

Conceptual Framework for Analyzing the MTS within the Intermodal System

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Outline

- The U.S. economic challenges highlight the need for a national integrated freight system.
- No single organization can centrally manage all the required investments for an integrated freight system.
- Waterways are in a unique position to think system-wide.
- Overview of an MTS intermodal analysis framework.
- Next steps.

U.S. Economic Challenges

Business

- Reduce costs.
 - ▶ Raw materials
 - ▶ Imports
 - ▶ Exports
- Increase Jobs
 - ▶ Cost competitive exports
 - ▶ Lower costs-> increase demand
- Technology creates challenges
 - ▶ Tracking, communication, efficiency
- Sustainability
 - ▶ Environment, society, profit

Government

- Decreased funding
- Increased scrutiny
- Pressure creates focus
- Encourages co-operation
- Infrastructure demands attention

We need a better understanding of our integrated freight system to help us face these issues.

No single organization can do this alone.

- Investments can be coordinated without being centrally planned.
- Shared data helps analysis.



Waterways are in a unique position to think system-wide.

- Movement data sets available.
- Federal control/responsibility for much of the system.
- Detailed tracking data available (AIS).
- History of economic-based investment decisions.
- Potential to LEAD in transportation modeling.

US Commercial Freight Magnitude

Total US International Trade 2010
\$4.1 Trillion

Exports
\$1.8 Trillion (44%)

Imports
\$2.3 Trillion (56%)

Services
\$549 Billion
(13%)

Total Goods
\$3.2 Trillion
(77%)

Services
\$403 Billion
(10%)

1.9 Billion tons

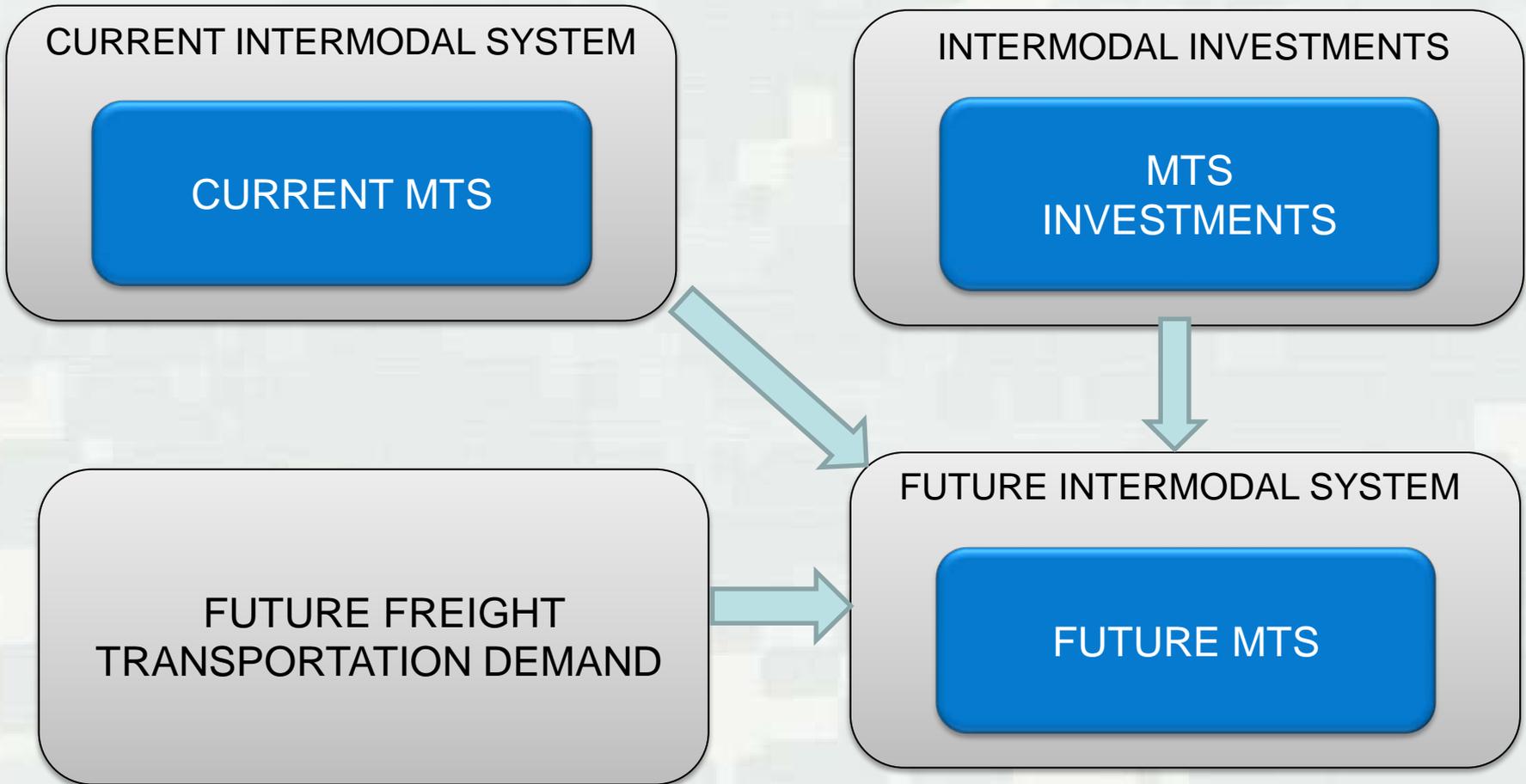
Waterborne
1.4 Billion tons (72%)

Air, Land, Pipeline
542 Million tons
(28%)

Sources: US Census Bureau, US Bureau of Economic
Analysis and Freight Analysis Framework v3.



