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.

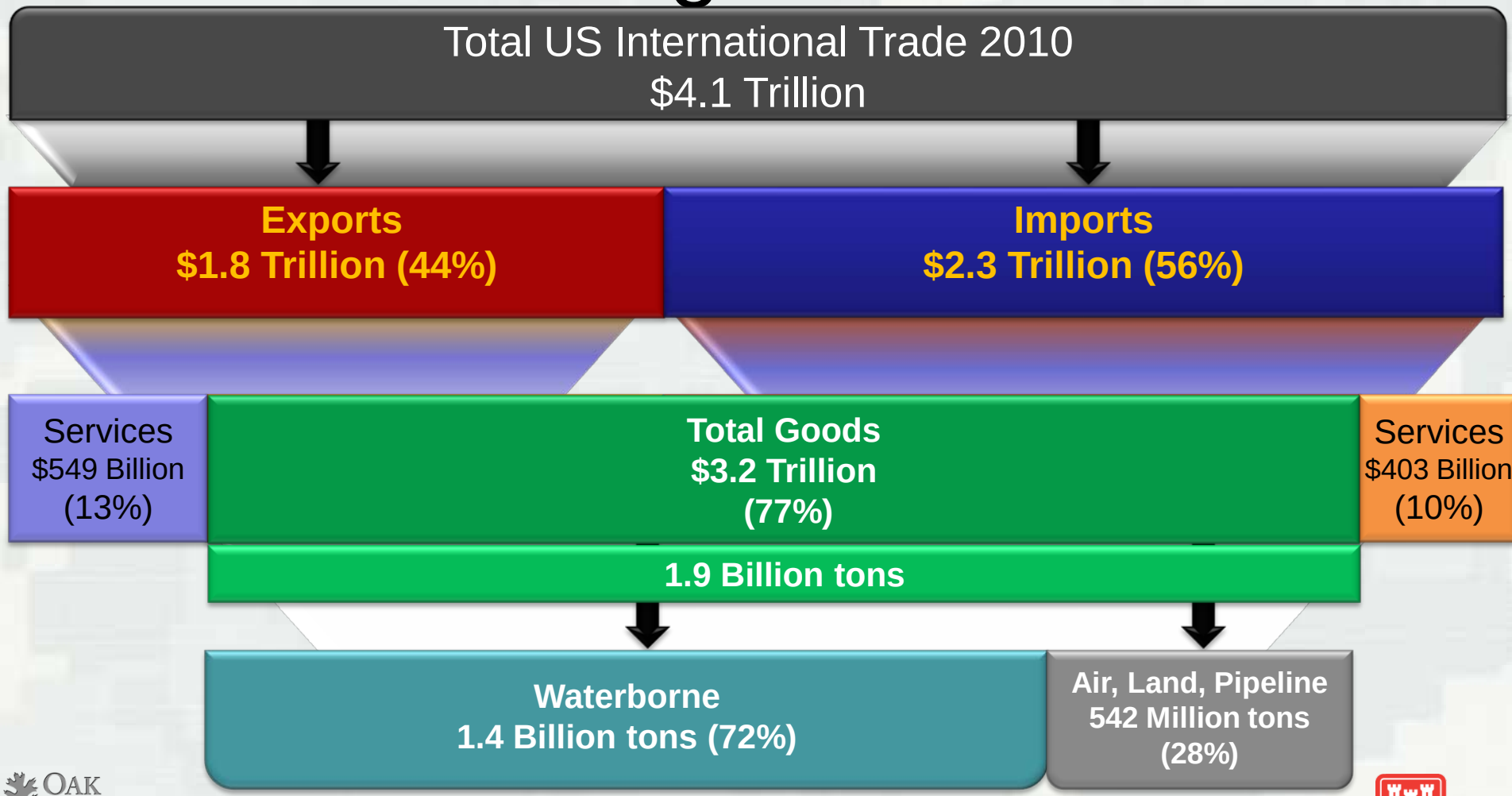




Waterways are in a unique position to think system-wide.

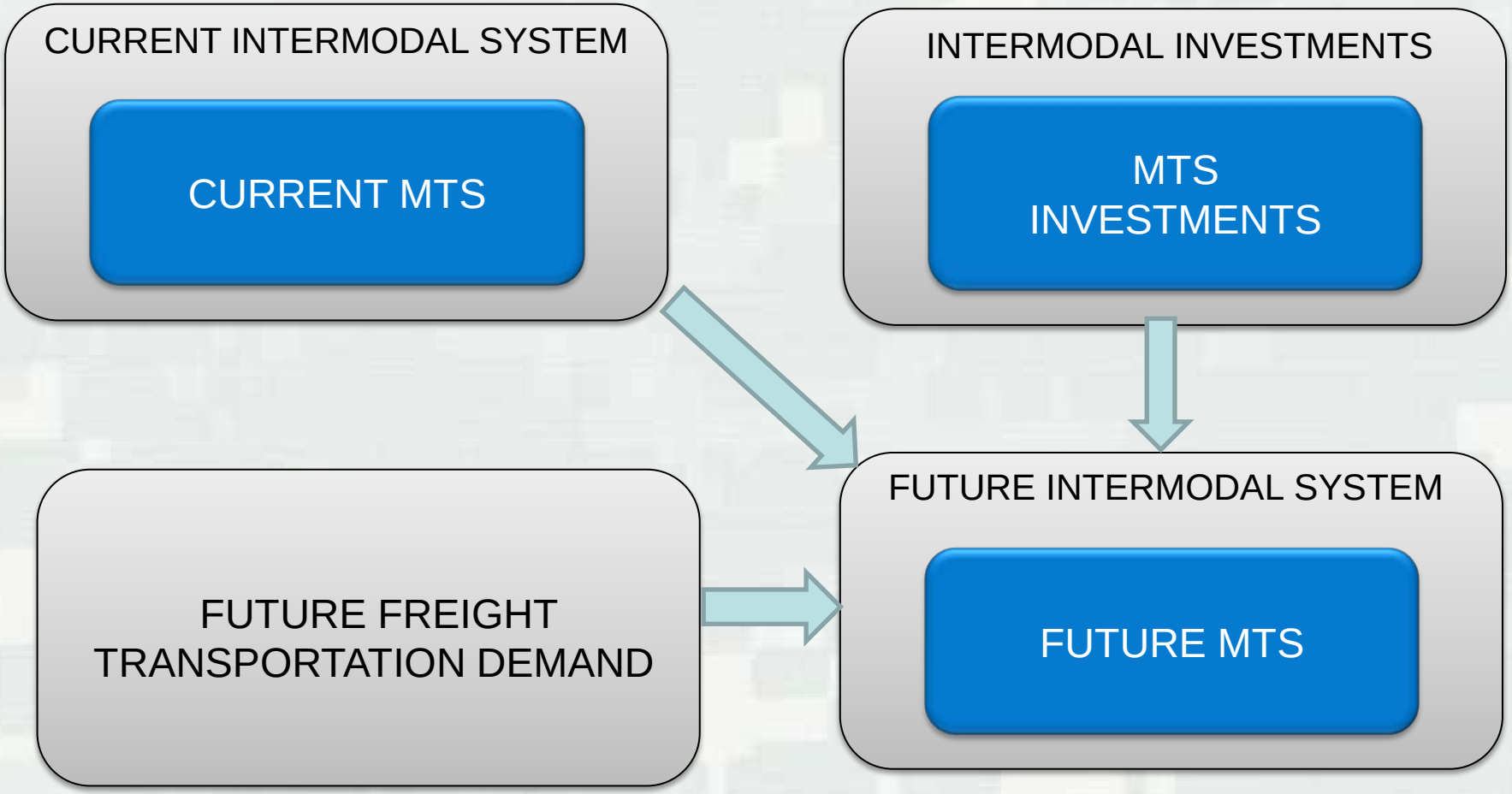
- Movement data sets available.
- Federal control/responsibility for much of the system.
- Detailed tracking data available (AIS).
- History of economic-based investment decisions.
- Potential to LEAD in transportation modeling.

