Contact Information

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