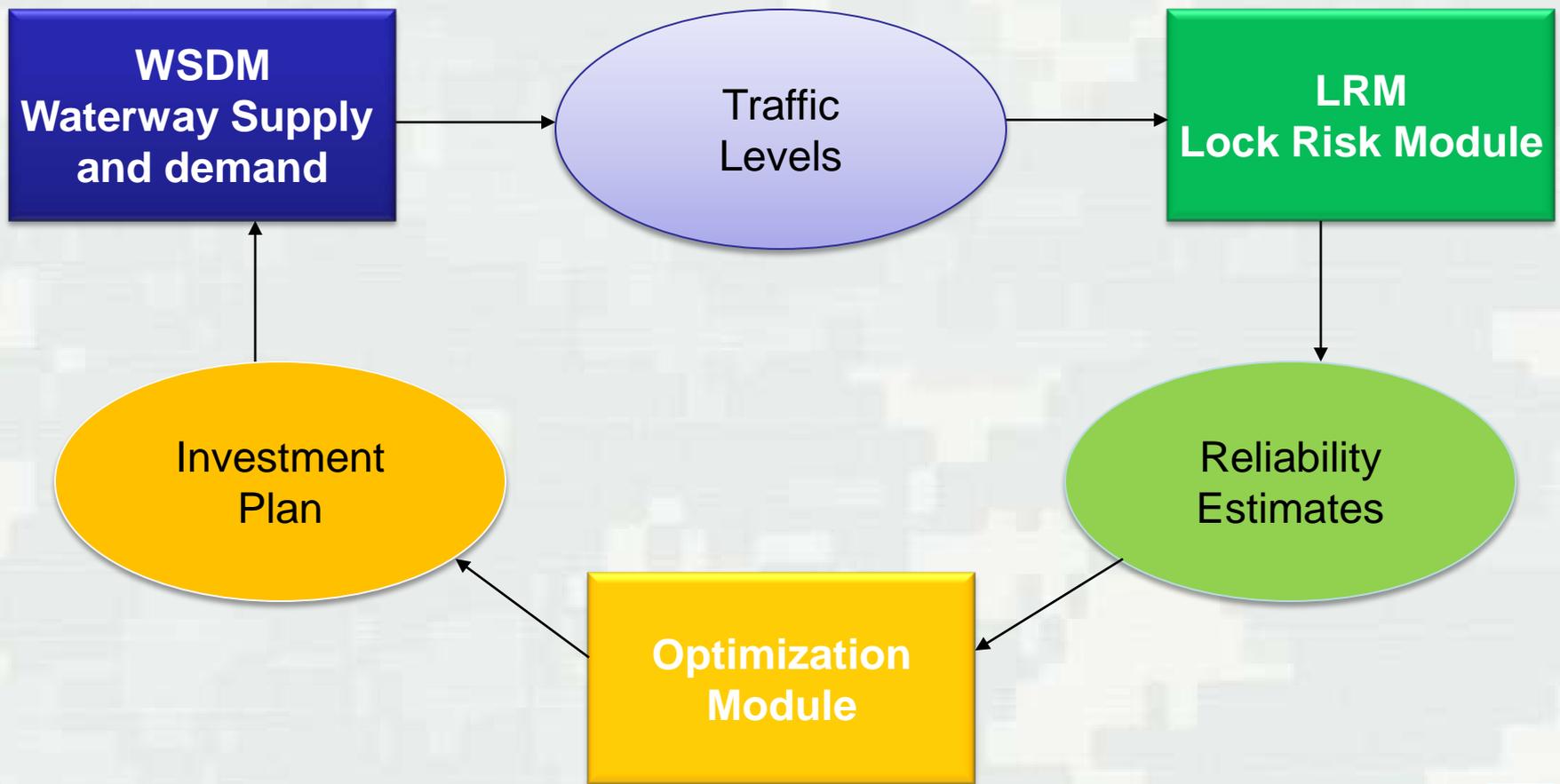
A Conceptual Framework



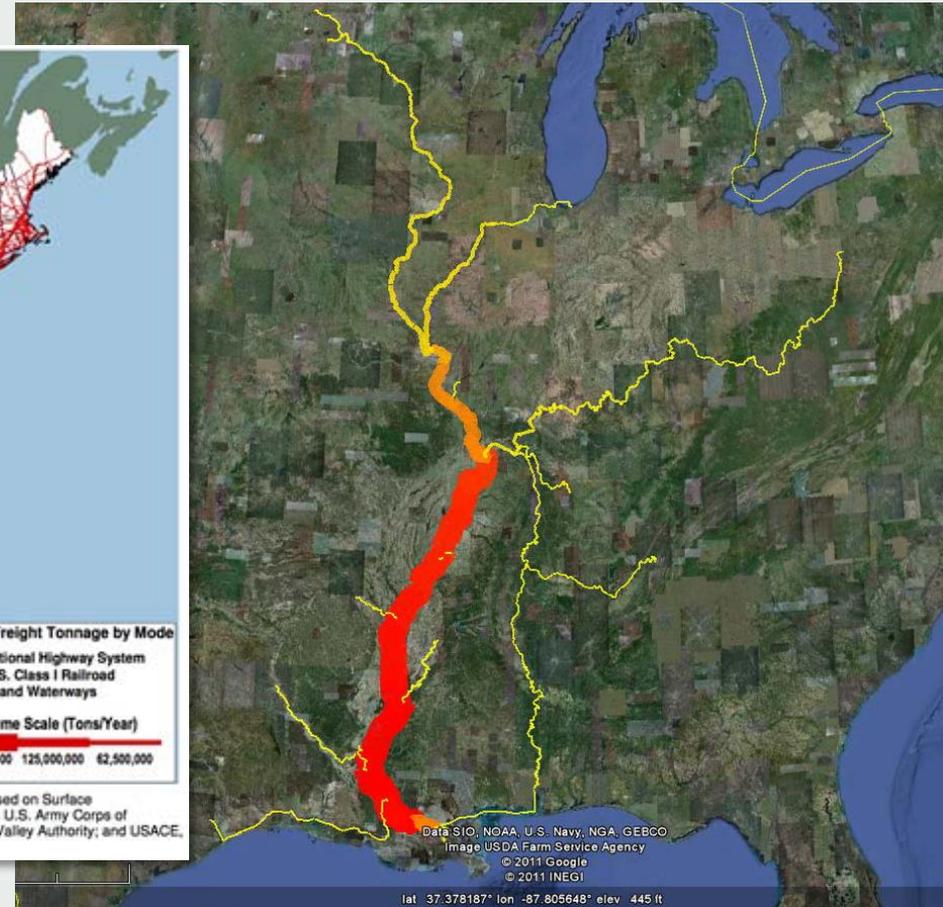
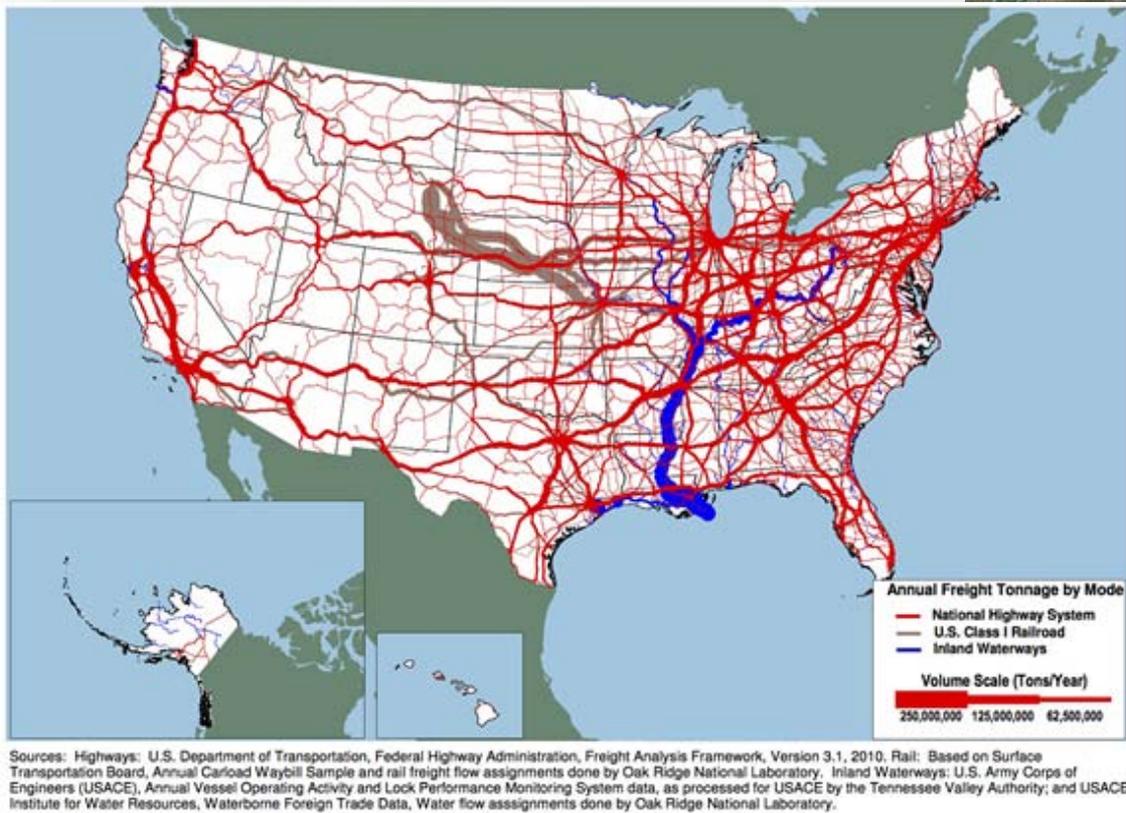
Two Big Challenges

- Predicting the future is hard.
- The intermodal system is very complex and hard to understand.
- But this is our charge...

Example: Navigation Investment Model



Examples: FAF³ and CPT



Current MTS

“We are a maritime nation.”

- MTS—A national resource
 - ▶ Ports, locks, waterways, vessels
 - ▶ Operational Practices
 - ▶ Technology in use
- Metrics we use for tracking MTS status
 - ▶ Cargo processed (tons, TEUs)
 - ▶ **Not systems thinking.** Average Delay at a lock
 - ▶ Ship drafts for arrivals/departures
 - ▶ Others—economic, environmental, social, security
- BIG DATA may tell us things we did not know.

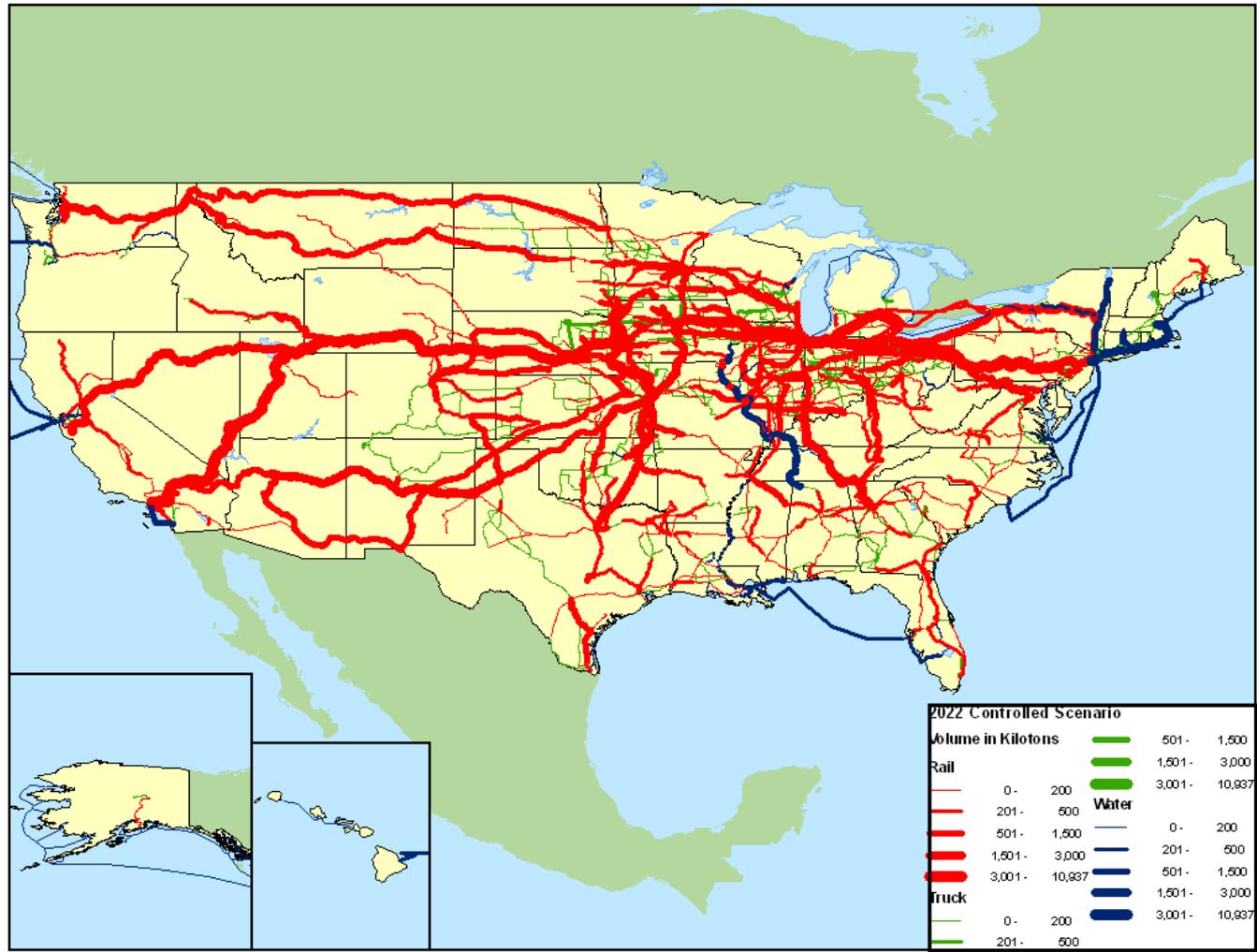
US Intermodal Freight Network



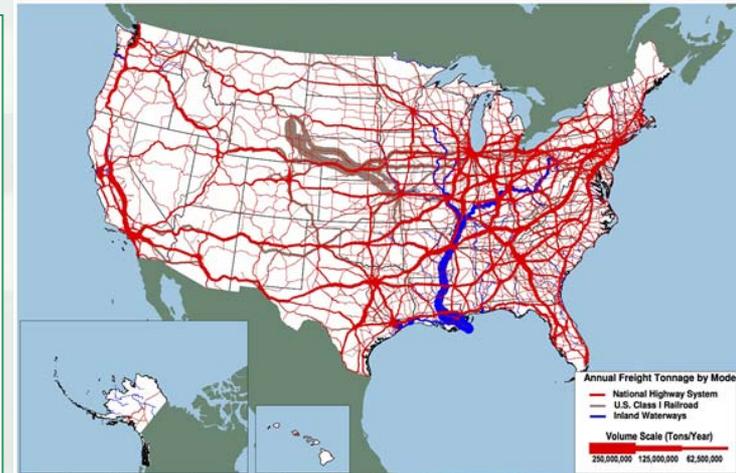
We need to understand how commodities flow on the network.