US Commercial Freight Magnitude



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

A Conceptual Framework

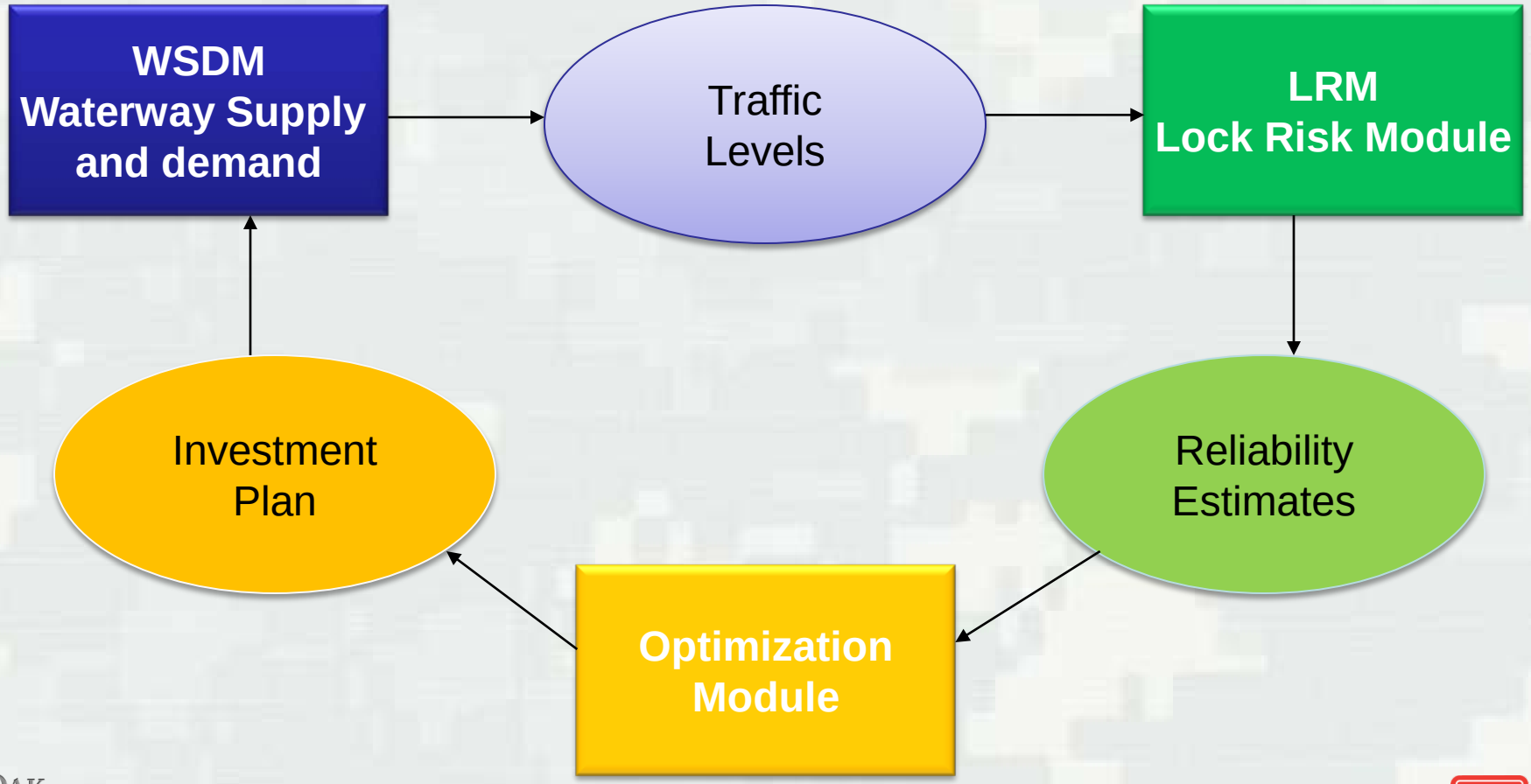


Two Big Challenges

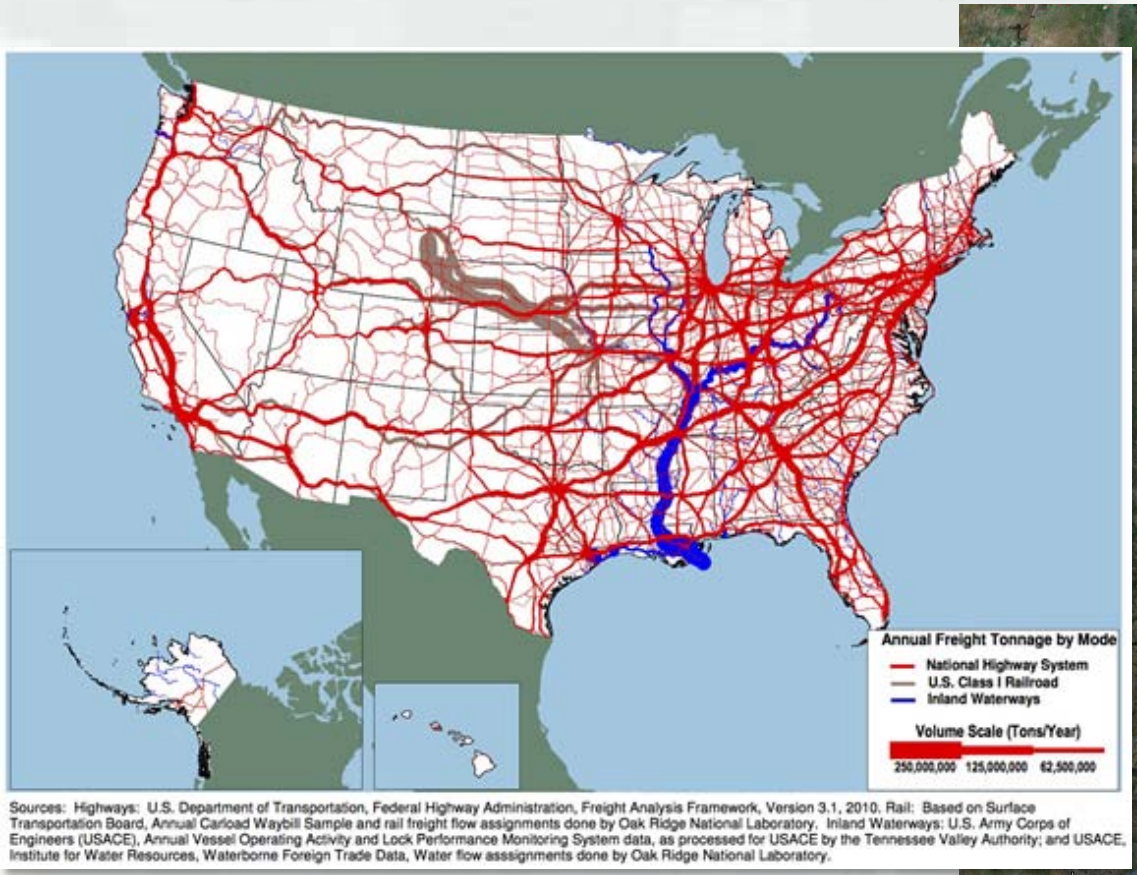
- Predicting the future is hard.
- The intermodal system is very complex and hard to understand.

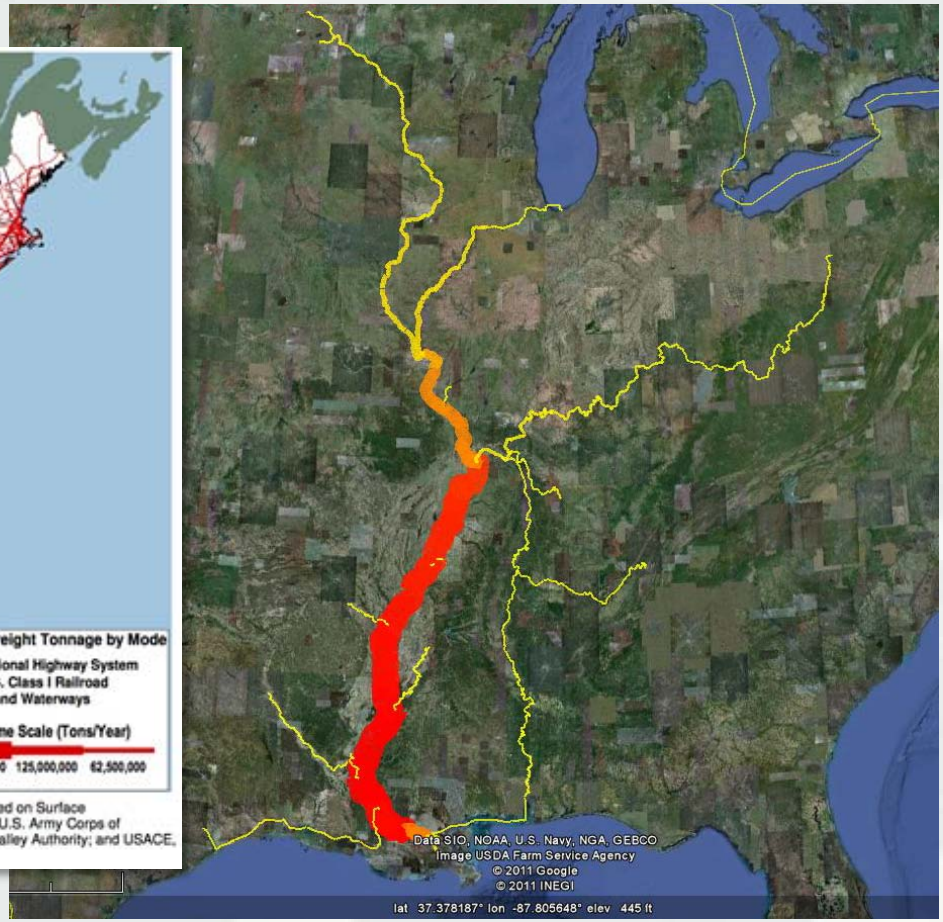
- But this is our charge…

Example: Navigation Investment Model



Examples: FAF^3 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)
  - Average Delay at a lock
  - Ship drafts for arrivals/departures
  - Others—economic, environmental, social, security

Not systems thinking.

- BIG DATA may tell us things we did not know.

US Intermodal Freight Network

This is not the system….

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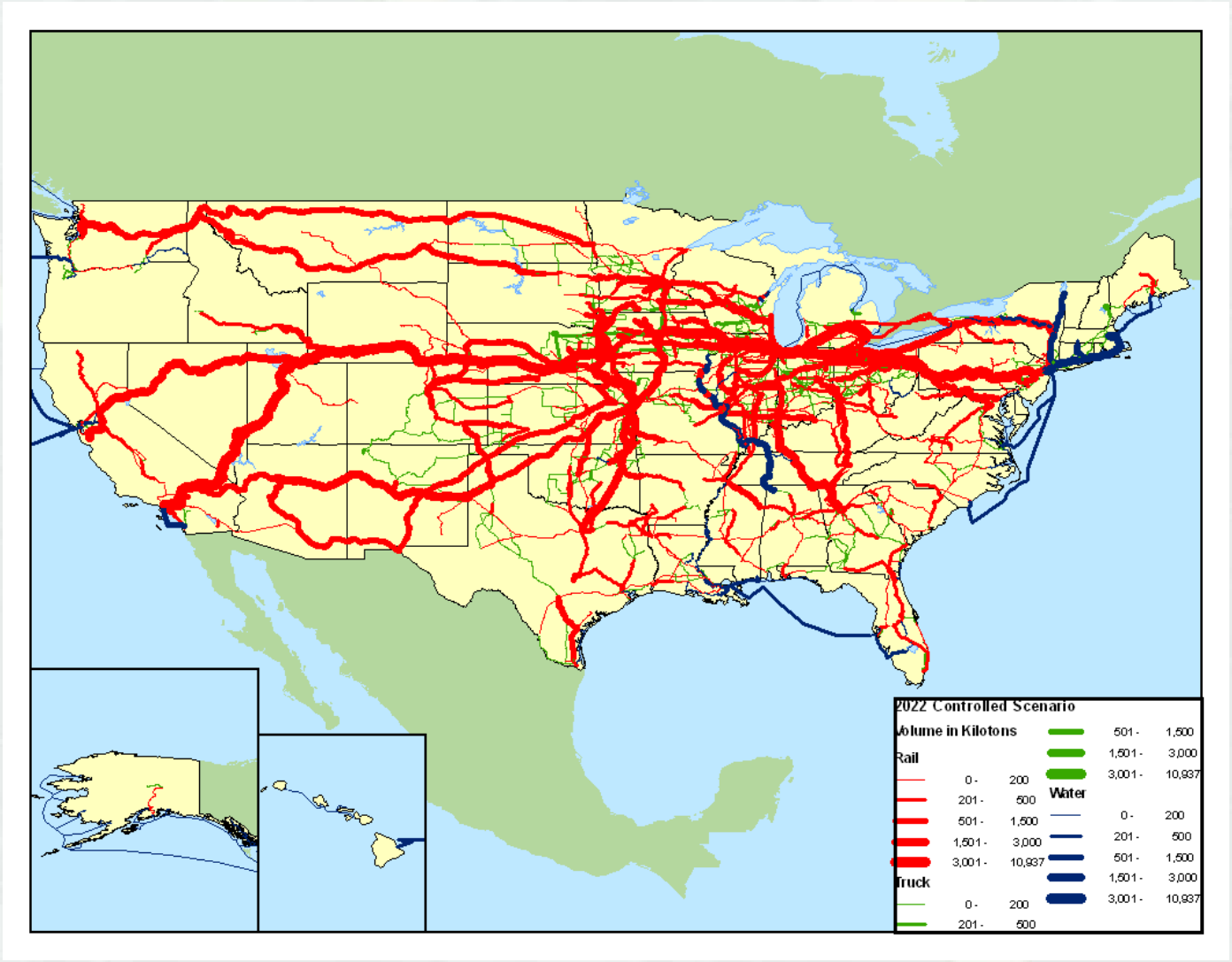
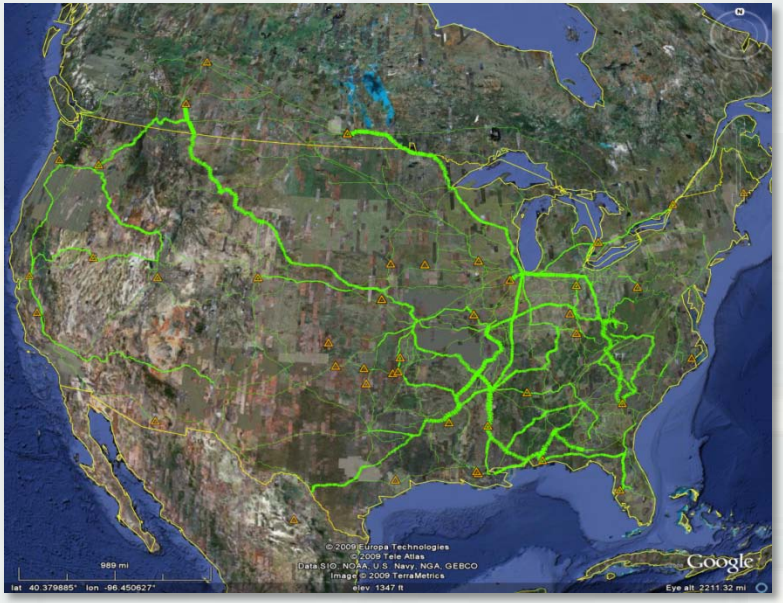
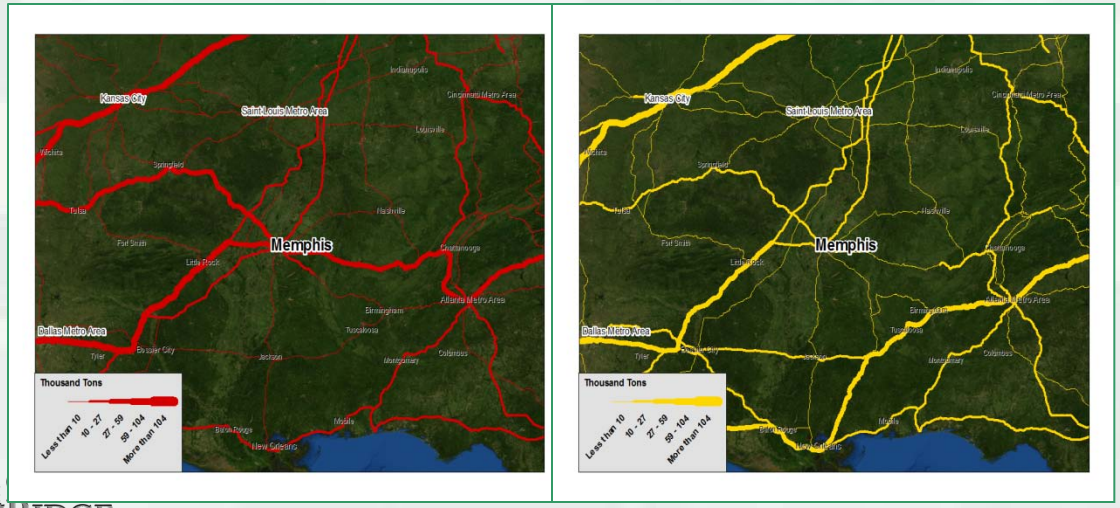
We need to understand how commodities flow on the network.

