AAPA American Association of Port Authorities

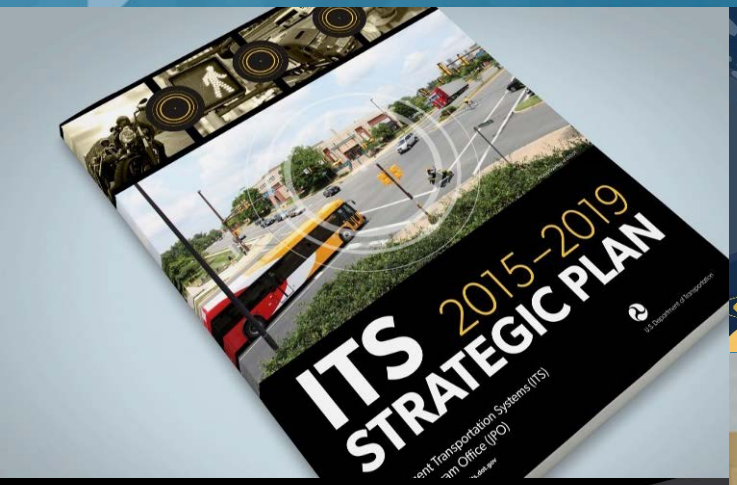
U.S. Department of Transportation
Maritime Administration &
Intelligent Transportation Systems
Joint Program Office

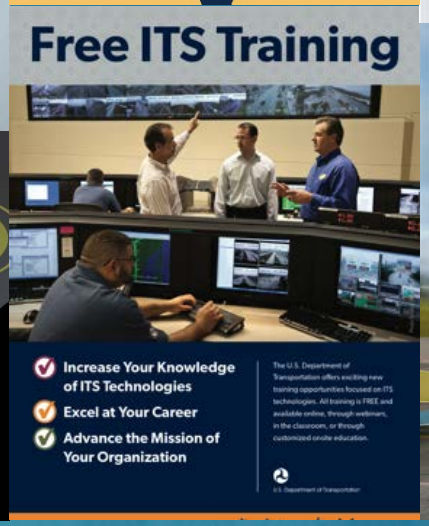
Intelligent Transportation Systems Applications for Ports

May 2, 2019

wsp

U.S. Department of Transportation





ITS Professional Capacity Building Program

Michelle Noch
ITS Joint Program Office
U.S. Department of Transportation

ITS PCB Program Background

Part of USDOT ITS Joint Program Office (JPO)

- **1996:** Authorized by Congress
- **2010:** Reauthorized by MAP-21
- **2016:** Reaffirmed by FAST Act

The ITS PCB Program supports a variety of ITS learning opportunities to accelerate ITS deployments and encourage more efficient operations

Program Strategy

Vision: Prepare a dynamically knowledgeable community of transportation industry professionals for a connected automated transportation system

Mission: Provide a multimodal and multi-disciplinary capacity building program for all levels of current and future transportation professionals to accelerate preparation for and the deployment of innovative ITS

ITS PCB Program – Portfolio of Products

AAPA American Association of Port Authorities

Intelligent Transportation Systems (ITS)

ePrimer

U.S. Department of Transportation
Maritime Administration &
Intelligent Transportation Systems
Joint Program Office

ITS ePrimer - ITS Profes | Google | Google

https://www.pcb.its.dot.gov/eprimer/default.aspx

United States Department of Transportation

About DOT | Briefing Room | Our Activities

Intelligent Transportation Systems
Joint Program Office

About OST-R | OST-R Publications | Library | Contact Us

Search PCB website | Submit

ITS Professional Capacity Building Program

SIGN UP FOR PCB UPDATES

Home | About | Training | Resources for Practitioners | Resources for Students and Instructors

Resources for Practitioners

ITS ePrimer

Welcome to the ITS ePrimer!

The ITS ePrimer provides transportation professionals with fundamental concepts and practices related to ITS technologies. This online resource can help practicing professionals and students better understand how ITS is integrated into the planning, design, deployment, and operations of surface transportation systems. The ITS ePrimer is both a stand-alone reference document for the practitioner as well as a text for education and training programs.

Please use the option to send feedback as you read through the ePrimer. The ITS PCB Program welcomes your comments and suggestions.

To view a module, click its plus button ⊕.

View All ⊕

Module 1 Introduction to ITS	Module 8 Electronic Toll Collection and Pricing
Module 2 Systems Engineering	Module 9 Supporting ITS Technologies
Module 3 Transportation Management Systems	Module 10 Rural and Regional ITS Applications
Module 4 Traffic Operations	Module 11 Sustainable Transportation
Module 5 Personal Transportation	Module 12 Institutional Issues
Module 6 Freight, Intermodal, and CVO	Module 13 Connected Vehicles
Module 7 Public Transportation	Module 14 Emerging Issues

For more information, contact:

Michelle Noch
ITS Professional Capacity Building Program Manager
ITS Joint Program Office
Office of the Assistant Secretary for Research and Technology (OST-R)
U.S. Department of Transportation
202-366-0278
Michelle.Noch@dot.gov

The ITS PCB Program would like to acknowledge the following individuals who volunteered their time to review the modules.