2022 Mode Specific Ethanol Movements (Ktons)

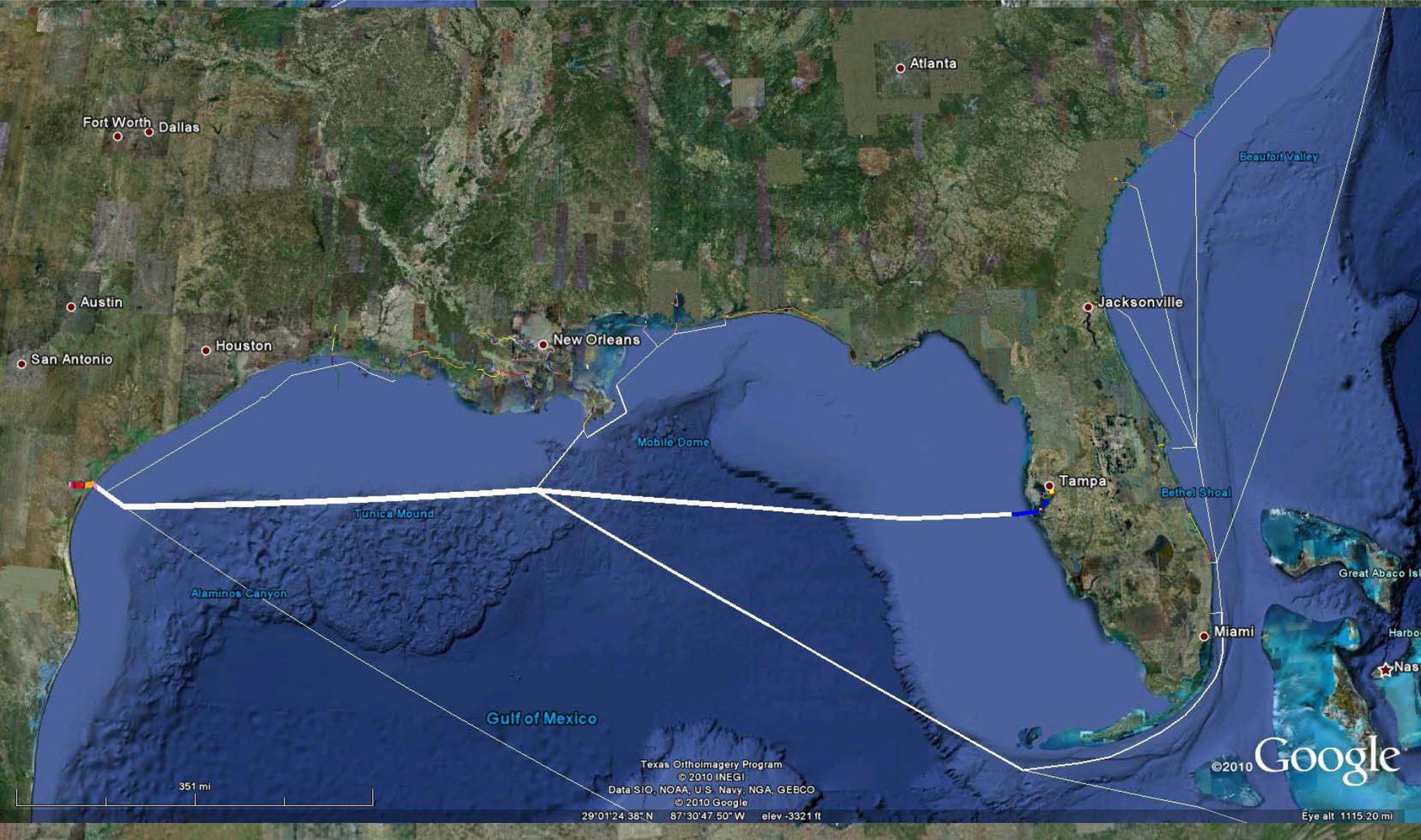


Multi-modal Freight Movements

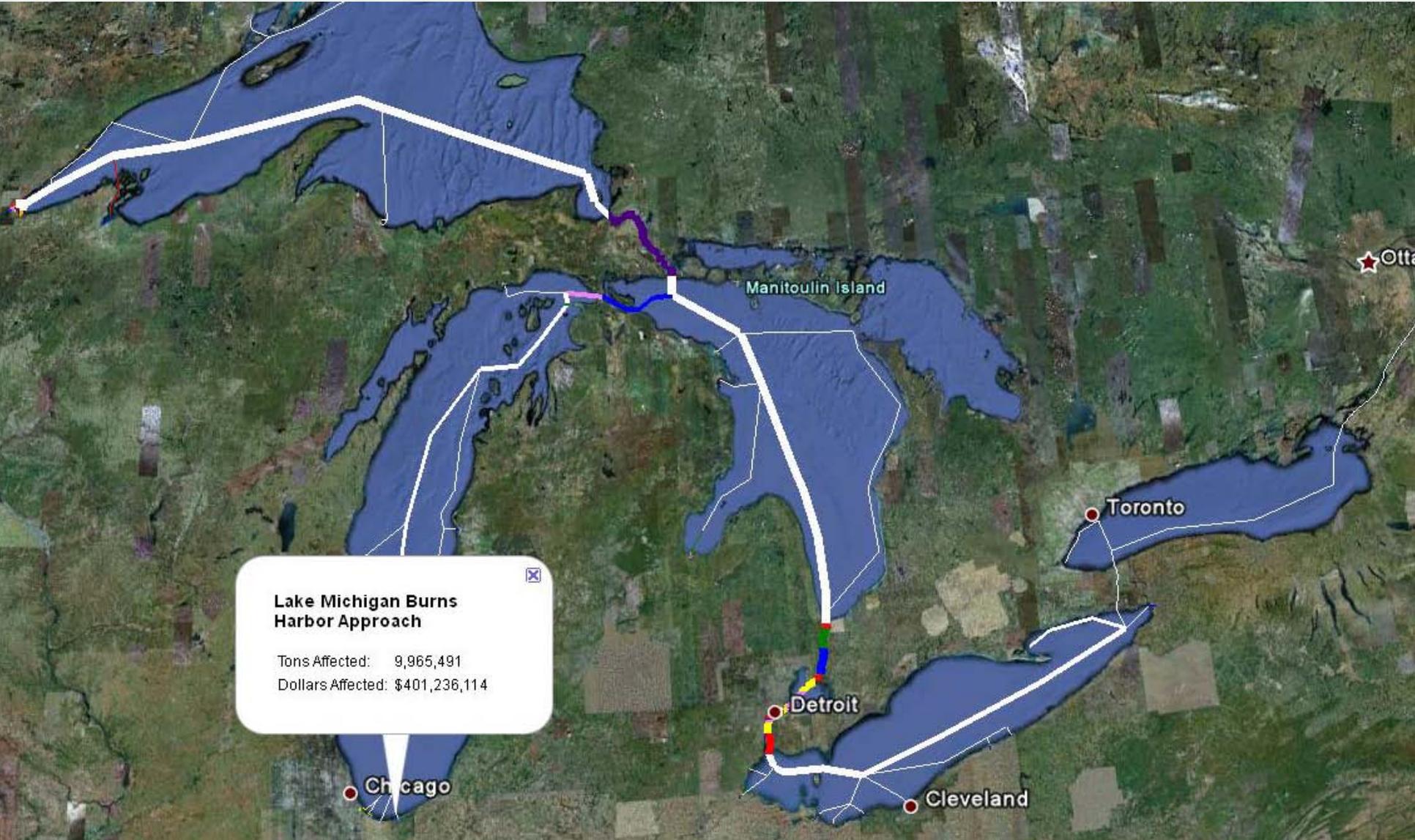


Sources: Highways: U.S. Department of Transportation, Federal Highway Administration, Freight Analysis Framework, Version 3.1, 2010; Rail: Based on Surface Transportation Board, Annual Carload Waybill Sample and rail freight flow assignments done by Oak Ridge National Laboratory; Inland Waterways: U.S. Army Corps of Engineers (USACE), Annual Vessel Operating Activity and Lock Performance Monitoring System data, as processed for USACE by the Tennessee Valley Authority, and USACE, Institute for Water Resources, Waterborne Foreign Trade Data, Water flow assignments done by Oak Ridge National Laboratory.

MTS Intermodal Role



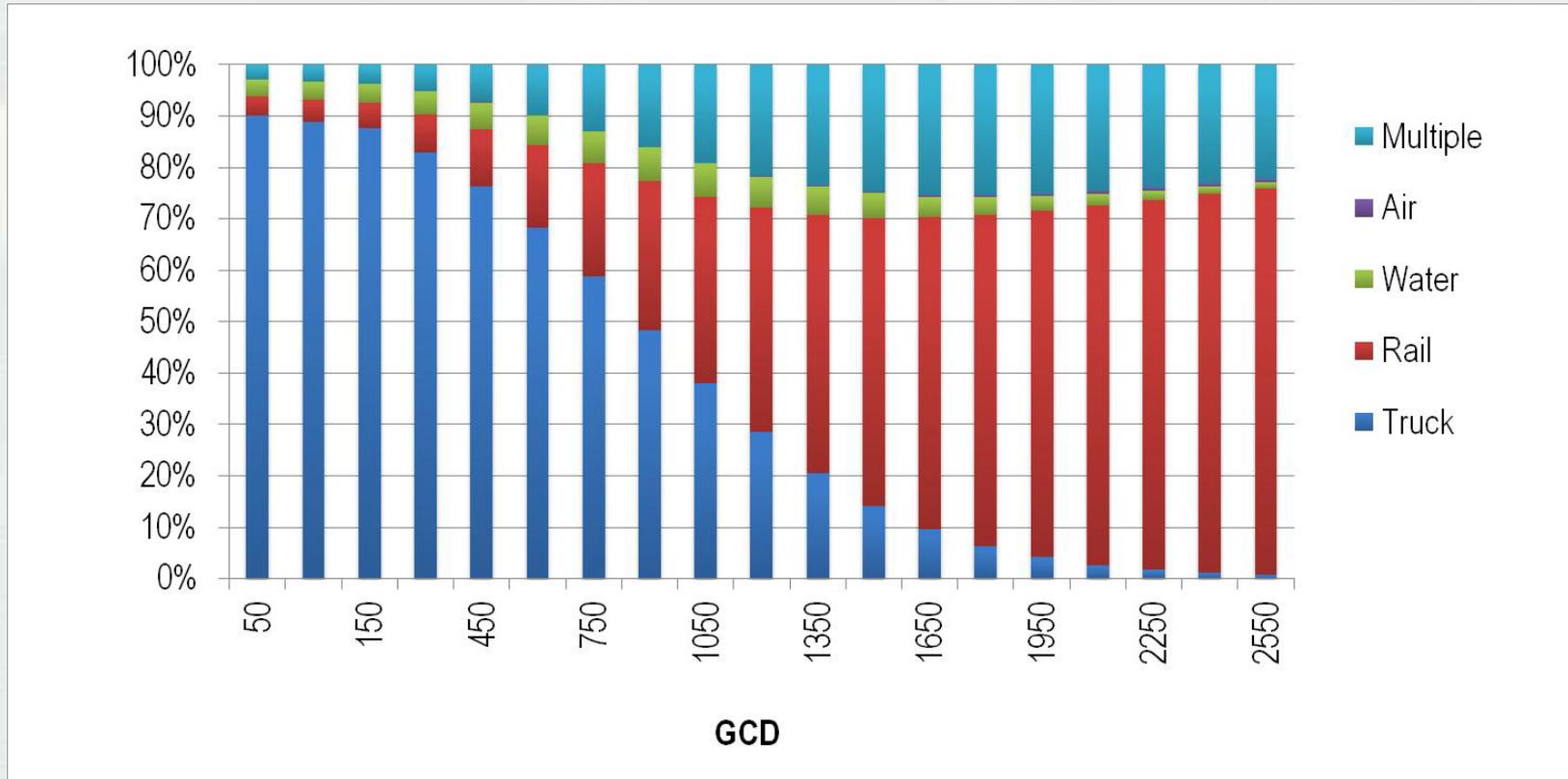
MTS Intermodal Role



How do we estimate freight transportation demand?