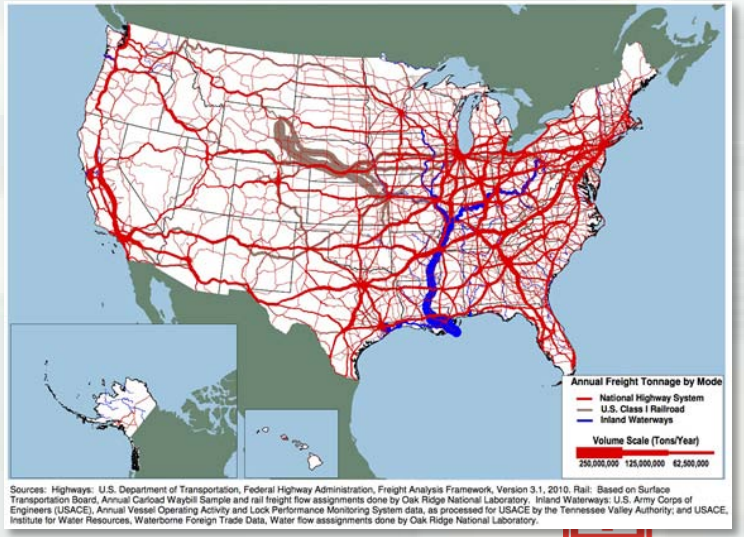
2022 Mode Specific Ethanol Movements (Ktons)