ITS PCB Program – Resources for Practitioners Tab

Type here to search

11:25 PM
2/27/2019

WSP

AAPA American Association of Port Authorities

U.S. Department of Transportation
Maritime Administration &
Intelligent Transportation Systems
Joint Program Office

Intelligent Transportation Systems (ITS)

ePrimer

Module 1 Introduction to ITS	Module 8 Electronic Toll Collection and Pricing
Module 2 Systems Engineering	Module 9 Supporting ITS Technologies
Module 3 Transportation Management Systems	Module 10 Rural and Regional ITS Applications
Module 4 Traffic Operations	Module 11 Sustainable Transportation
Module 5 Personal Transportation	Module 12 Institutional Issues
Module 6 Freight, Intermodal, and CVO	Module 13 Connected Vehicles
Module 7 Public Transportation	Module 14 Emerging Issues

(https://www.pcb.its.dot.gov/eprimer/default.aspx)

wsp

U.S. Maritime Administration

- MARAD seeks to increase cargo capacity and reliability of freight moving through ports
- Challenges & Issues
  - Marine terminal congestion is an ongoing challenge in the U.S.
  - Economic growth driving cargo volume growth
  - Exacerbated by larger container ships, infrastructure improvements – channel deepening, air draft clearance projects, Panama Canal expansion
  - Complexity of multi-modal port operations
- *Maritime Administration Strategic Plan (2017-2021)* … Strategic Goal #5: Maritime Innovation
- ITS MARAD Truck Staging Study (joint project with ITS JPO, FHWA, and FMSCA) – Webinar available at https://ops.fhwa.dot.gov/freight/fpd/talking_freight/index.htm by June 2019

American Association of Port Authorities

- The unified voice of the seaport industry in the Americas, representing more than 130 public port authorities in the U.S., Canada, the Caribbean and Latin America.
- AAPA events, resources and partnerships
  - connect, inform and unify seaport leaders and maritime professionals
  - promotes the common interests of the port community
  - provides advocacy and effective public outreach to influence seaports' most urgent public policy issues

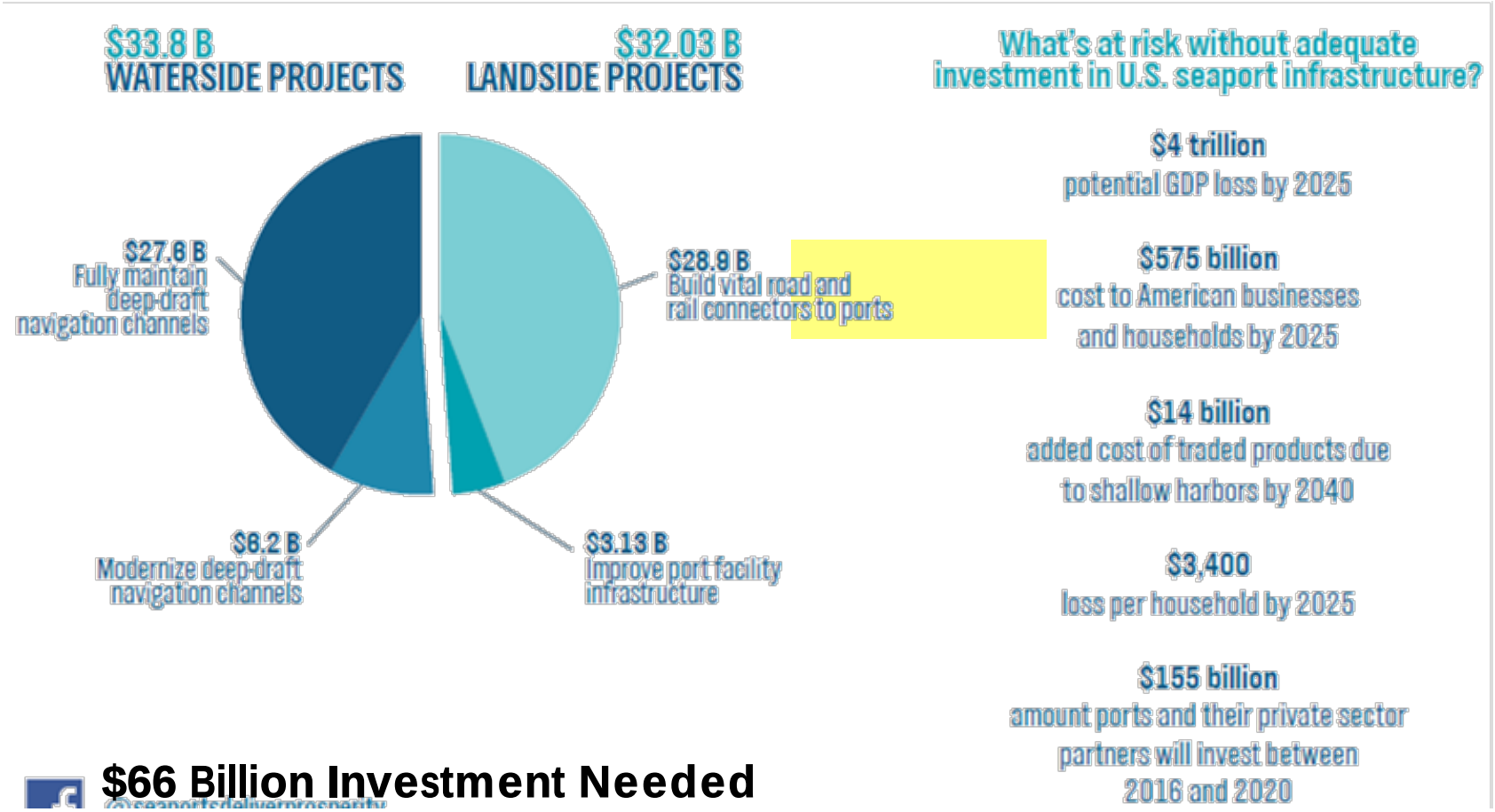
Information Technology Committee

The AAPA Information Technology Committee focuses on electronic data interchange, management information systems and other automation initiatives. The Committee is open to all members of the Association, including corporate (port) members and sustaining (port industry solution providers) members.