- Waterborne Commerce Data
- FAF³
- AIS
- Import/Export Trends
- Input/Output models of manufacturing
- F**ecasting

- **Mode Share for the Manufacturing Sector**



Water movements are more likely to happen around 1000 miles

Based on a logit model using FAF data.



U.S. Committee on the Marine Transportation System



TRANSPORTATION RESEARCH BOARD

OF THE NATIONAL ACADEMIES



BIENNIAL RESEARCH AND DEVELOPMENT CONFERENCE

**DIAGNOSING THE MARINE TRANSPORTATION SYSTEM:
MEASURING PERFORMANCE AND TARGETING IMPROVEMENT**

WASHINGTON, D.C. • JUNE 26 - 28, 2012

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2101 CONSTITUTION AVENUE, NW
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**Abstracts
Due
March 31, 2012**



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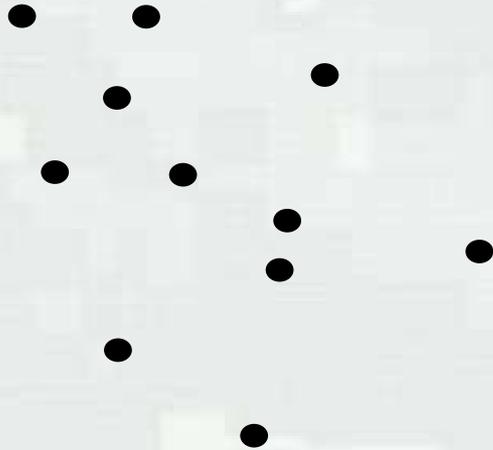
System Investments

- Construction, maintenance/rehab, dredging
- Operational changes
- Technology—RIS, eNav, construction, materials
- Vessels
- Innovations by industry

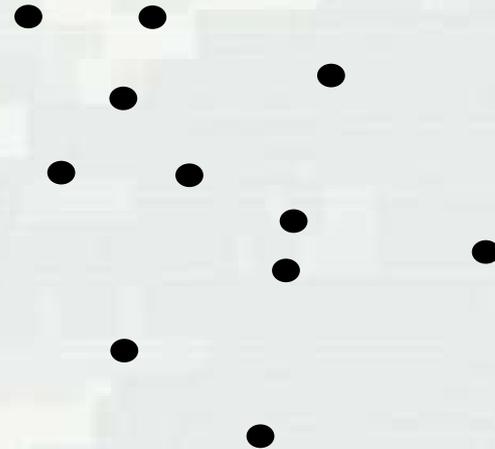
Challenges for Investment Planning

- *What is our baseline for comparison?*
- *How should we finance the investments?*
- *How should we plan for unpredictable financing?*

Connect the Dots

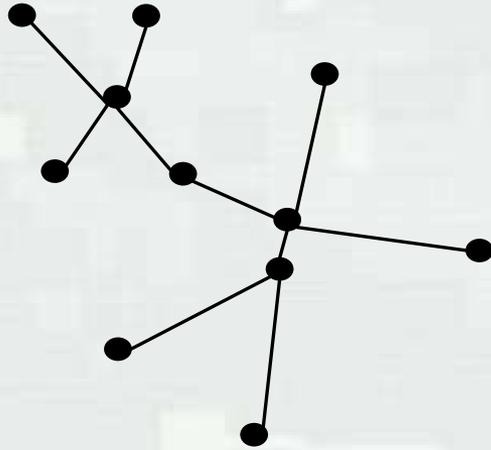


Problem A

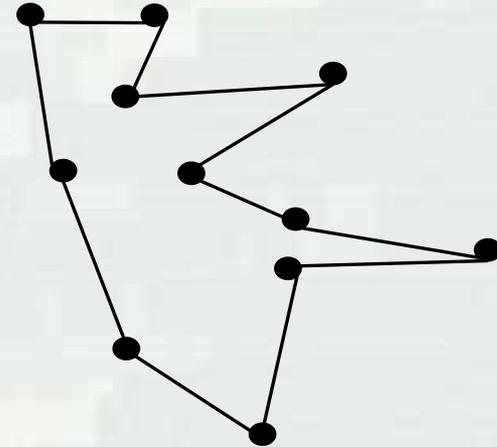


Problem B

Connect the Dots

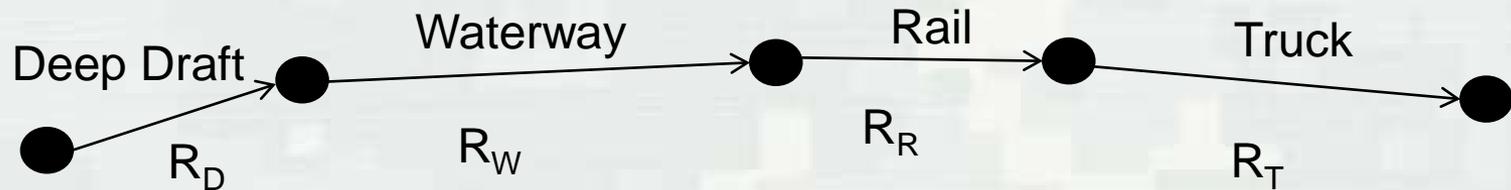


Problem A
Easy



Problem B
Hard

Supply Chain Reliability



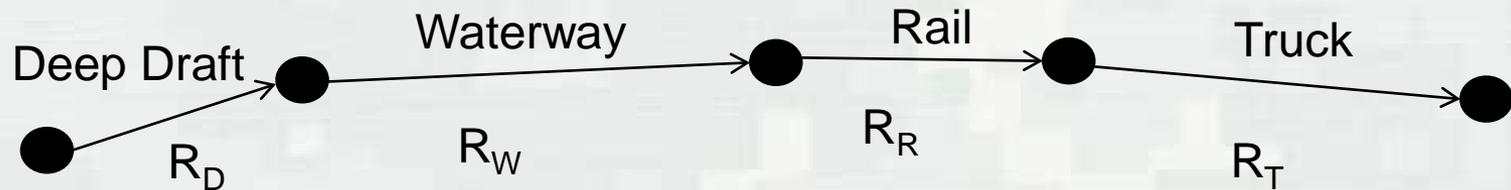
$$\text{System Reliability} = R_D * R_W * R_R * R_T$$



- Traffic flows
- Physical conditions
- Investments
- Intermodal connections



Supply Chain Reliability



$$\text{System Reliability} = R_D * R_W * R_R * R_T$$

- Traffic flows (congestion)
- Physical condition (level of service)
- Investment (maintained funding levels)
- International (times)

**Evaluated via
Metrics**

- But we must understand the system...

How to Improve System Reliability?

- Yes, target the weak links, but understand their contribution to the overall system.
- We need coordination and understanding across:
 - ▶ Government
 - ▶ Industries
 - ▶ Operators
 - ▶ Generations

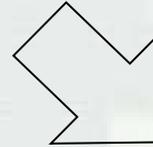
Future MTS Synergies

- **Government**
 - ▶ Commodity flow data (USDOT, USACE)
 - ▶ Investment coordination
 - ▶ Implementing new technologies
- **Industries and Operators**
 - ▶ Understand the full supply chain, conduct business and advocate accordingly
 - ▶ Competition
- **Generations**
 - ▶ Sustained societal commitment to MTS

National Needs → Metrics and Objectives

National Needs

- Reduced Cost
- Increased Profits
- Economic Growth
- Jobs
- Security
- Resiliency
- Safety
- Environment
- Energy reduction



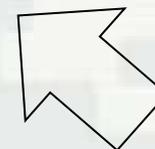
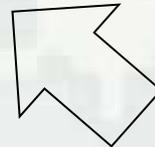
Metrics

- Traffic accommodated
- Traffic diverted
- Average Delays
- Capacity utilization
- Transit times