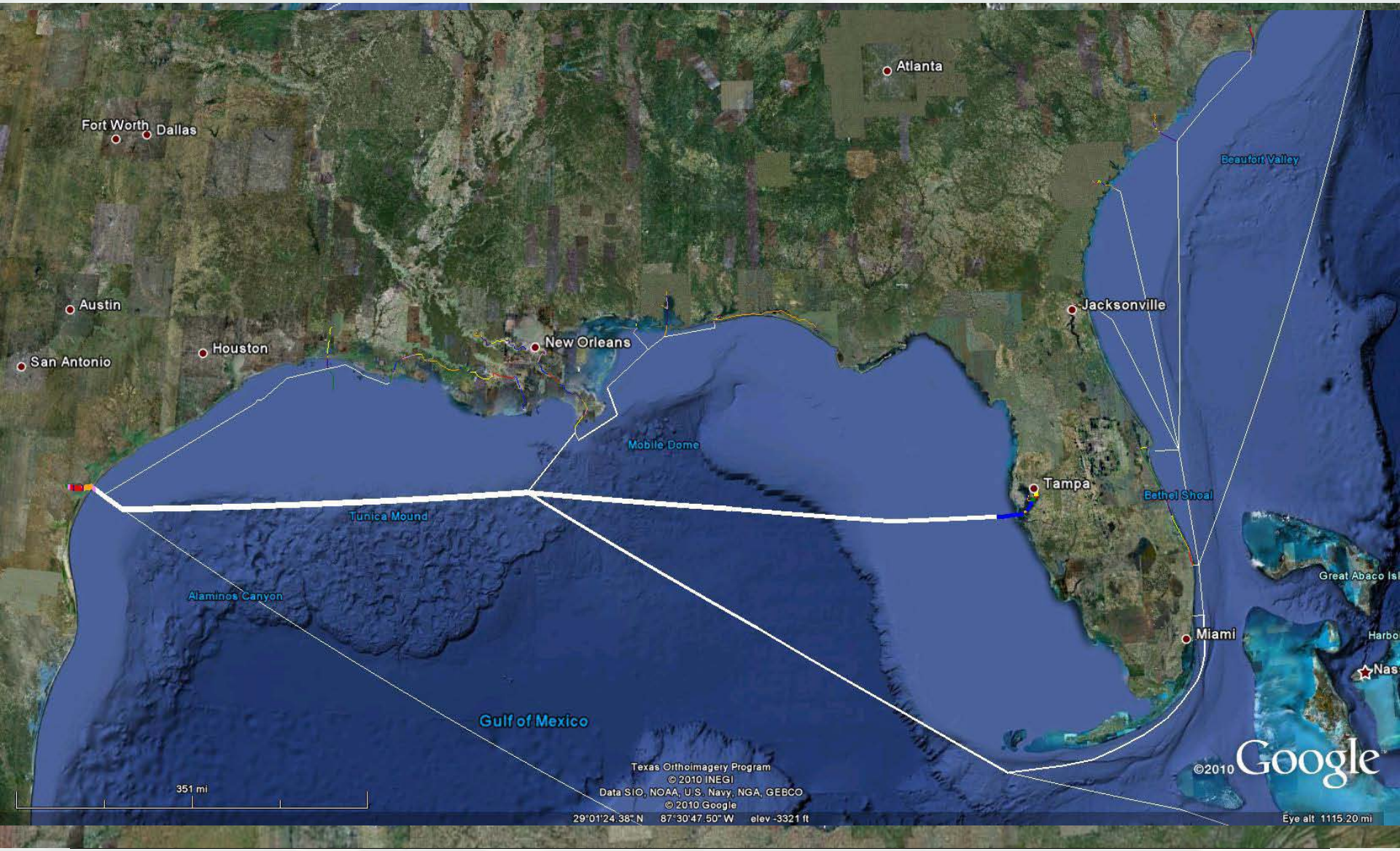
Multi-modal Freight Movements



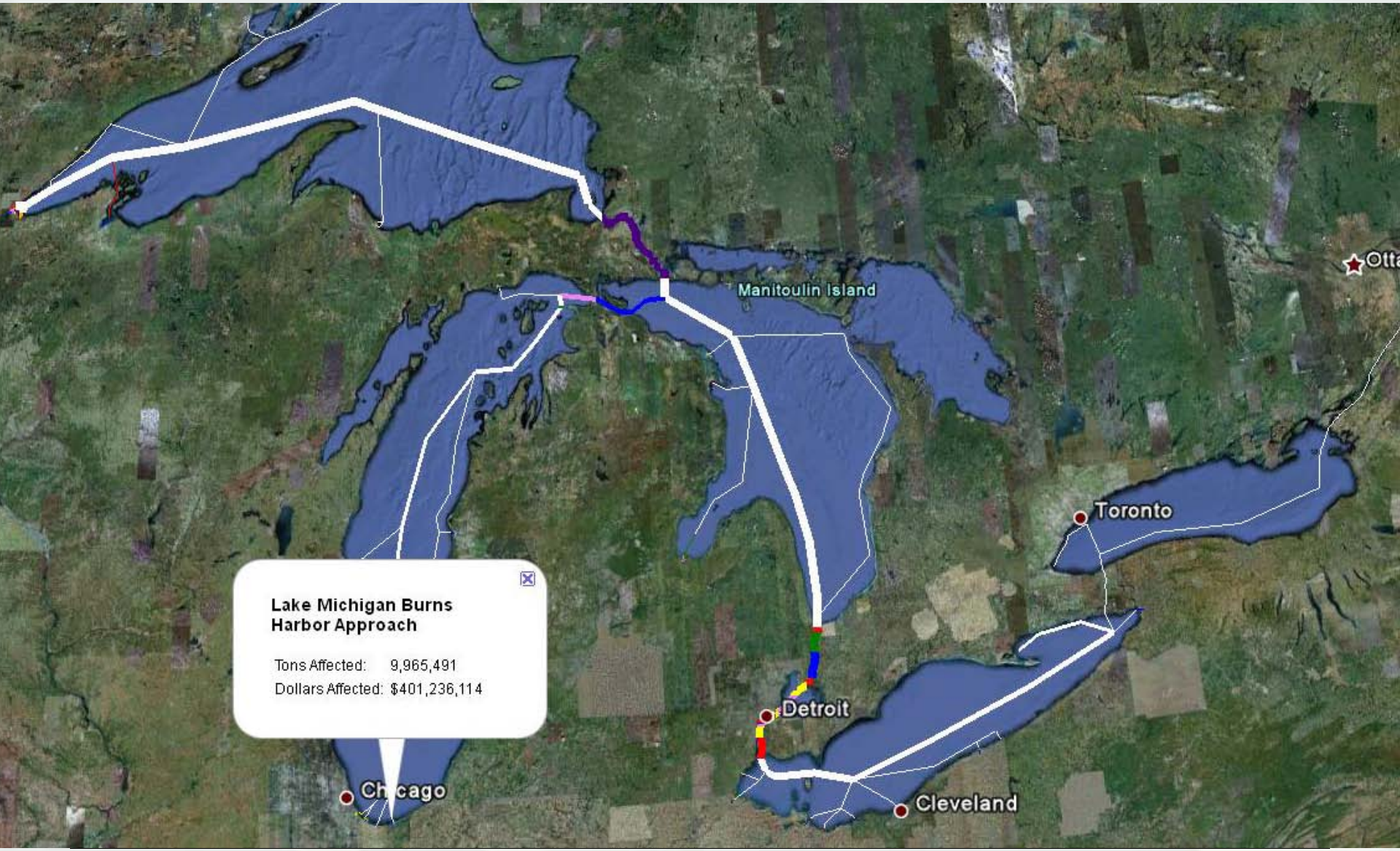




MTS Intermodal Role



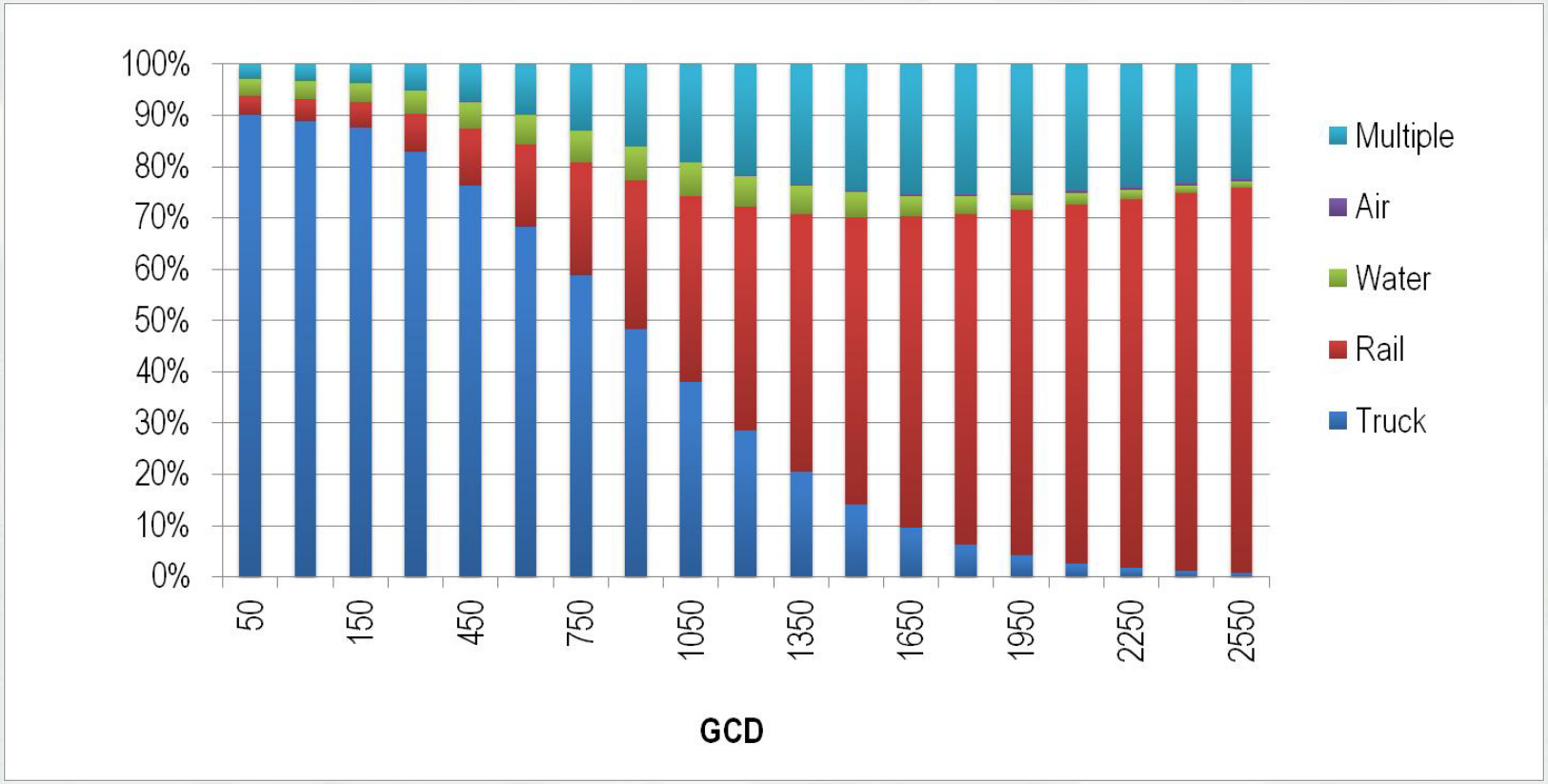
MTS Intermodal Role



How do we estimate freight transportation demand?

- Waterborne Commerce Data
- FAF^3
- 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.

CMTS
U.S. Committee on the Marine Transportation System

TRB 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

NATIONAL ACADEMY OF SCIENCES BUILDING
2101 CONSTITUTION AVENUE, NW
WASHINGTON, D.C. 20418

Abstracts Due
March 31, 2012

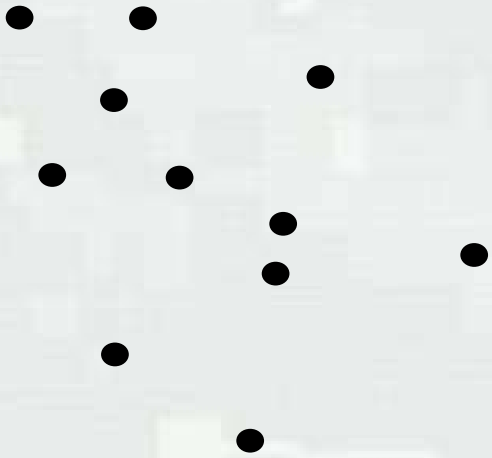
System Investments

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

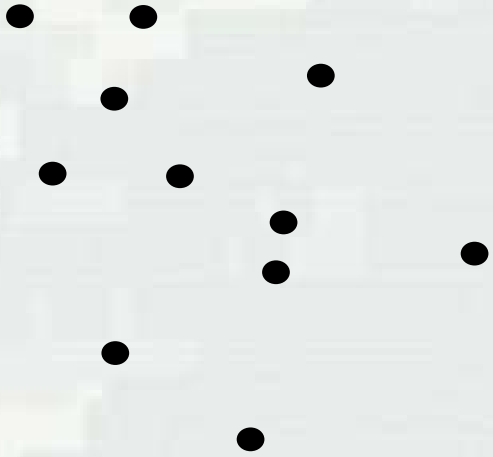
Challenges for Investment Planning

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

Connect the Dots

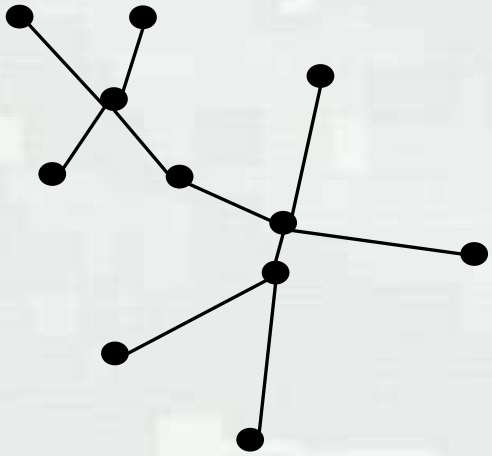


Problem A

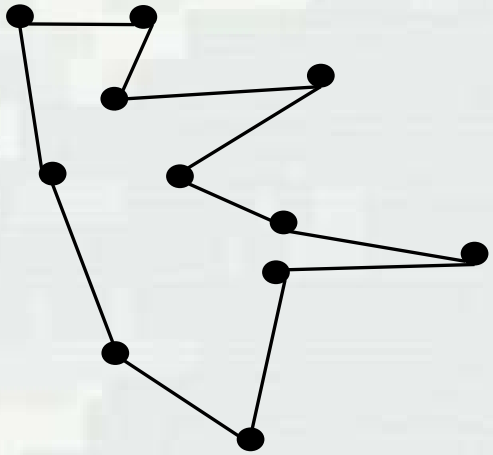


Problem B

Connect the Dots

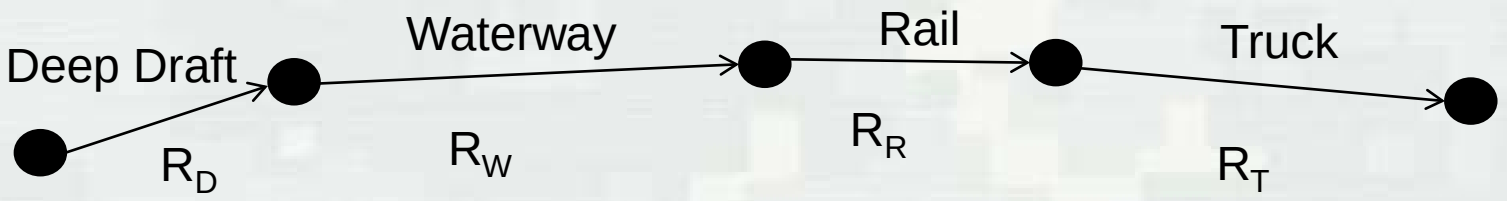


Problem A
Easy



Problem B
Hard

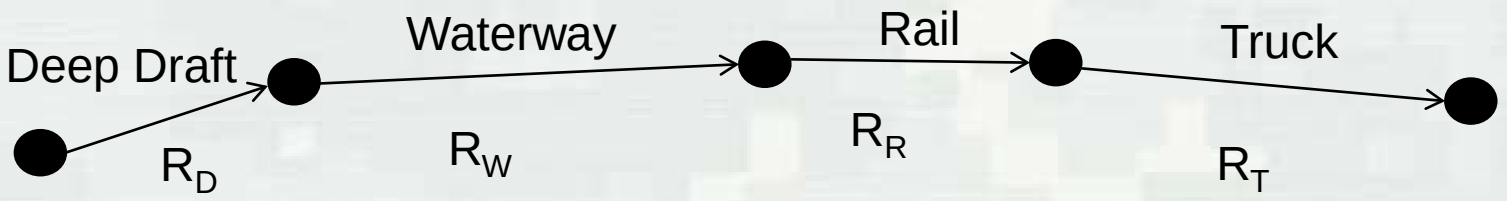
Supply Chain Reliability



System Reliability = R_D* R_W* R_R* R_T

- **Traffic flows**
- **Physical conditions**
- **Investments**
- **Intermodal connections**

Supply Chain Reliability



System Reliability = R_D* R_W* R_R* R_T

- **Traffic flows (congestion)**
- **Physical con… …of service)**
- **Investm… …tained funding levels)**
- **Interm… …nes)**