Information Technology Awards Program

The AAPA Information Technology Awards highlight port technology accomplishments in the areas of "Port Operations and Management Systems" and "Improvements in Intermodal Freight Transportation." Participation is open to all corporate members of the association.

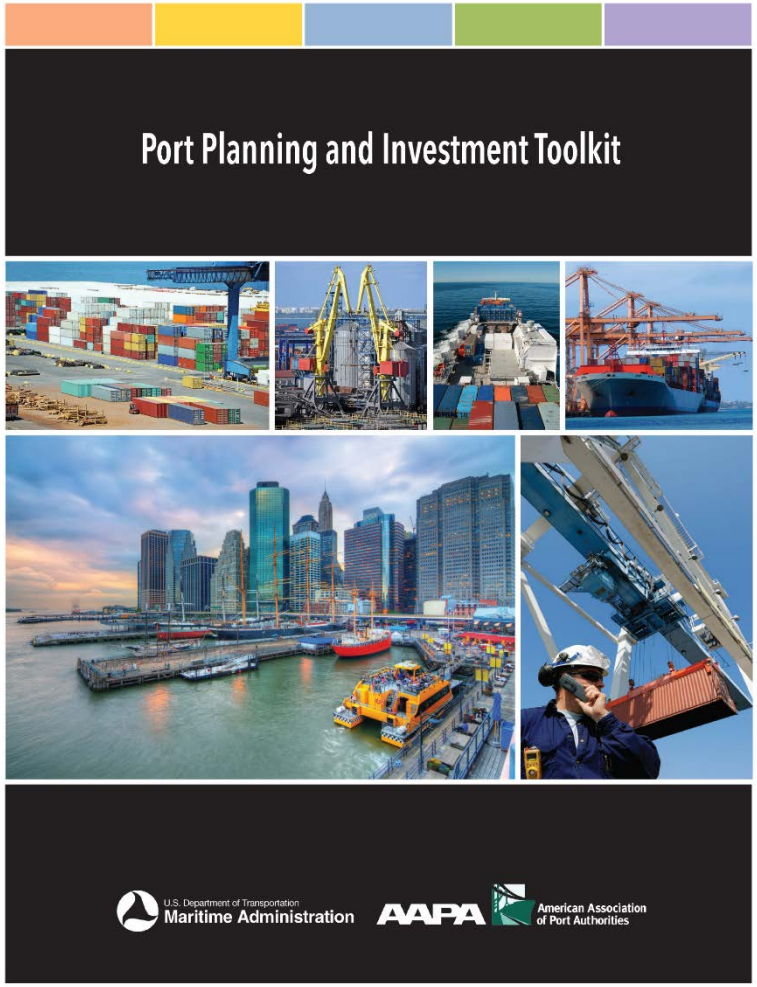
Needed Port Investments – ITS Opportunities



$66 Billion Investment Needed For Port Infrastructure – 44% Could Include ITS Solutions

Port Planning & Investment Toolkit (PPIT)

- Led by:
  - AAPA
  - MARAD
  - 64 Port Staff, PPM Candidates, Consultants
- Goal is to assist Ports:
  - Develop capital plans that clearly identify future needs;
  - Determine the most cost-effective, sustainable and efficient solutions to port challenges;
  - Position port projects for federal funding such as BUILD, INFRA and MPO grants;
  - Get port infrastructure projects into MPO and state transportation programs to qualify for other government funding; and
  - Obtain private sector funding to support their infrastructure projects.



PPIT and ePrimer Modules

- PPIT information, updates, and resources are available at:
  - AAPA website at http://www.aapa-ports.org/PPIT
  - MARAD website at https://www.maritime.dot.gov/ports/port-planning-and-investment-toolkit
- ITS Professional Capacity Building Program – ITS ePrimer Modules at https://www.pcb.its.dot.gov/eprimer/default.aspx
- PPIT and ePrimer ITS for Port Operations Module available June 2019

Intelligent Transportation Systems

- An engineering discipline that encompasses the research, planning, design, integration, and deployment of systems and applications to:
  - Manage traffic and transit,
  - Improve safety,
  - Provide environmental benefits, and
  - Maximize the efficiency of surface transportation systems.