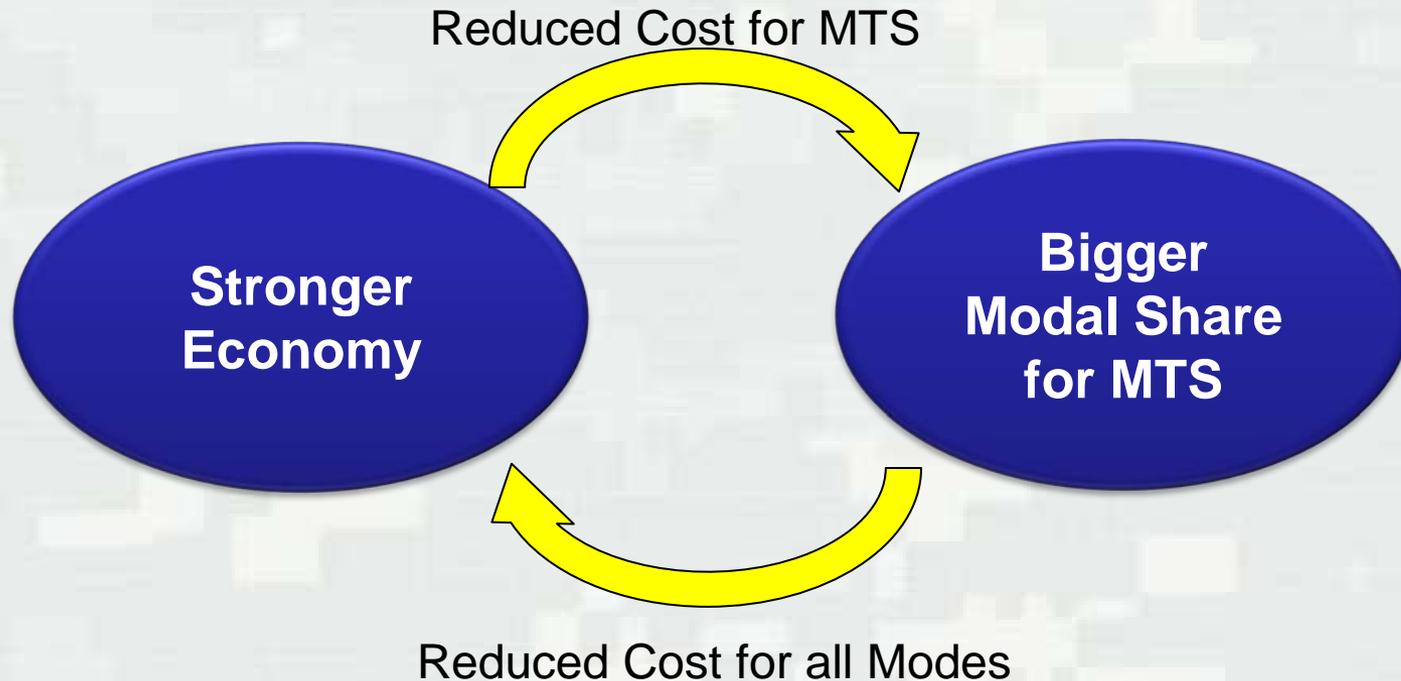
Optimization Objectives

- Net benefits
- Profit



Future MTS

Ultimate Measure of Success

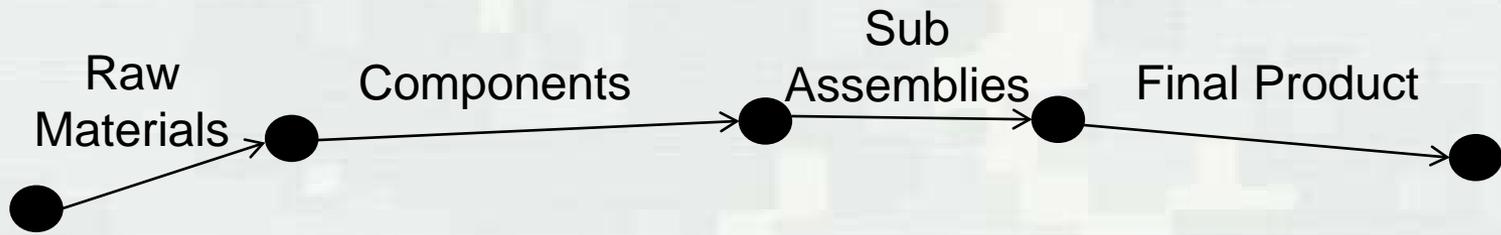


Maximum Value to the Nation

Conceptual Framework for Analyzing the MTS within the Intermodal Freight System

Questions and Discussion

Backup slides



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The 40,000 foot view

Measure and Model

Current MTS

- Ports
- Locks
- Channels
- Fleet
- Operating costs

Current Freight Traffic

- Water
- Highway
- Rail

Investments & Plans

- Short Term
- Long Term
- Operational Changes
- Taxes, fees
- Industry evolution

Envision the Future & Choose Alternatives

Potential Future MTS

- Ports
- Locks
- Channels
- Fleet
- Operations costs

Potential Future Freight Demands

- Imports
- Exports
- Domestic

Investment Alternatives

- Construction
- Maintenance/Rehab
- Dredging
- Taxes, fees
- Information technology
- Operational changes

Implement Goals and Plans

Goal MTS

- Ports
- Locks
- Channels
- Fleet
- Operations costs

Future Freight Traffic

- Water
- Highway
- Rail

Investment Plan

- Construction
- Maintenance/Rehab
- Dredging
- Information technology
- Operational/policy changes

Satisfy National Needs

Cost

- Profits
- Econ. Growth
- Jobs
- Security
- Resiliency
- Environment
- Energy
- Safety

The 40,000 foot view

Measure and Model

Current MTS

- Ports
- Locks
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Current Freight Traffic

- Water
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Investment Alternatives

- Construction
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- Information technology
- Operational changes

Implement Goals and Plans

Goal MTS

- Ports
- Locks
- Channels
- Fleet
- Operations costs

Future Freight Traffic

- Water
- Highway
- Rail

Investment Plan

- Construction
- Maintenance/Rehab
- Dredging
- Information technology
- Operational/policy changes
- Financing

Satisfy National Needs

• Reduced

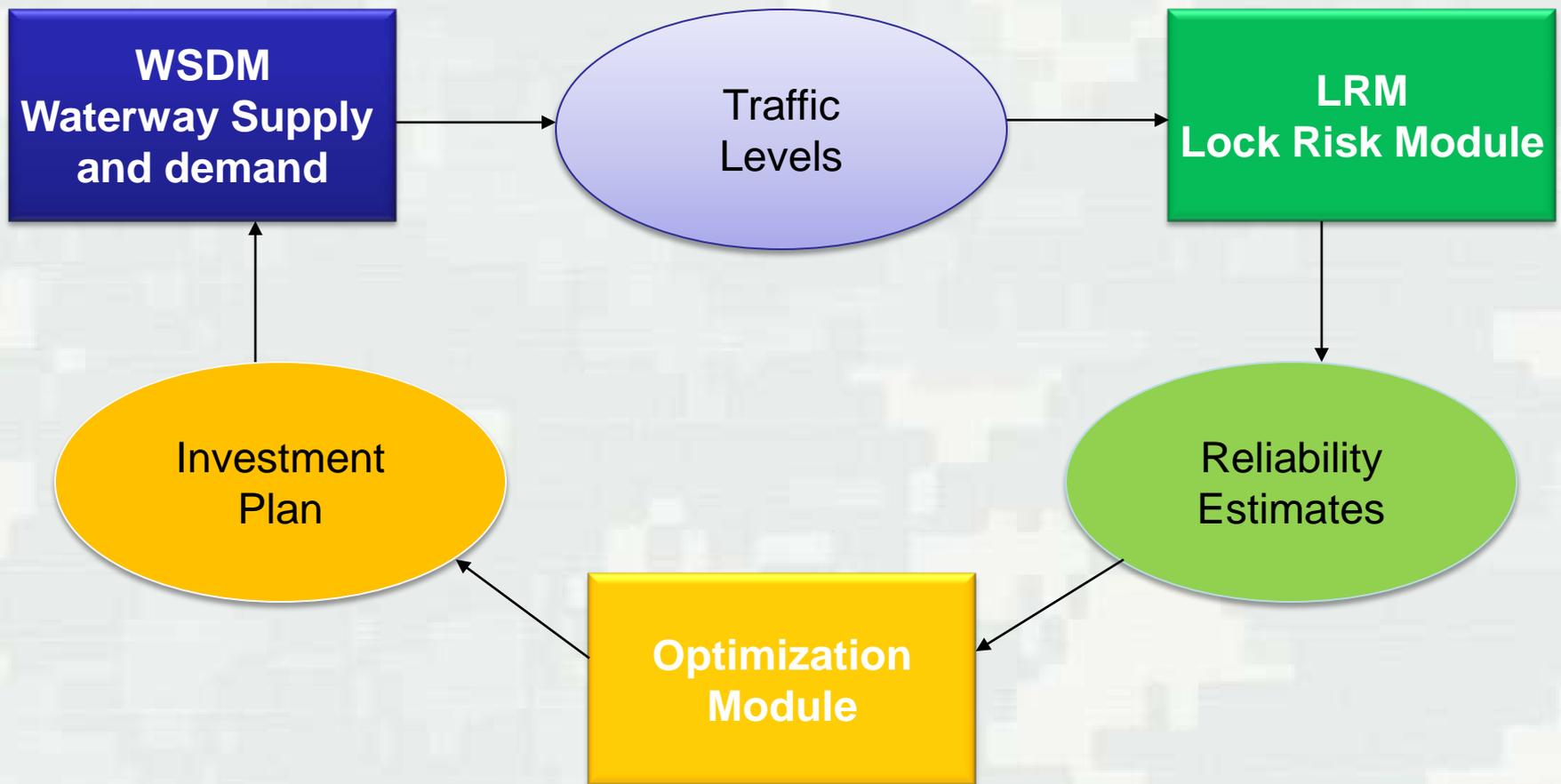
Cost

- Profits
- Econ. Growth
- Jobs
- Security
- Resiliency

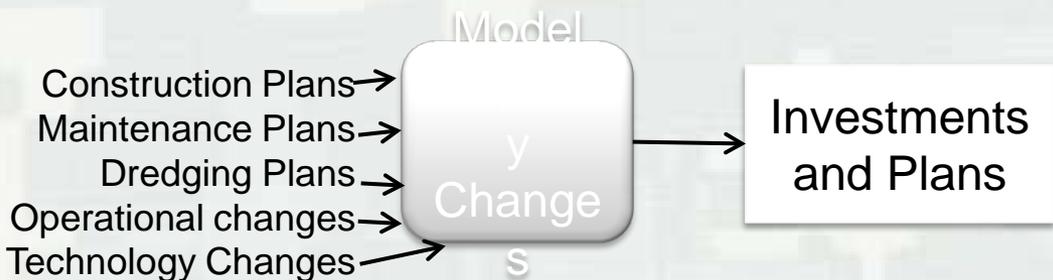
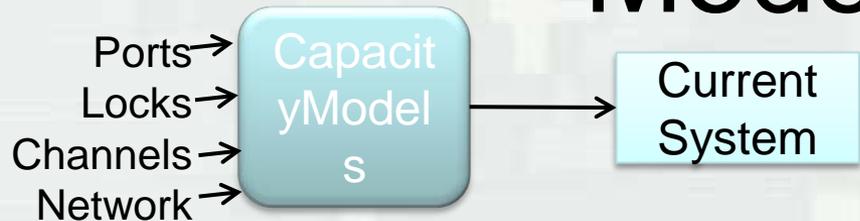
Environment