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

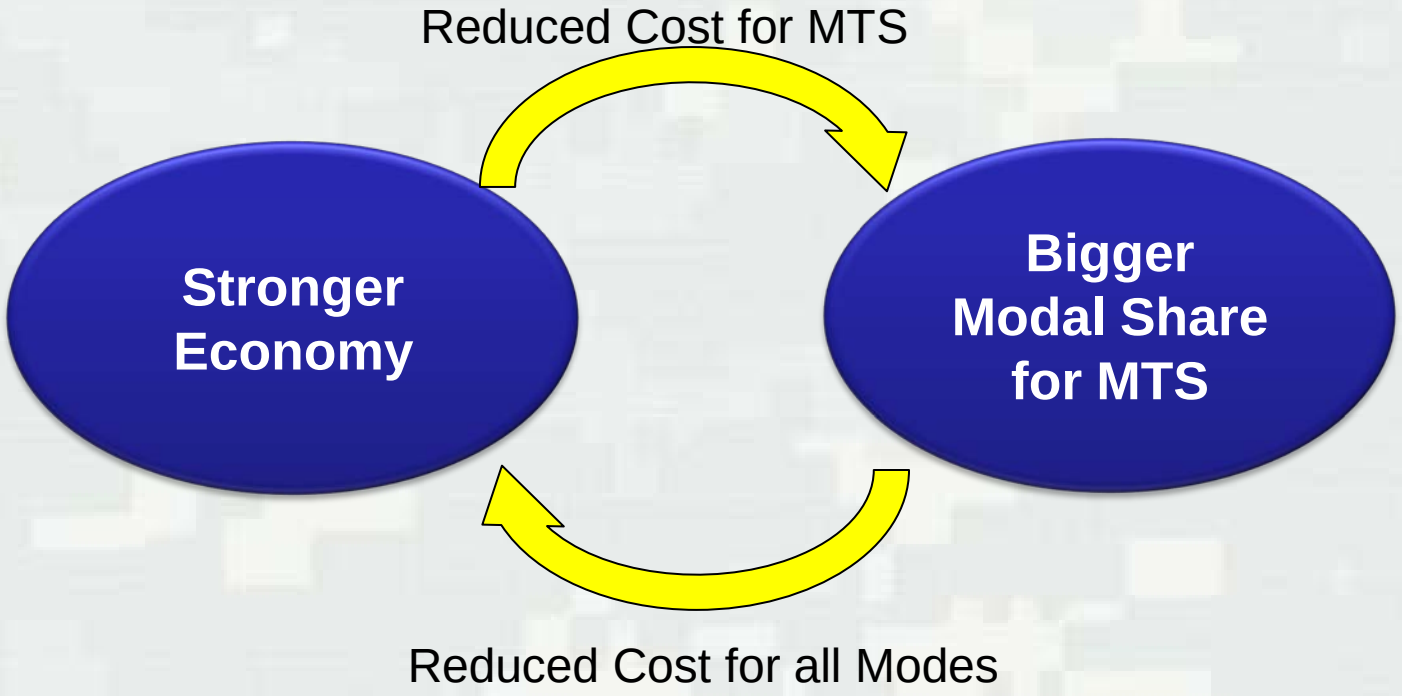
Metrics

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

Optimization Objectives

- Net benefits
- Profit

Future MTS
Ultimate Measure of Success

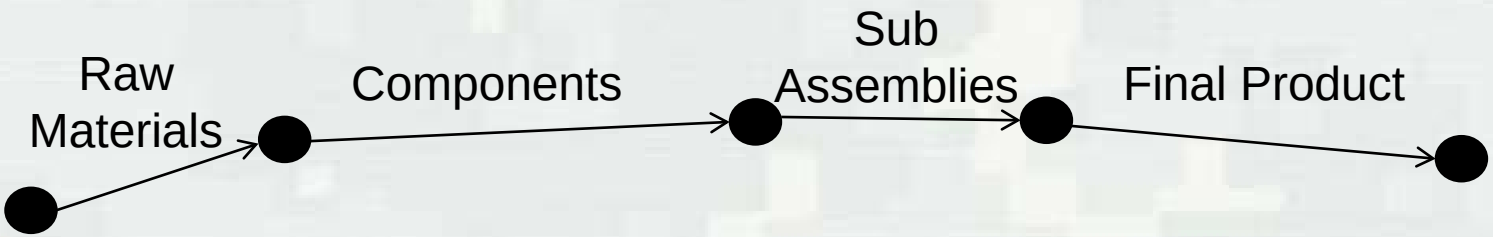


Maximum Value to the Nation

Conceptual Framework for Analyzing the MTS within the Intermodal Freight System

Questions and Discussion

Backup slides


Raw Materials
Components
Sub Assemblies
Final Product

The 40,000 foot view

Measure and Model	Envision the Future & Choose Alternatives	Implement Goals and Plans	Satisfy National Needs
Current MTS • Ports •Locks •Channels • Fleet • Operating costs	**Potential Future MTS** • Ports •Locks •Channels • Fleet • Operations costs	**Goal MTS** • Ports •Locks •Channels • Fleet • Operations costs	**Cost** **• Profits** **•Econ. Growth** **• Jobs** **• Security** **•Resiliency** **• Environment** **• Energy** **• Safety**
Current Freight Traffic • Water •Highway •Rail	**Potential Future Freight Demands** • Imports • Exports • Domestic	**Future Freight Traffic** • Water •Highway •Rail	
Investments & Plans • Short Term • Long Term • Operational Changes • Taxes, fees •Industry evolution	**Investment Alternatives** • Construction • Maintenance/Rehab • Dredging • Taxes, fees • Information technology • Operational changes	**Investment Plan** • Construction • Maintenance/Rehab • Dredging • Information technology • Operational/policy changes	

The 40,000 foot view

Measure and Model	Envision the Future & Choose Alternatives	Implement Goals and Plans	Satisfy National Needs
Current MTS • Ports •Locks •Channels • Fleet • Operating costs	**Potential Future MTS** • Ports •Locks •Channels • Fleet • Operations costs	**Goal MTS** • Ports •Locks •Channels • Fleet • Operations costs	**Reduced Cost** **• Profits** **•Econ. Growth** **• Jobs** **• Security** **•Resiliency** **• Environment** **• Energy** **• Safety**
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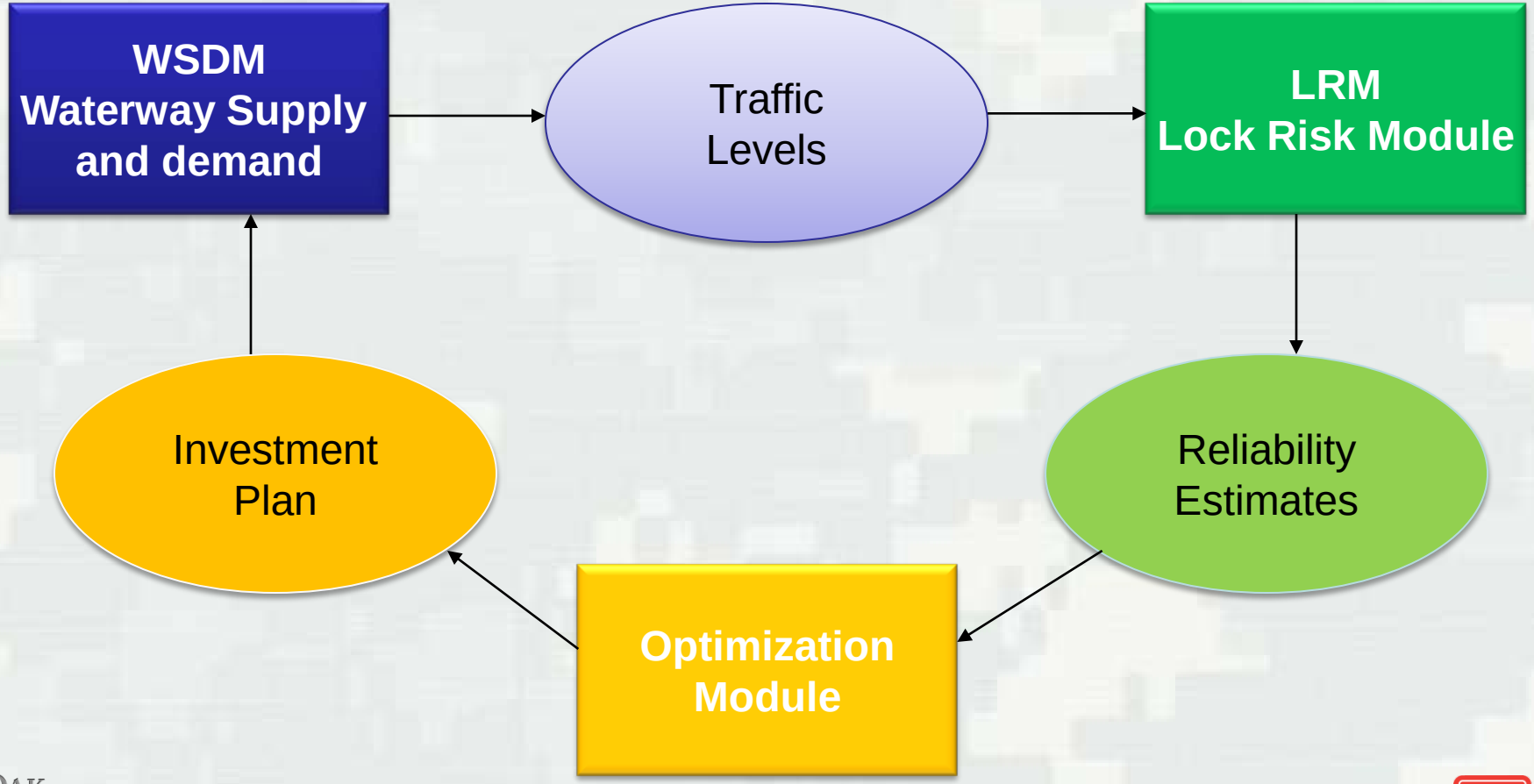
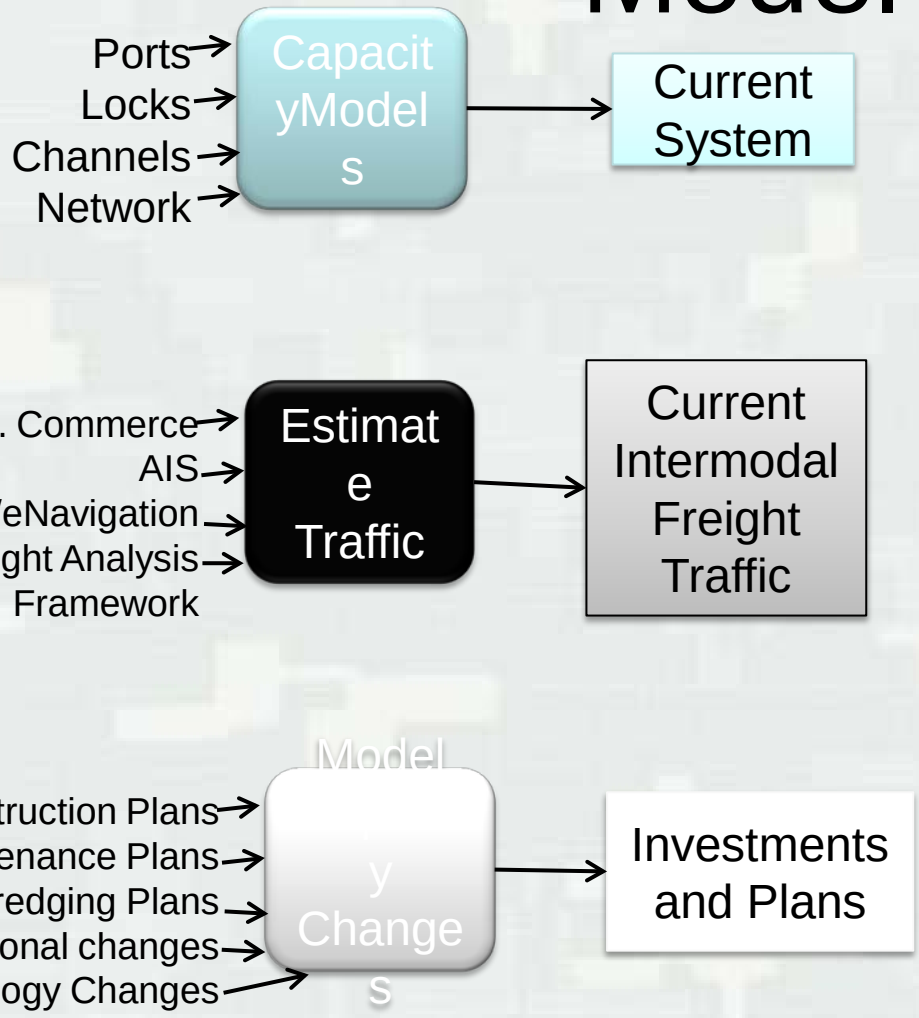
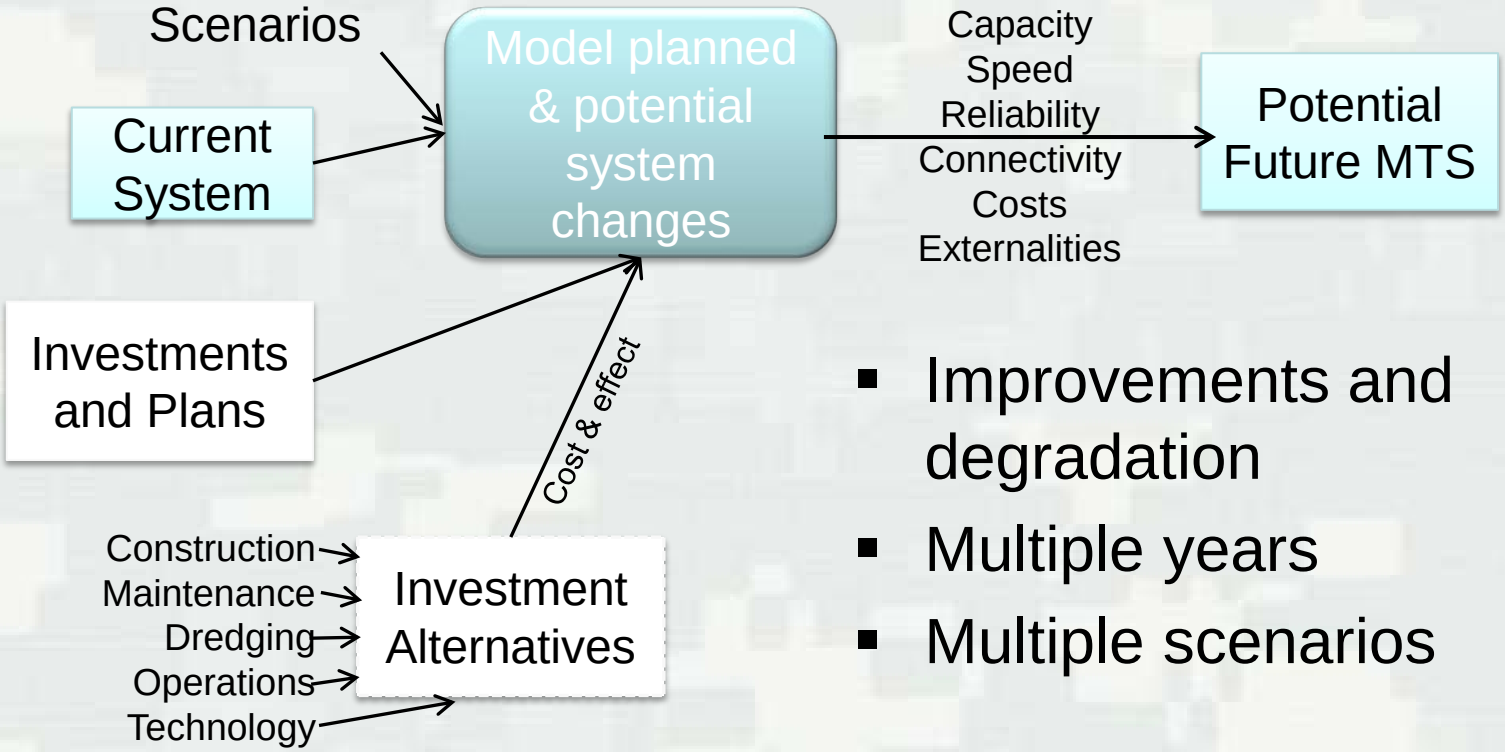
Example: Navigation Investment Model