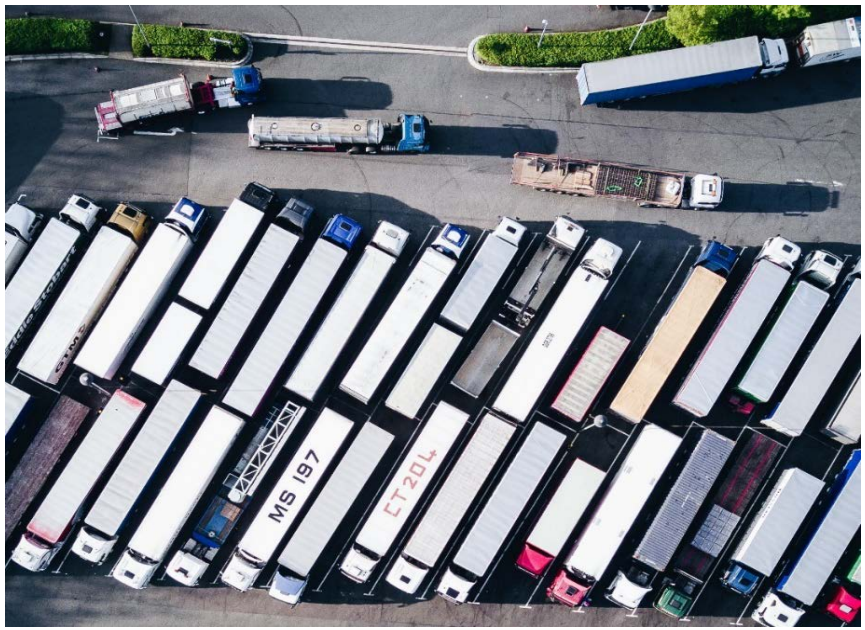
ITS in the Port Context

Traditional Focus:

- Moving **vehicles,** on an **open** public network without **transactions** under limited **regulations** for **public** stakeholders

Port + ITS Focus:

- Moving **trucks** and **trains** on a **bounded** network, accessing **private** spaces, for **commercial** transactions under **tight** regulations for **private** stakeholders



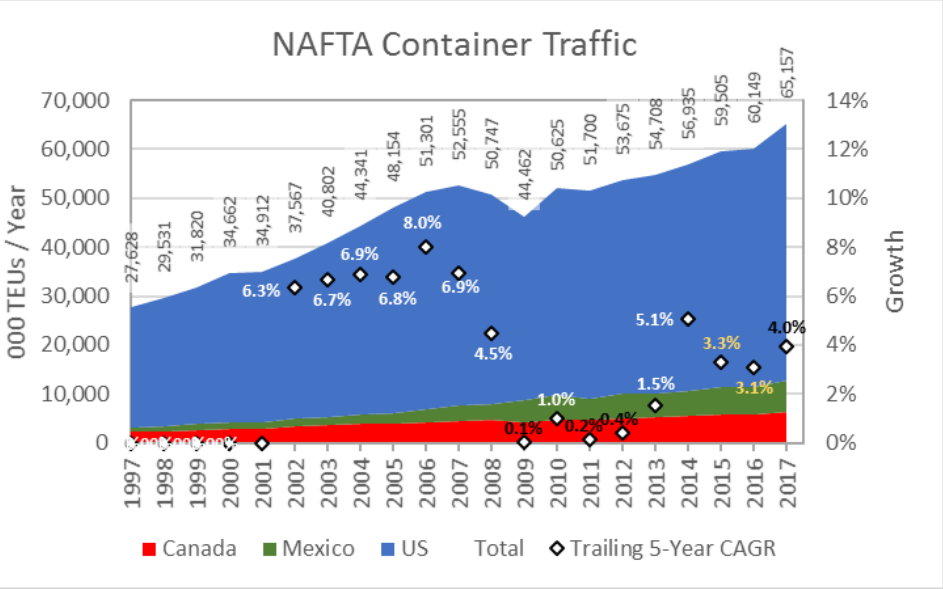
ITS in the Port Context

- **Local/regional** – Applications of ITS for the surrounding road and rail network that indirectly impact port operations. This could include the provision of freight signal priority (FSP) on road and rail interchanges in proximity to a terminal.
- **Port specific** – Applications of ITS for the port area transportation network, such as terminal roadways, gate access management, and reservation systems.
- **Combination** – Applications of ITS that addresses port operations, the port area transportation network and the region. This could include a truck staging and parking application that provides staging information at the terminal, and detailed route information for efficient and timely access to the facility.

The Need for ITS in Ports

Demands and Constraints

- 52 M TEUs / year in 2017
  114 M by 2040: **+118%**
- Demand is spikier
- Port road and rail systems are static