- Energy
- Safety

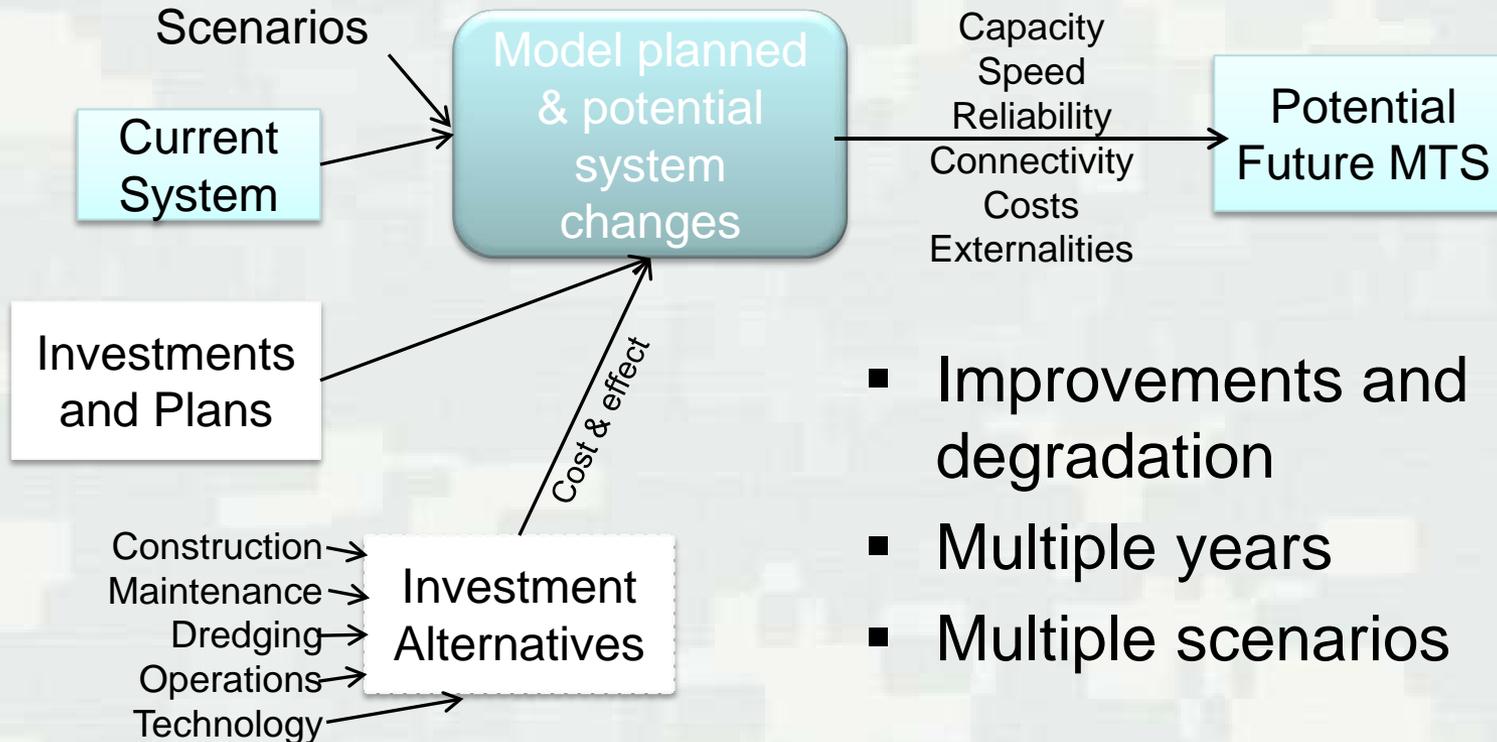
Example: Navigation Investment Model



20,000 Foot view-Measure and Model



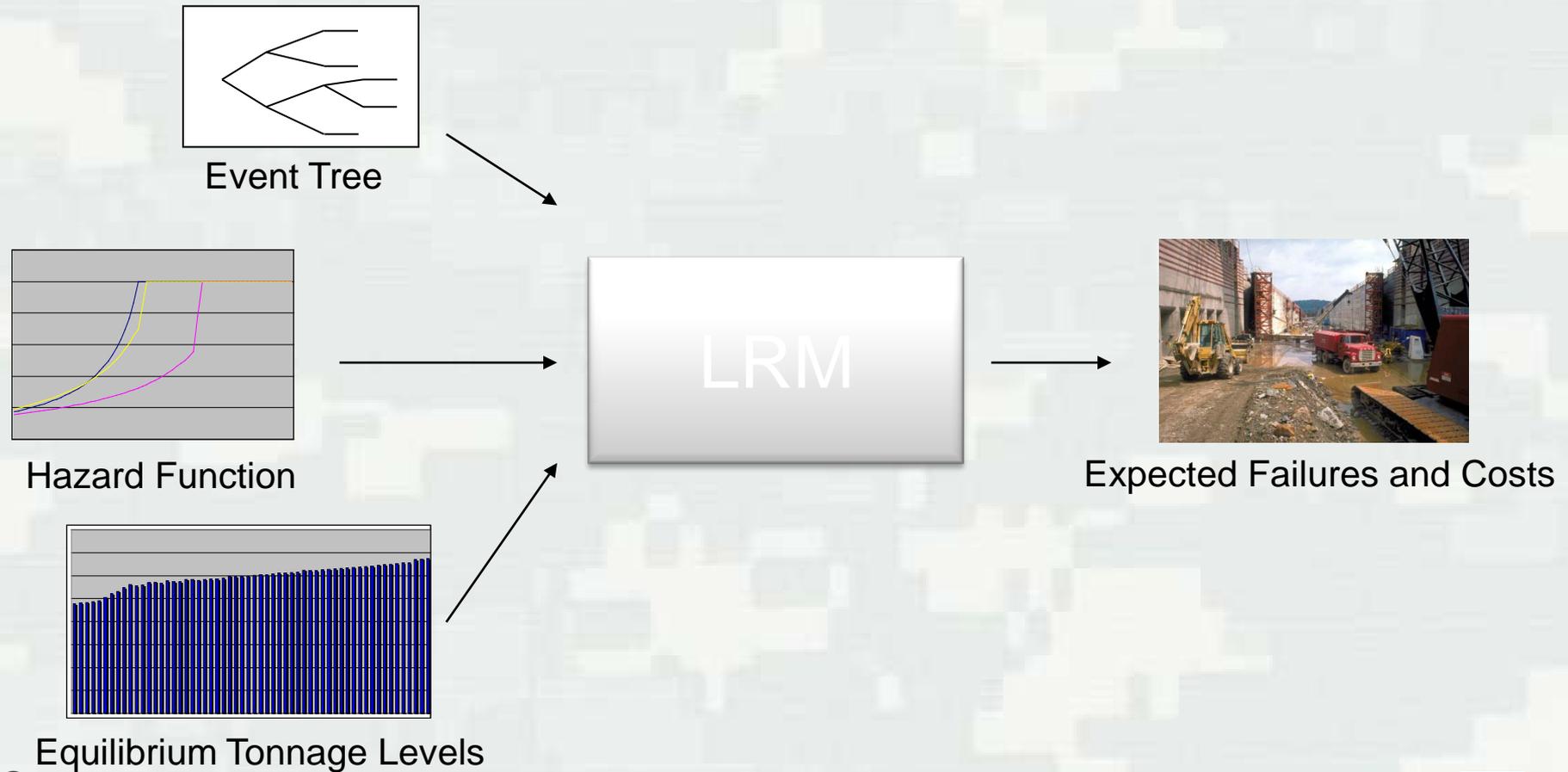
Envision The Future—system changes



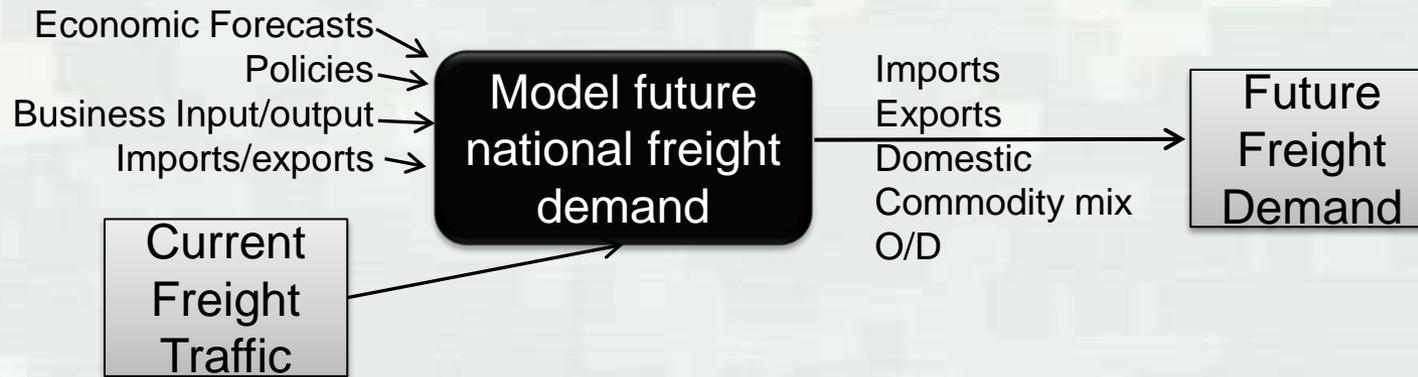
- Improvements and degradation
- Multiple years
- Multiple scenarios

Example: Lock Risk Module

How does maintenance affect reliability?



Envision The Future—freight demand



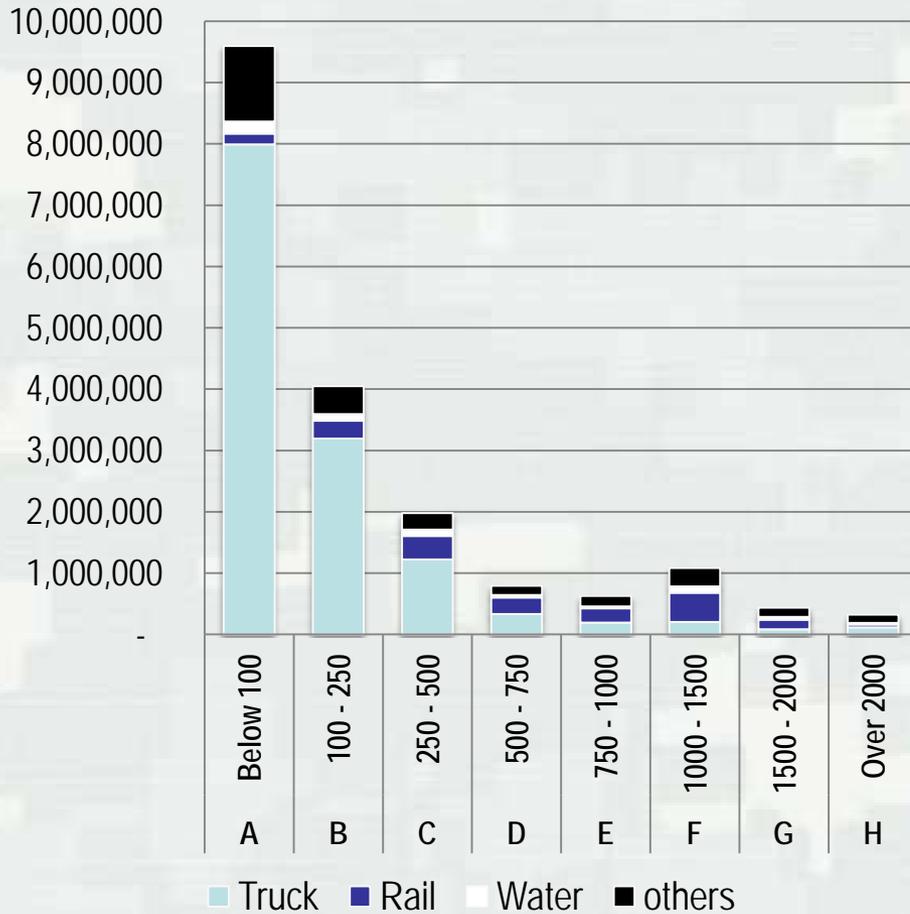
- Can be linked to an input/output model of business at the county level
- Based on a scenario(s)—robust decisions
- Supply chain based
- The F word