20,000 Foot View-Measure and Model



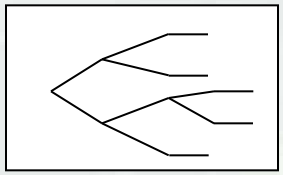
Envision The Future—system changes



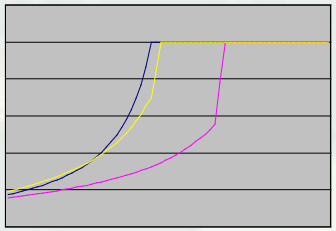
- Improvements and degradation
- Multiple years
- Multiple scenarios

Example: Lock Risk Module

How does maintenance affect reliability?



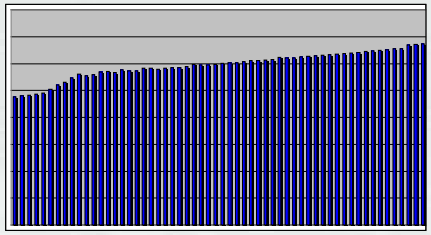
Event Tree



Hazard Function

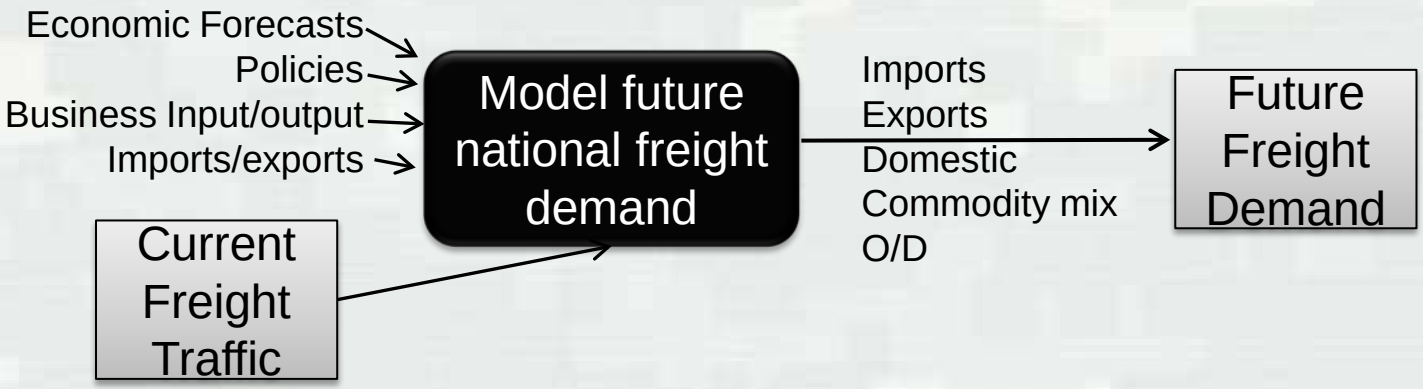
LRM

Expected Failures and Costs



Equilibrium Tonnage Levels

Envision The Future—freight demand

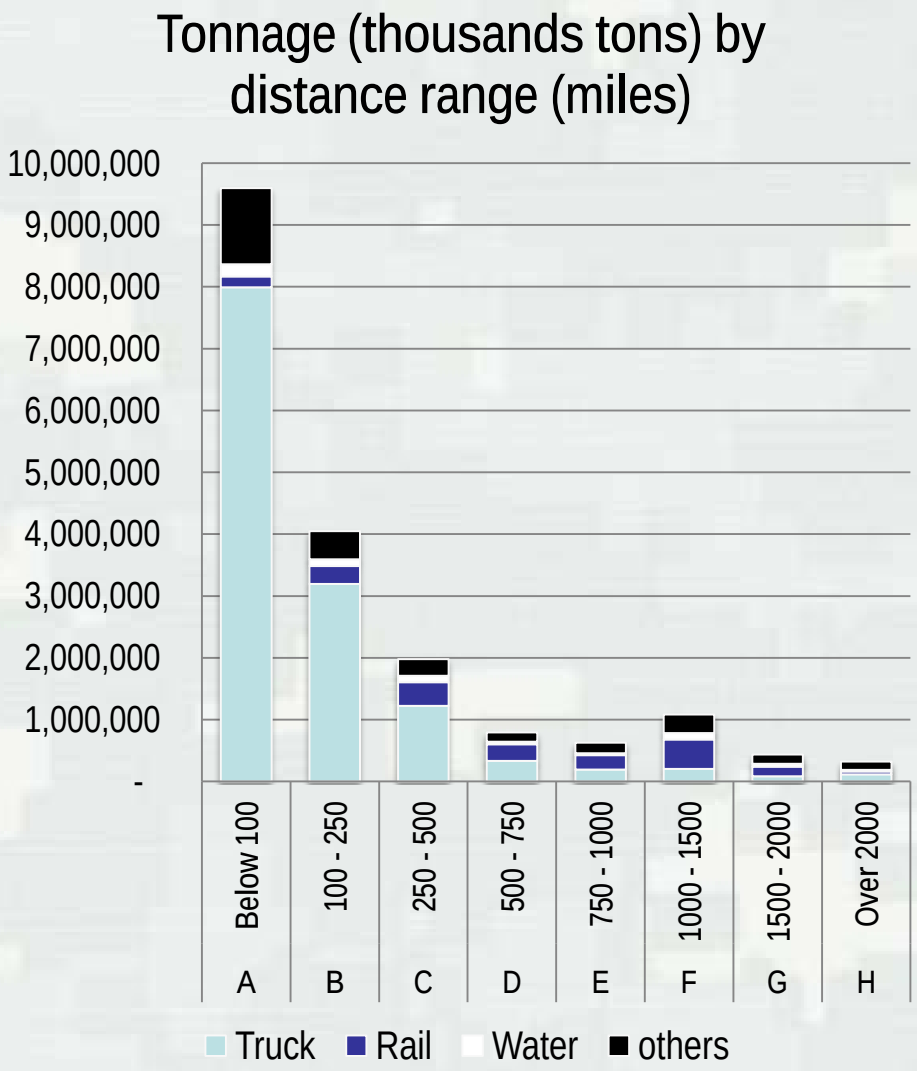


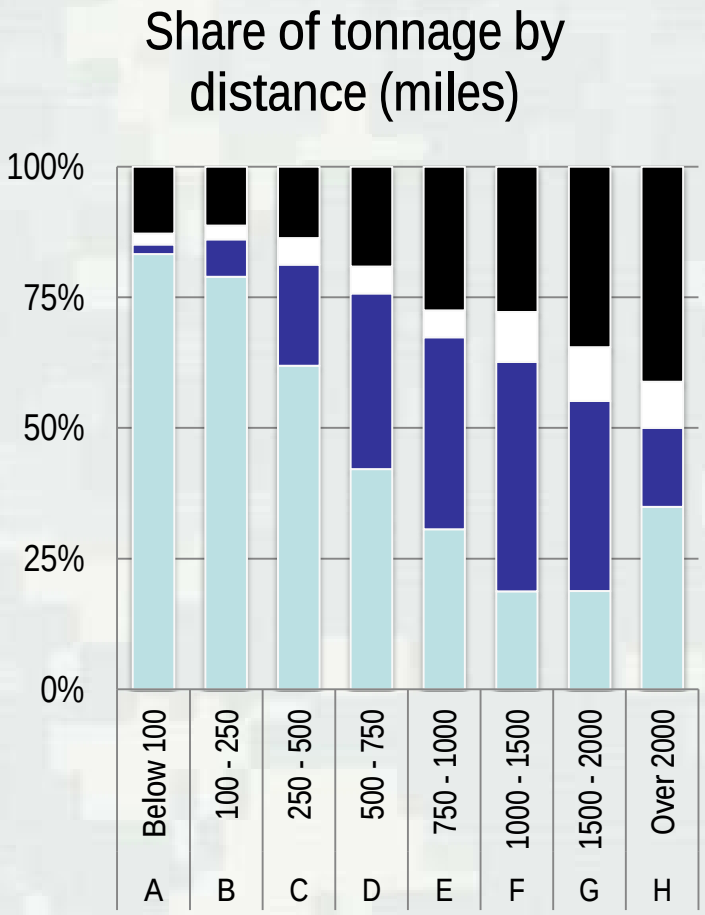
- Can be linked to an input/output model of business at the county level
- Based on a scenario(s)—robust decisions
- Supply chain based
- The F word