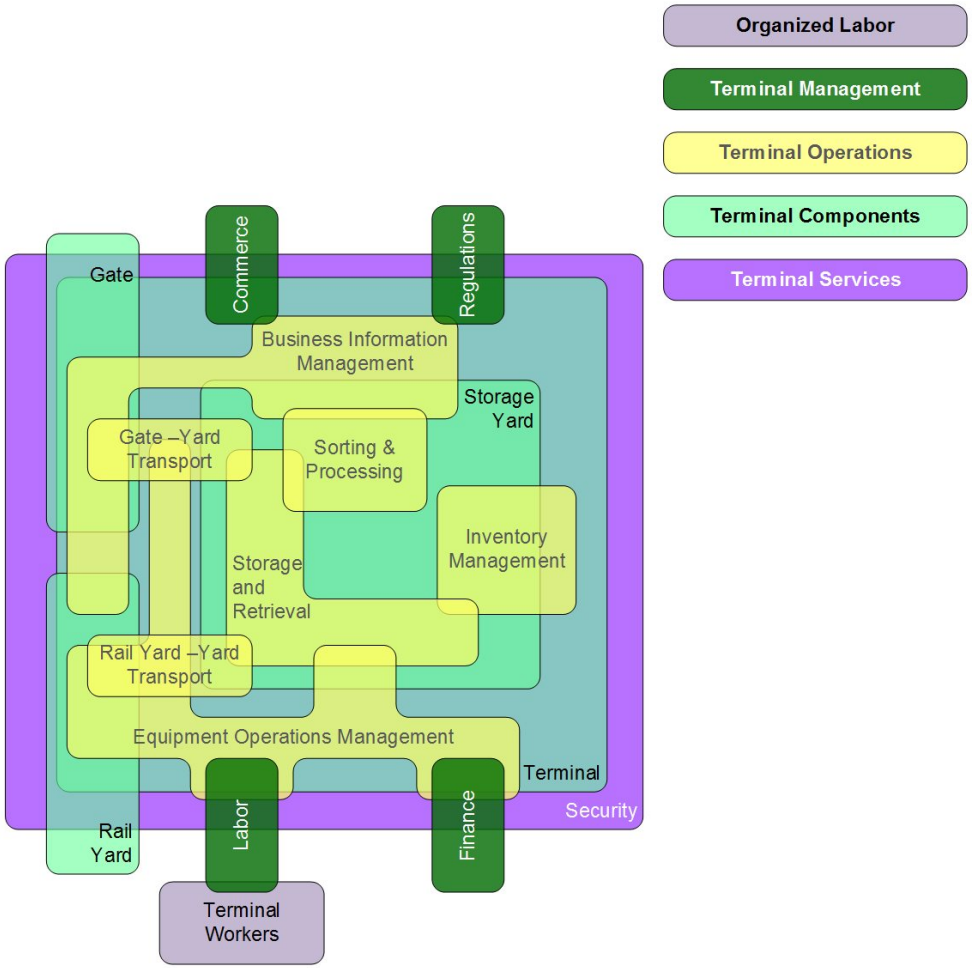
Alternatives

- Build **new ports**
  - Flat Land + Deep Water: Rare and Constrained
- Build **more roads** in ports
  - Cities have expanded toward their ports, hemming them in
- **Shift** traffic off of roads
  - Intermodal rail has similar issues
- Build **smarter** roads
- Use resources more **efficiently**