Demand is ultimately dependent on industry business patterns

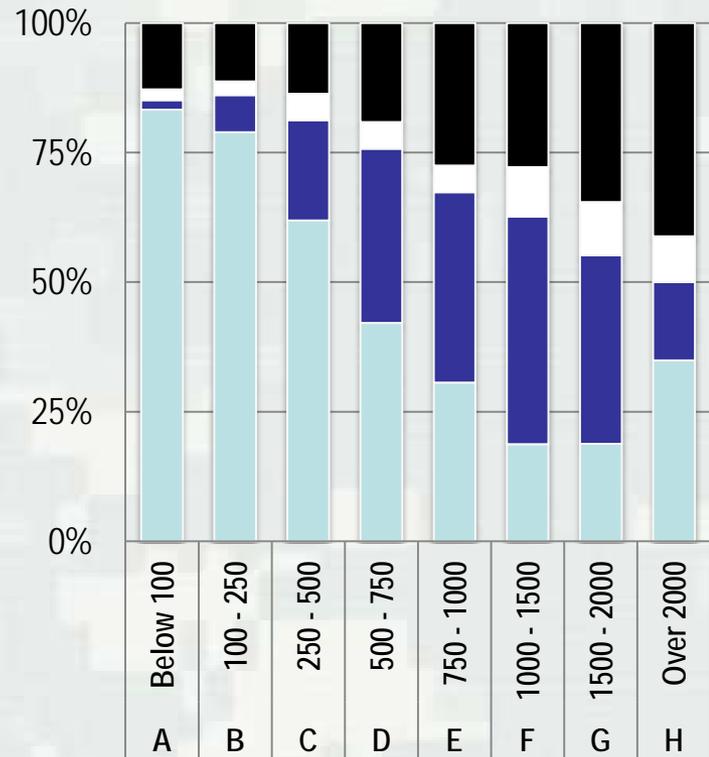
- Business I/O graphic here
- Or other FAF graphic

Mode Share by Distance

Tonnage (thousands tons) by distance range (miles)



Share of tonnage by distance (miles)