Demand is ultimately dependent on industry business patterns

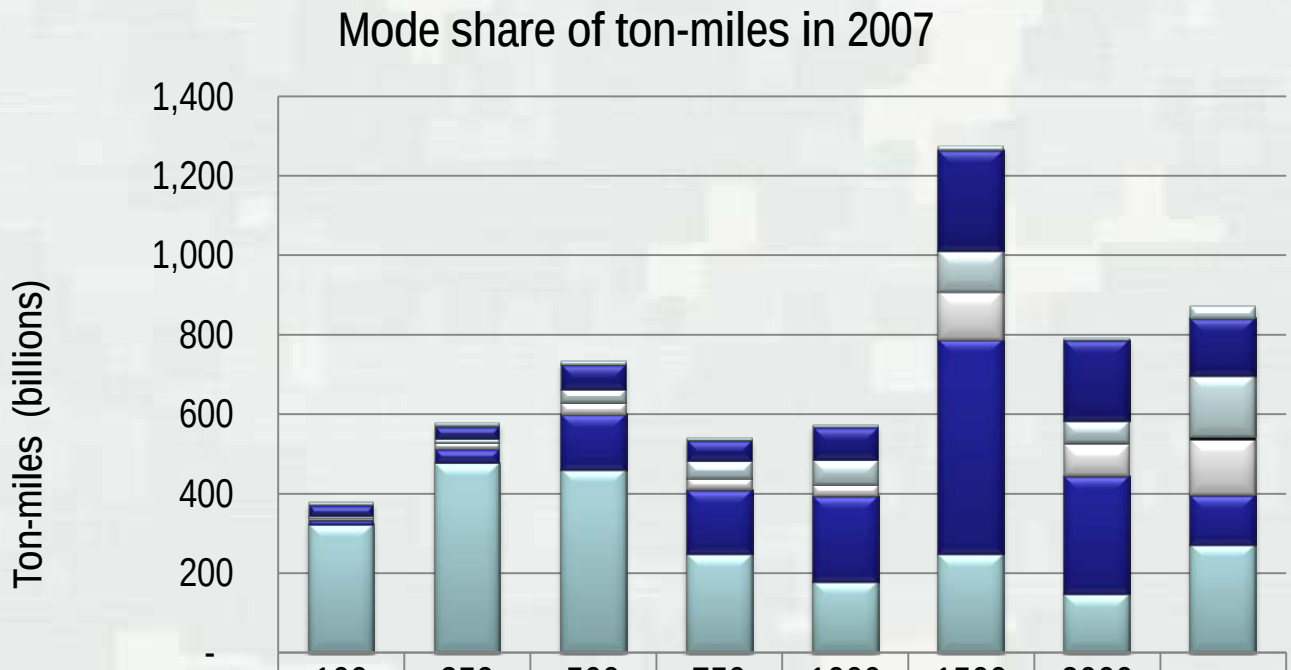
- Business I/O graphic here
- Or other FAF graphic

Mode Share by Distance





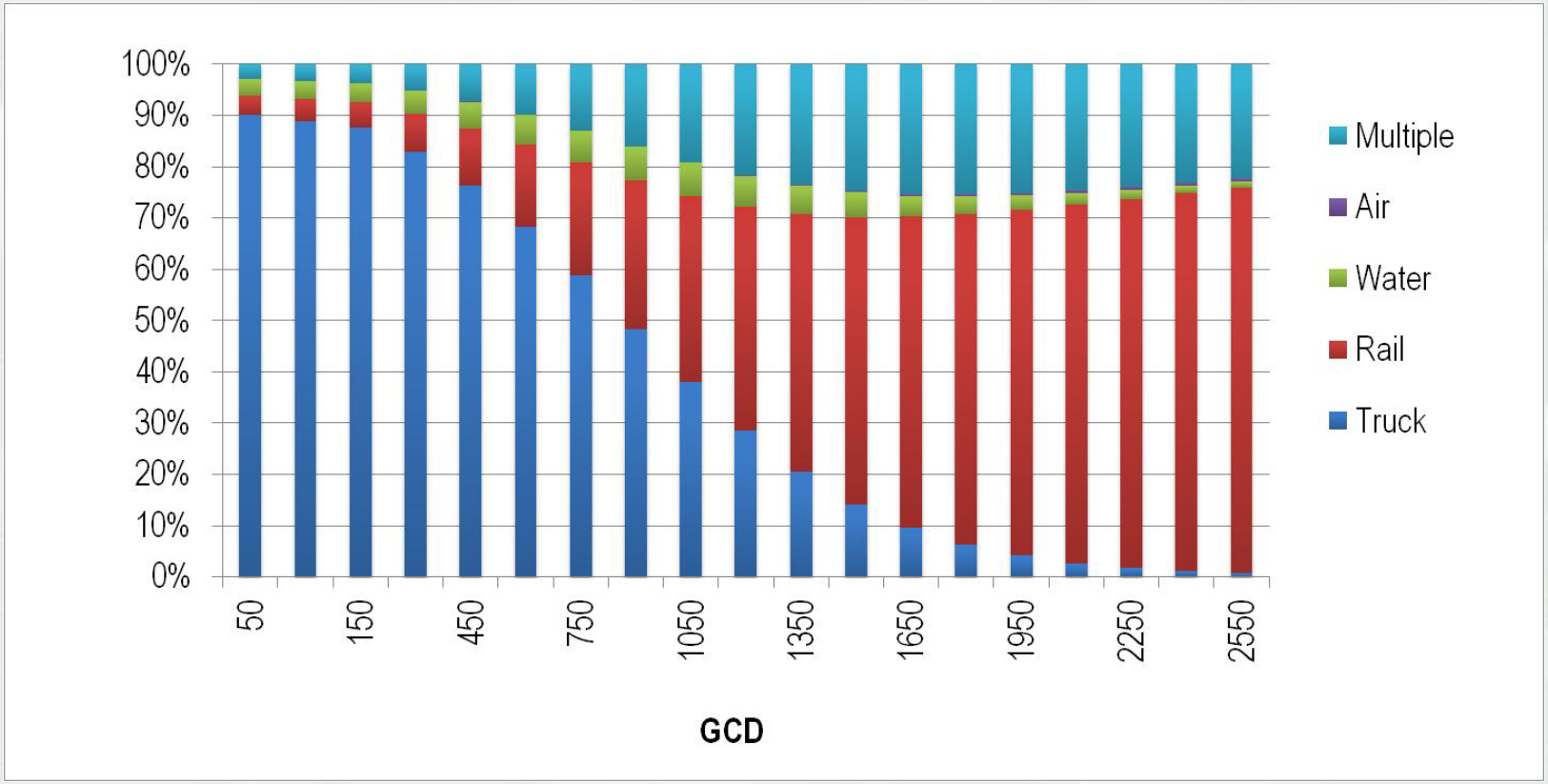
Freight activity by distance



	100	250	500	750	1000	1500	2000	over
other&unknown	8	9	10	6	7	10	6	31
pipeline	27	32	62	52	82	255	203	143
multiple	4	11	33	44	63	102	57	156
air	0	0	0	0	0	1	1	7
water	7	15	30	29	28	120	81	139
rail	12	36	138	161	215	540	297	124
truck	321	476	460	248	178	247	148	272

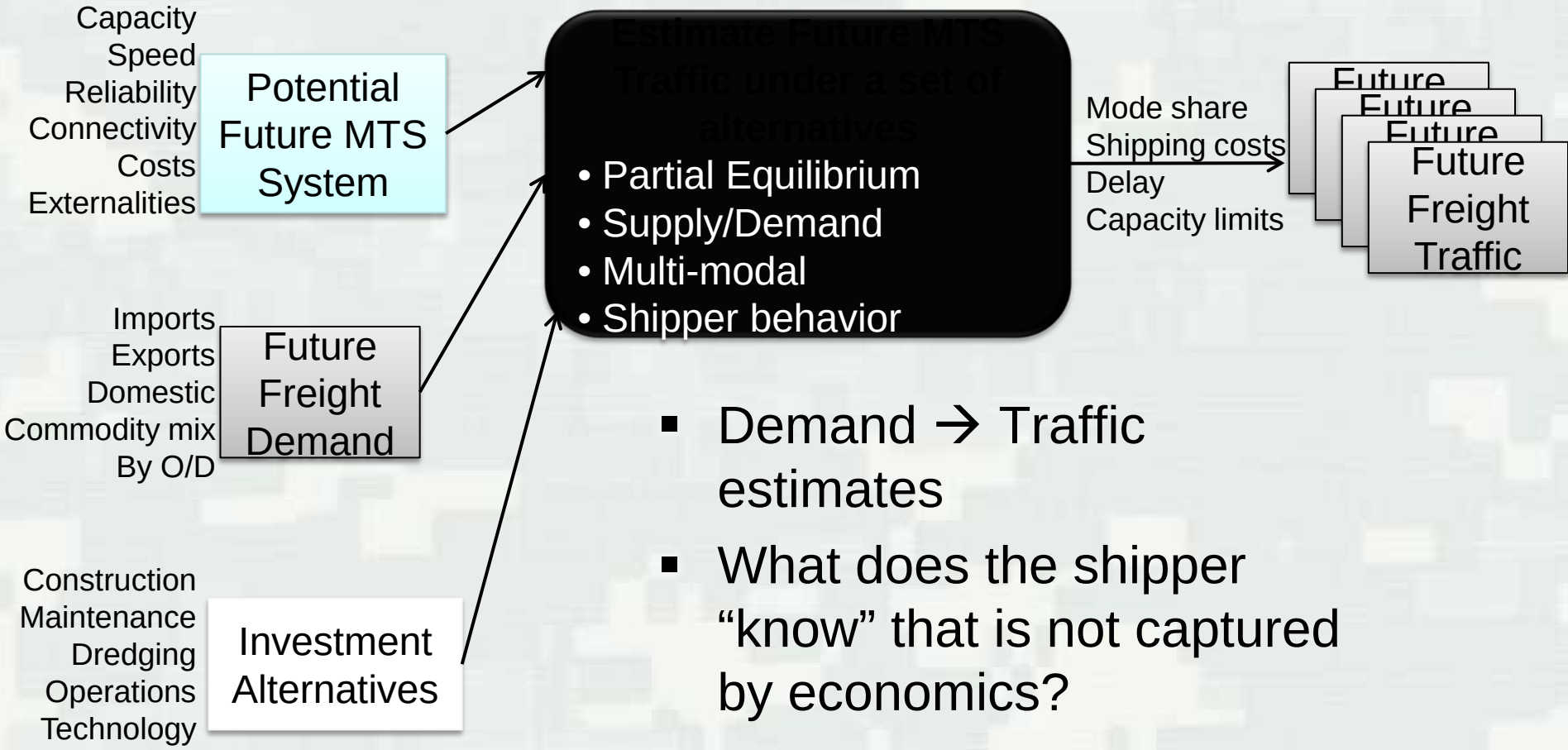
Example: Logit Model

- **Mode Share for the Manufacturing Sector**



Water movements are more likely to happen around 1000 miles

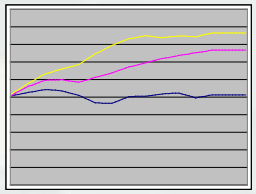
Choose Alternatives—estimate impacts



- Demand → Traffic estimates
- What does the shipper "know" that is not captured by economics?
  - Cost of uncertainty
  - Cost of change
- Challenge: to account for

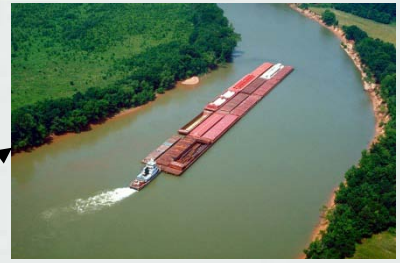
Waterway Supply and Demand Module

Traffic estimates based on demand and costs.