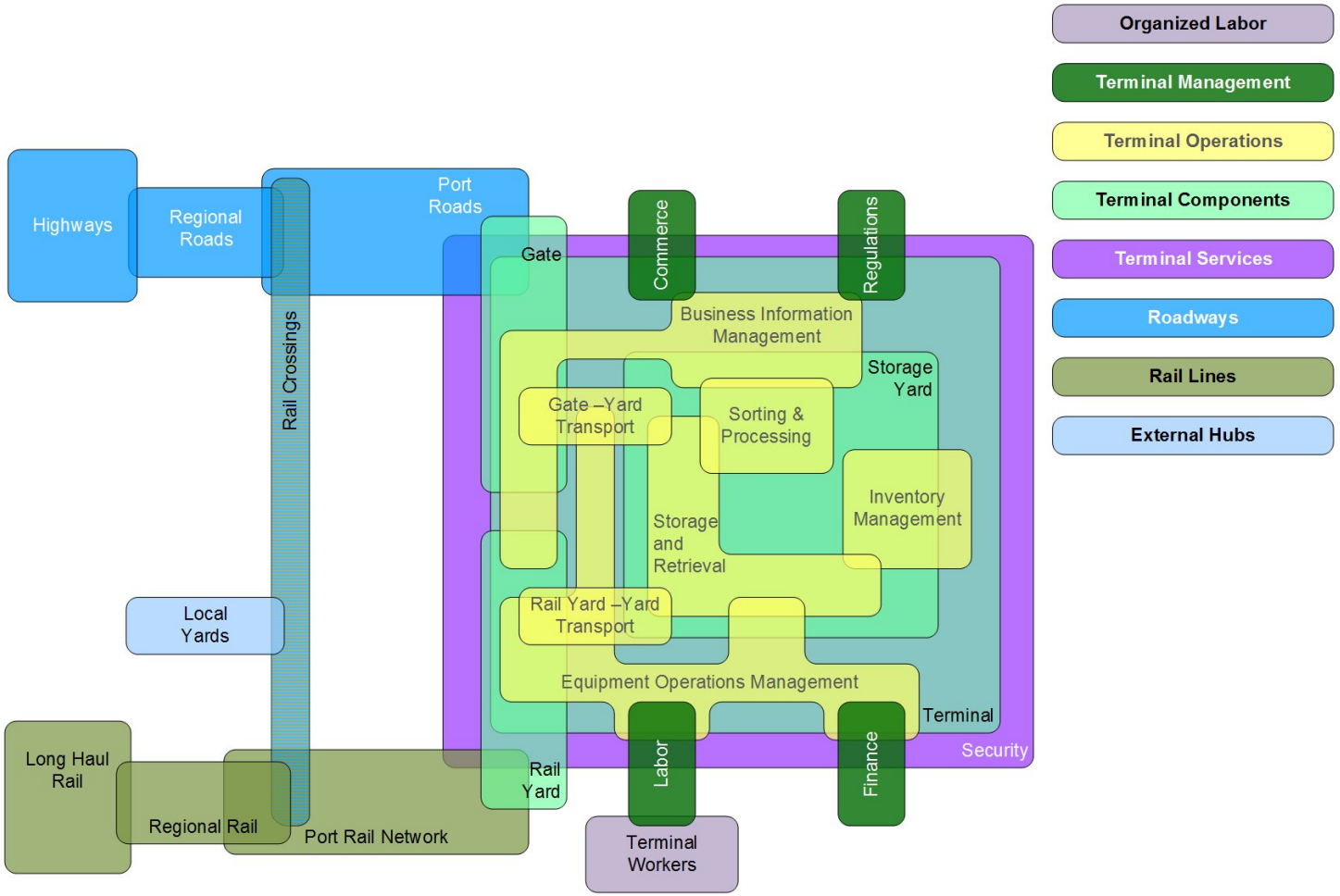
Potential Benefits for Ports

Service Element	Benefits
Safety and Reliability	Avoid port-area collisions, goods movement accident losses, hazardous material releases.
Resilience	Mitigate the impact of disruptive events.
Cargo Visibility, Reliability	Improve the reliability and timeliness of cargo transport. Improve the responsiveness of service providers.
Vehicle Efficiency and Mobility	Reduce travel time, queuing and idling. Maintain network fluidity. Improve transport workforce efficiency.
Gate Efficiency	Reduce queuing. Improve accuracy, avoid transaction failure. Improve gate transaction speed, extend hours, and optimize labor.
Terminal Yard Efficiency	Improve density and velocity. Improve cargo handling equipment deployment. Reduce cargo rehandling.
Port Efficiency	Balance load between terminals. Respond to congestion events.