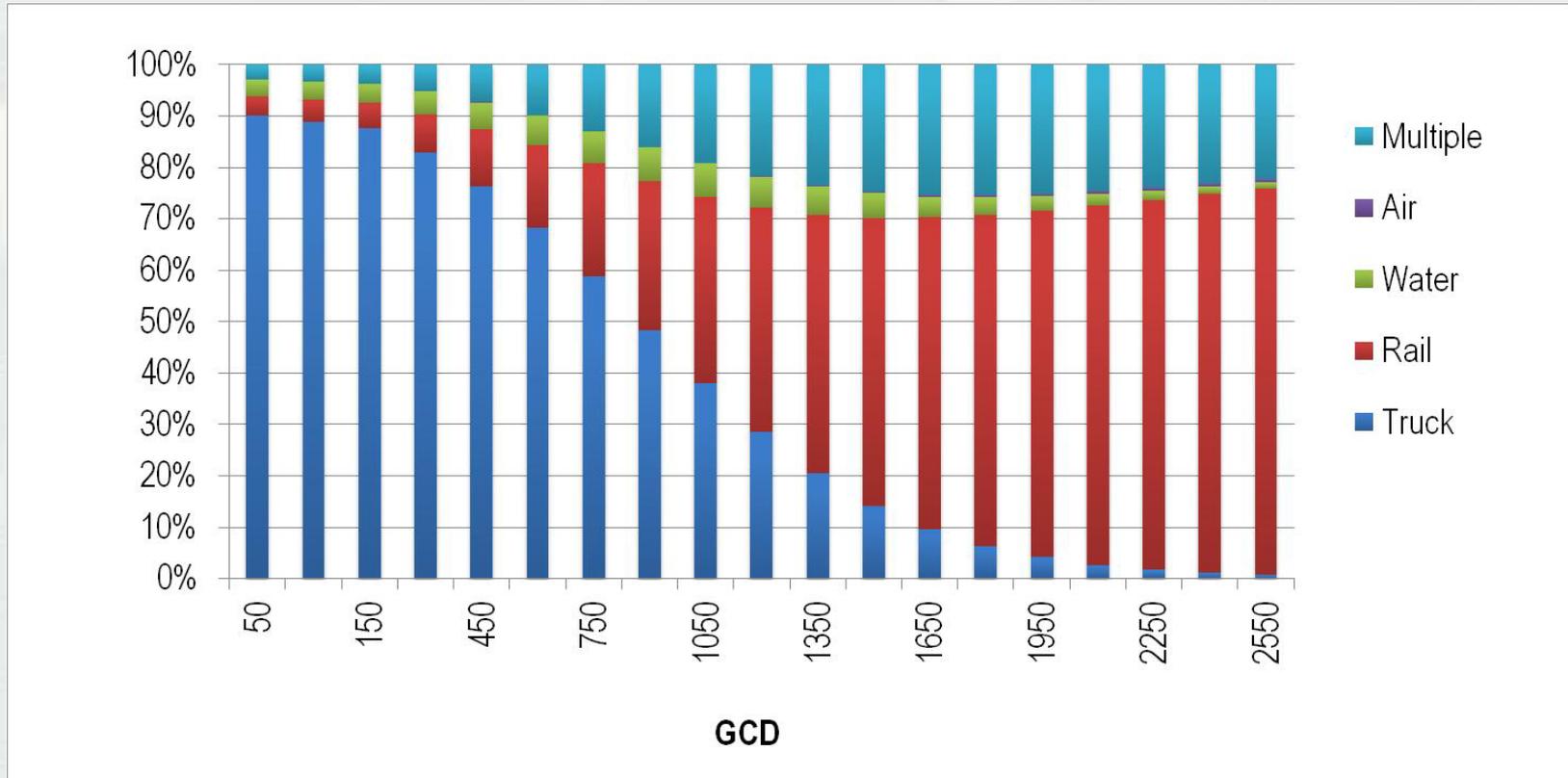
Freight activity by distance

Mode share of ton-miles in 2007



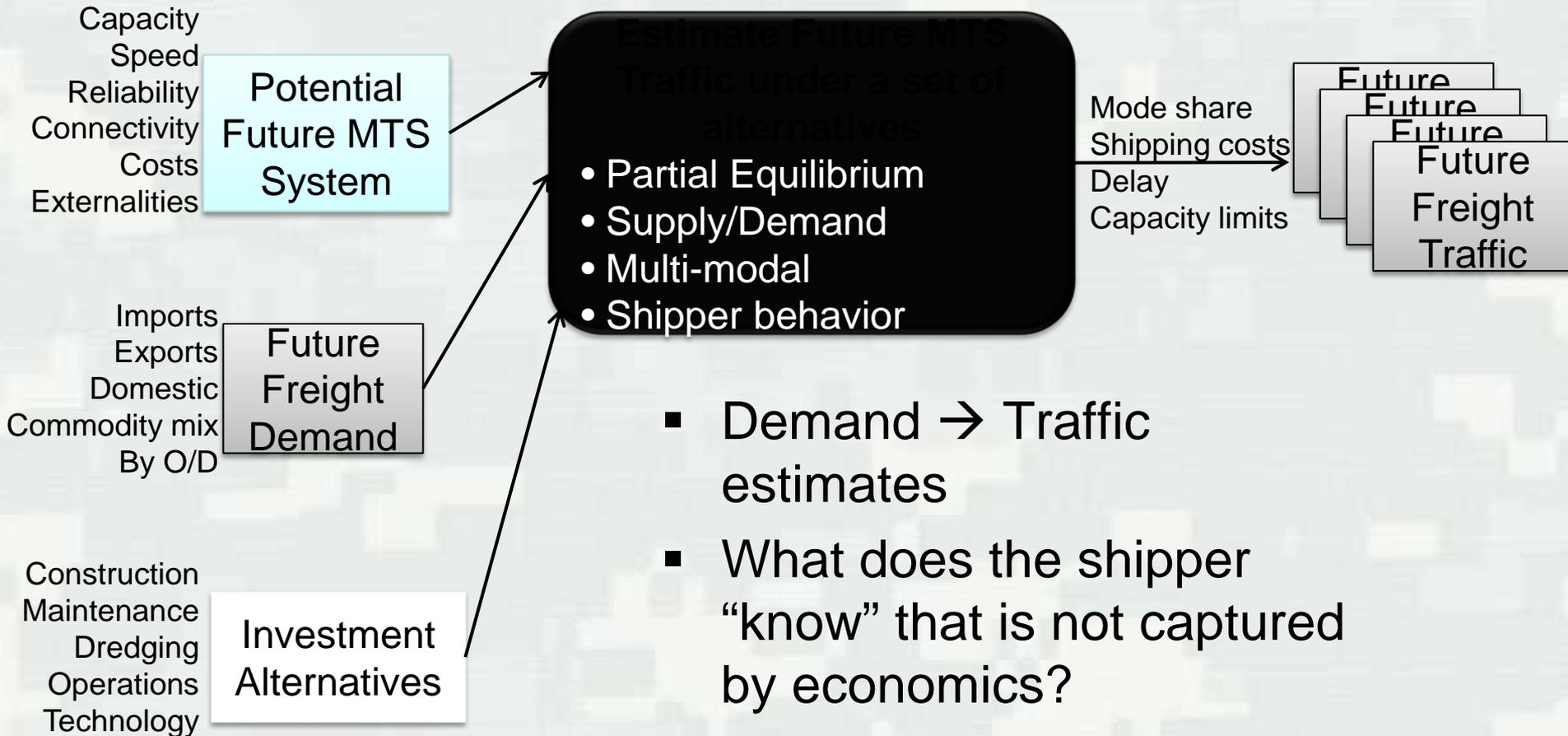
Example: Logit Model

- **Mode Share for the Manufacturing Sector**



Water movements are more likely to happen around 1000 miles

Choose Alternatives—estimate impacts

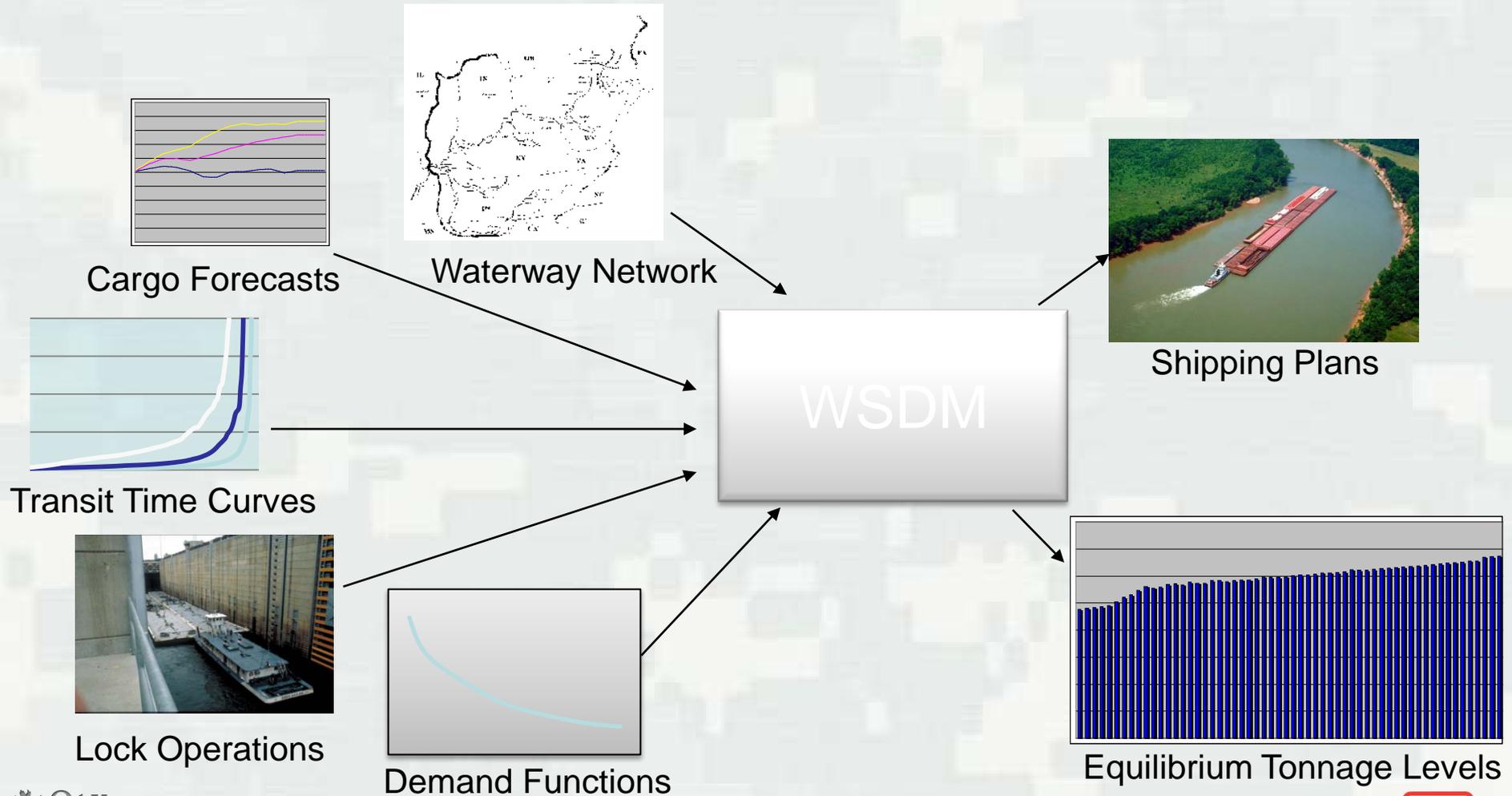


- Demand → Traffic estimates
- What does the shipper “know” that is not captured by economics?
 - ▶ Cost of uncertainty
 - ▶ Cost of change

- Challenge: to account for

Waterway Supply and Demand Module

Traffic estimates based on demand and costs.



WSDM Equilibrium Process

Each movement has its own cost curve and demand function:



Select “best” investment plan



- Discounted costs and benefits
- Local standards vs. system metrics
- Optimality vs. heuristics vs. consensus

Example: Channel Portfolio Tool

- Need a graphic here, instead of NIM slide.

Example. NIM Optimization

Module

Best investment at the best time.



Construction Plans

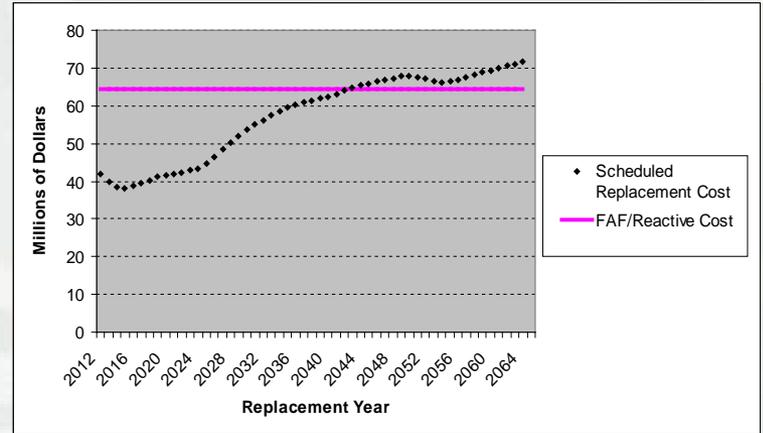


Random Minors



Expected Failures and Costs

Optimization



Optimal Alternative Selection and Timing

Implement Goals and Plans

- Financing
- Short term plans
 - ▶ Dredging
 - ▶ Maintenance
 - ▶ Systems deployment (e.g. RIS)
 - ▶ Policy changes (taxes, fees)
- Long term plans
 - ▶ Major rehab
 - ▶ Construction (e.g. lock extension)

■ Visibility to MTS community

■ Visibility to other modal planning

Waterways can demonstrate system-wide modeling to the freight community.

- Develop tools to use DOT transportation data (e.g., FAF)
- Leverage real-time data (LOMA, AIS)
- Integrate deep draft and inland modeling
- Integrate operational (short term) and long term models

PRRM Needs: Intermodal Freight Network



National Highway Network Database



National Rail Network Database



National Waterway Network Database



Global Seaways Network Database



Intermodal, Truck, Rail and Water Terminals Databases



Operational Rail Network Database

Operational Waterways Network Database

Combines Inland, Intra-Coastal, Great Lakes & Trans-Oceanic Links

Unified Multimodal/Intermodal Freight Network (A National Resource)

Routing

Traffic Estimates

Reliability

Hazardous

Restrictions



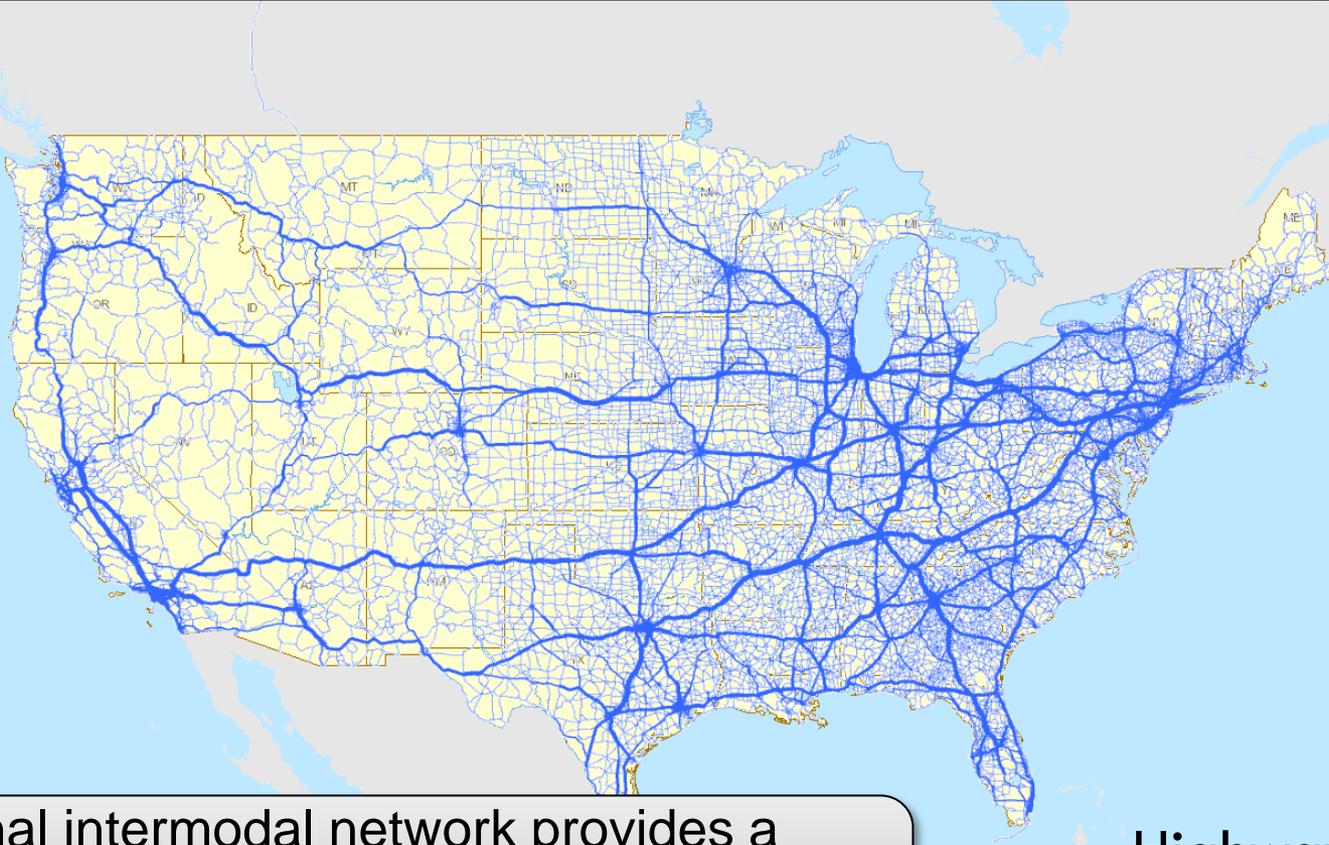
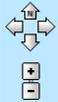
PRRM Needs: Intermodal Freight Network

Freight Analysis Mapping Application

ORNL | ETS Division | CTA | CTA Intermodal Network

Print

1:20,356,570



The national intermodal network provides a unified modeling framework for costs and traffic flows.

Highway Freight