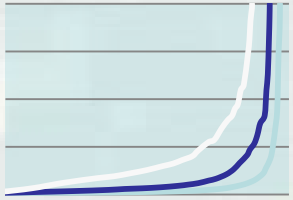


Cargo Forecasts

Waterway Network

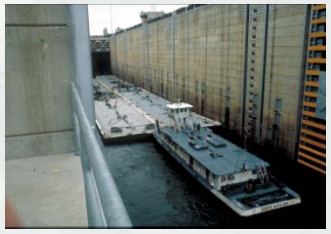


Shipping Plans

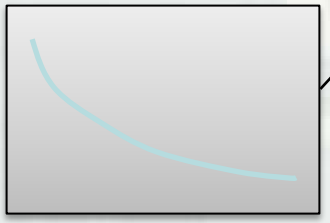


Transit Time Curves

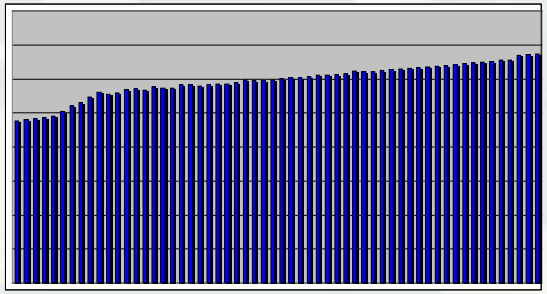
WSDM



Lock Operations



Demand Functions



Equilibrium Tonnage Levels

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

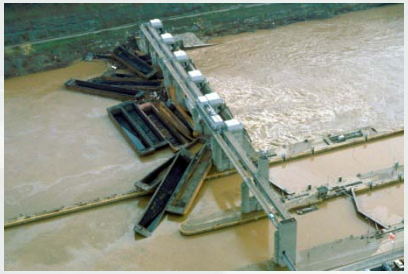
Example: Channel Portfolio Tool

- Need a graphic here, instead of NIM slide.

Example: NIM Optimization Module

Best investment at the best time.

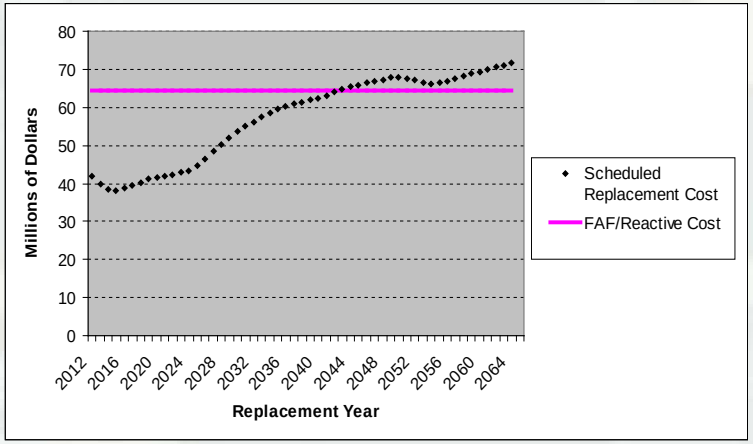
Construction Plans



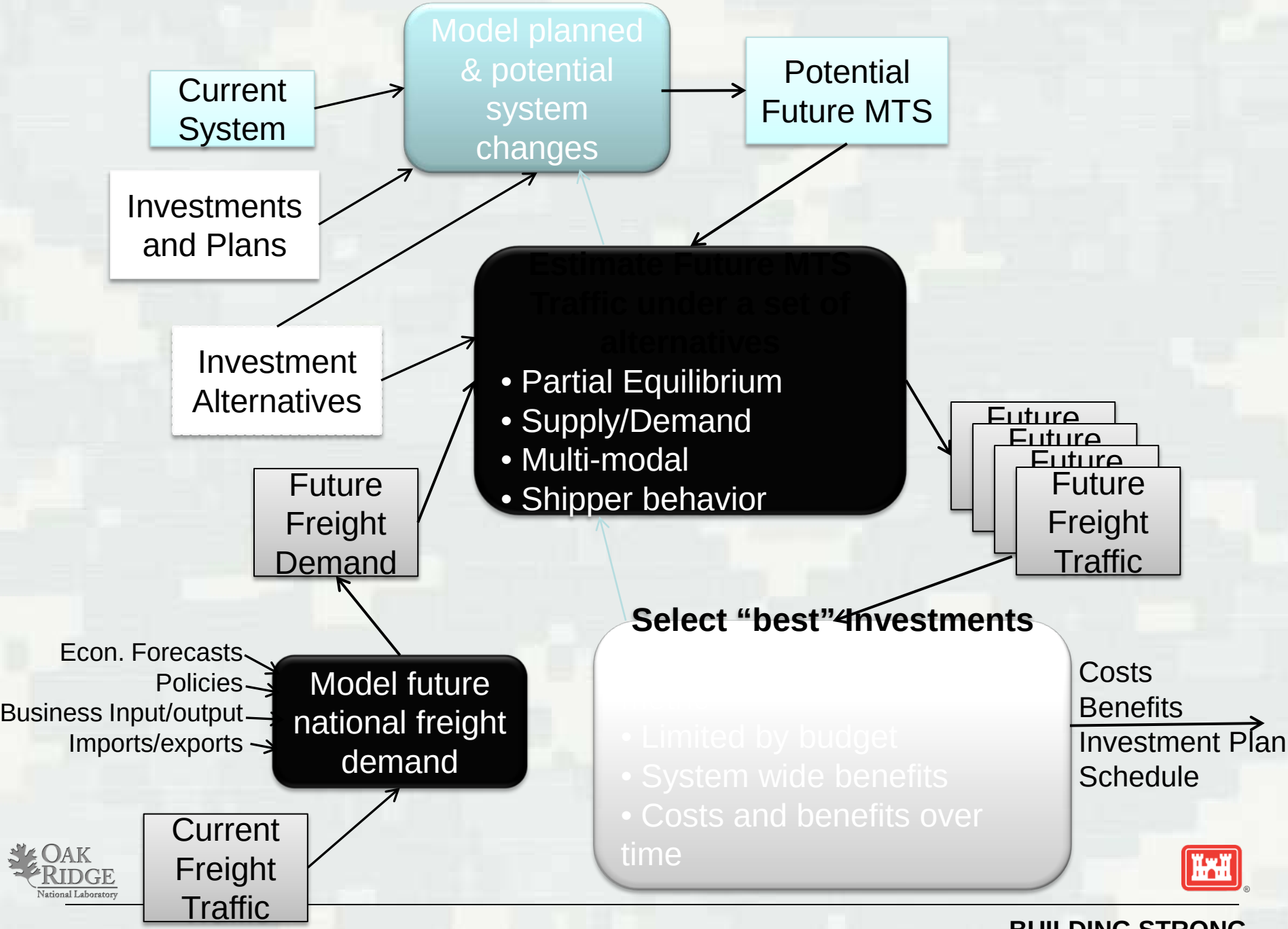
Random Minors

Expected Failures and Costs

Optimization



Optimal Alternative Selection and Timing


Model planned & potential system changes
Current System
Potential Future MTS
Investments and Plans
Investment Alternatives
Estimate Future MTS Traffic under a set of alternatives
• Partial Equilibrium
• Supply/Demand
• Multi-modal
• Shipper behavior
Future Freight Traffic
Future Freight Demand
Select "best" Investments
• Limited by budget
• System wide benefits
• Costs and benefits over time
Costs
Benefits
Investment Plan
Schedule
Econ. Forecasts
Policies
Business Input/output
Imports/exports
Model future national freight demand
Current Freight Traffic

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

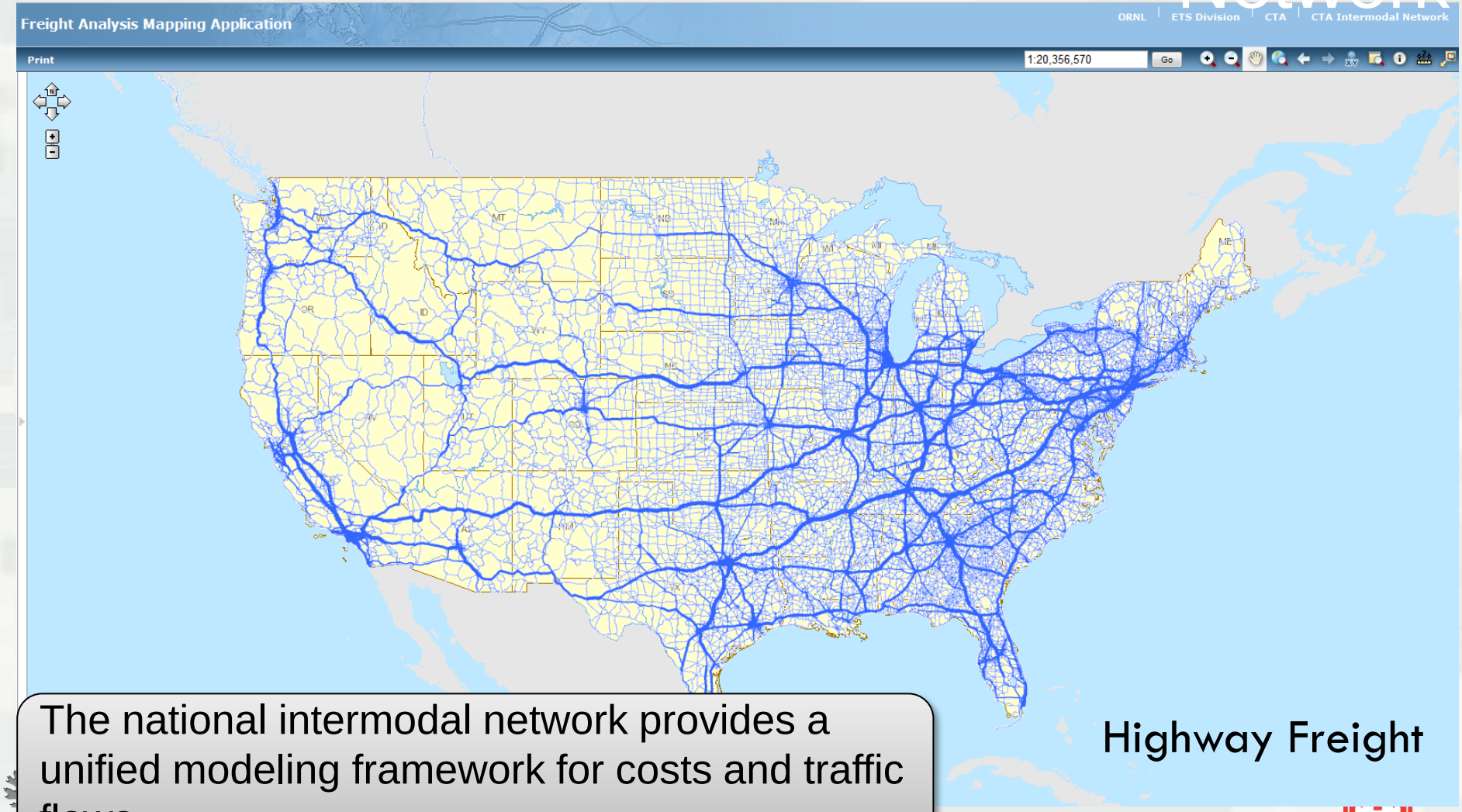
Operational Waterways Network Database

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



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