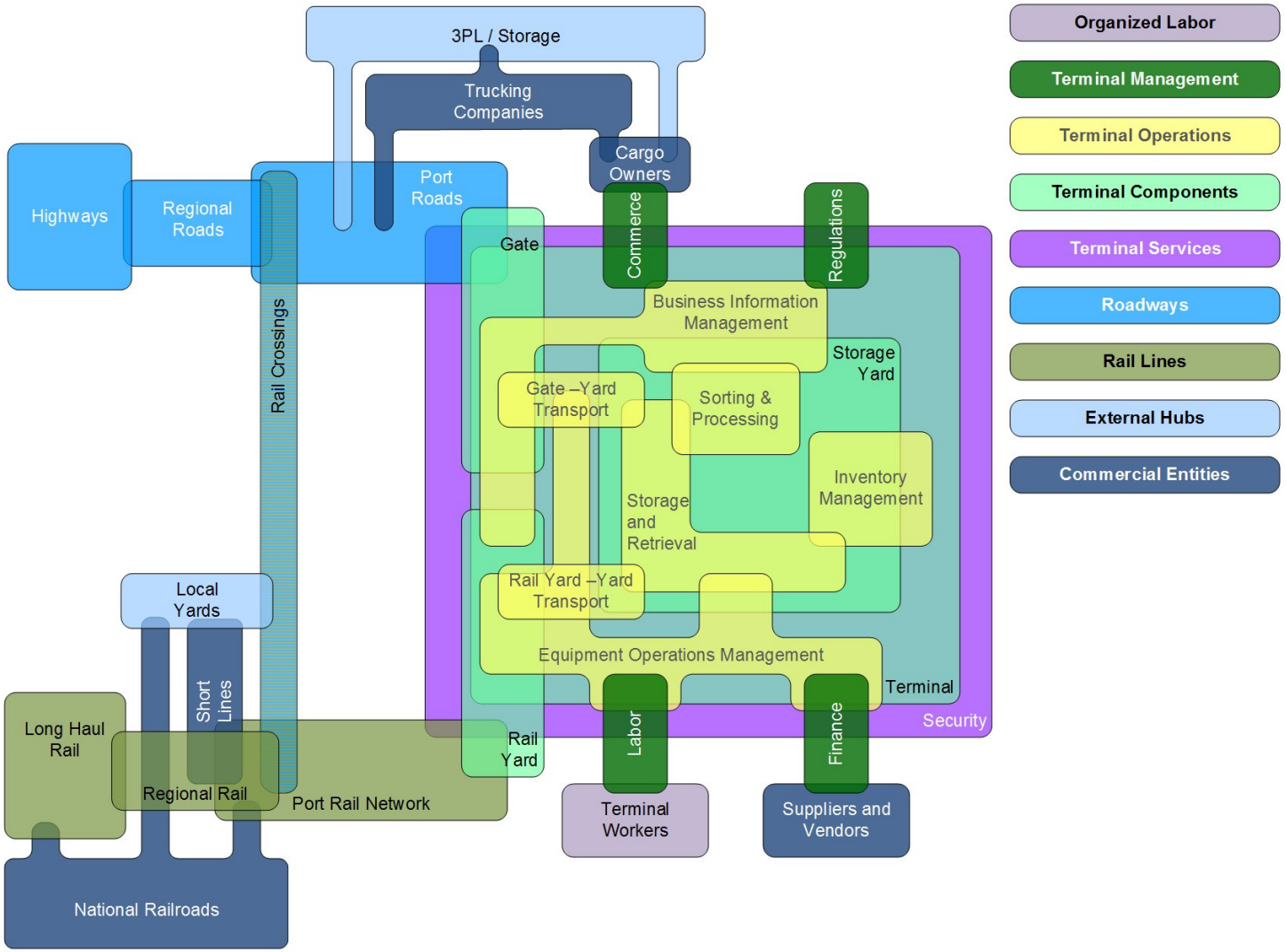
Not a Simple Playing Field - Terminals



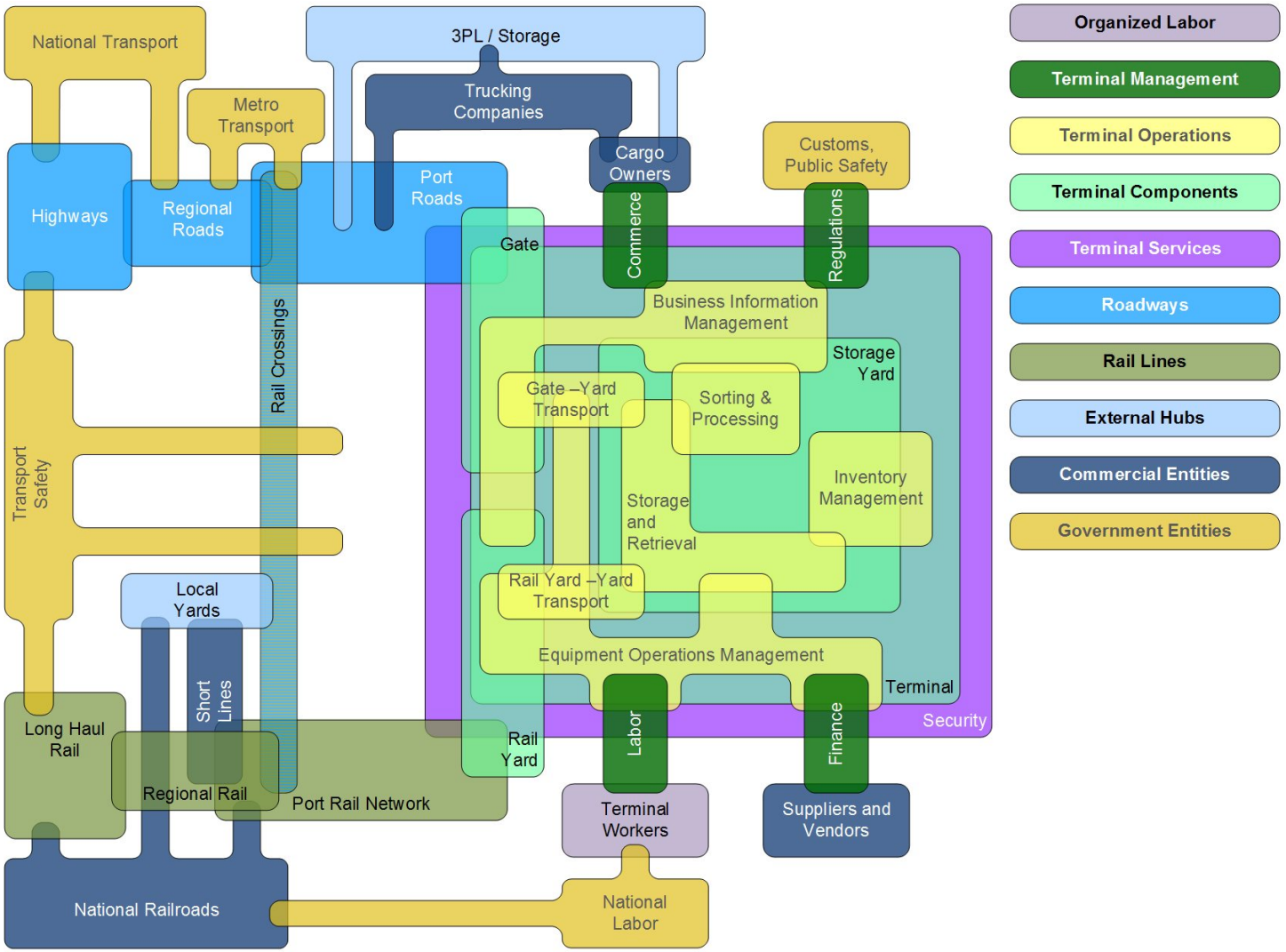
Not a Simple Playing Field – Networks



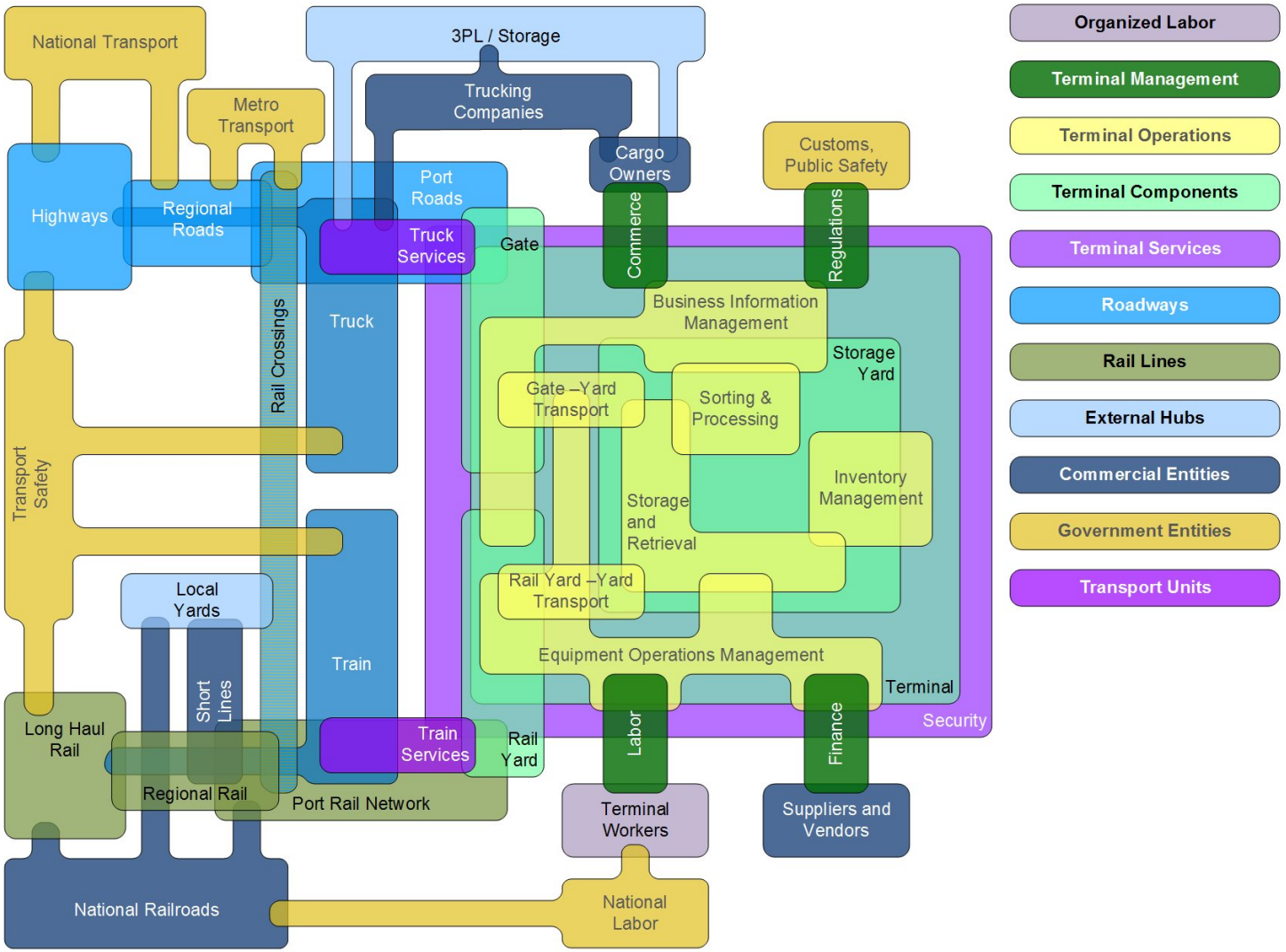
Not a Simple Playing Field - Commerce



Not a Simple Playing Field - Governance



Not a Simple Playing Field - Transporters



Enabling Technologies

PX — **Proximity and Detection Systems**

- Smart Cameras
- Laser / Infrared Scanners
- Radio Detection and Ranging **RADAR**
- Light Detection and Ranging **LIDAR**

ID — **Cargo and Vehicle ID Systems**

- Optical Character Recognition - **OCR**
- License Plate Recognition - **LPR**

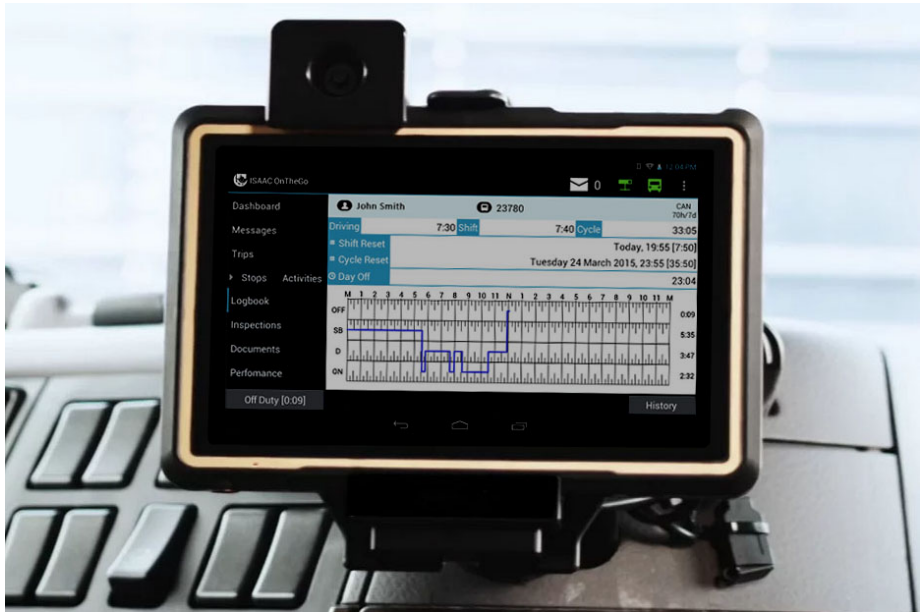
Enabling Technologies

VI Vehicle Information Systems

- Weigh-in-motion - **WIM**
- Vehicle Telematics
- Electronic Logging Devices - **ELD**
- Radio Frequency Identification - **RFID**

LO Location Determination Systems

- Geographic Positioning System - **GPS**
- Differential GPS
- Bluetooth Tracking



Enabling Technologies

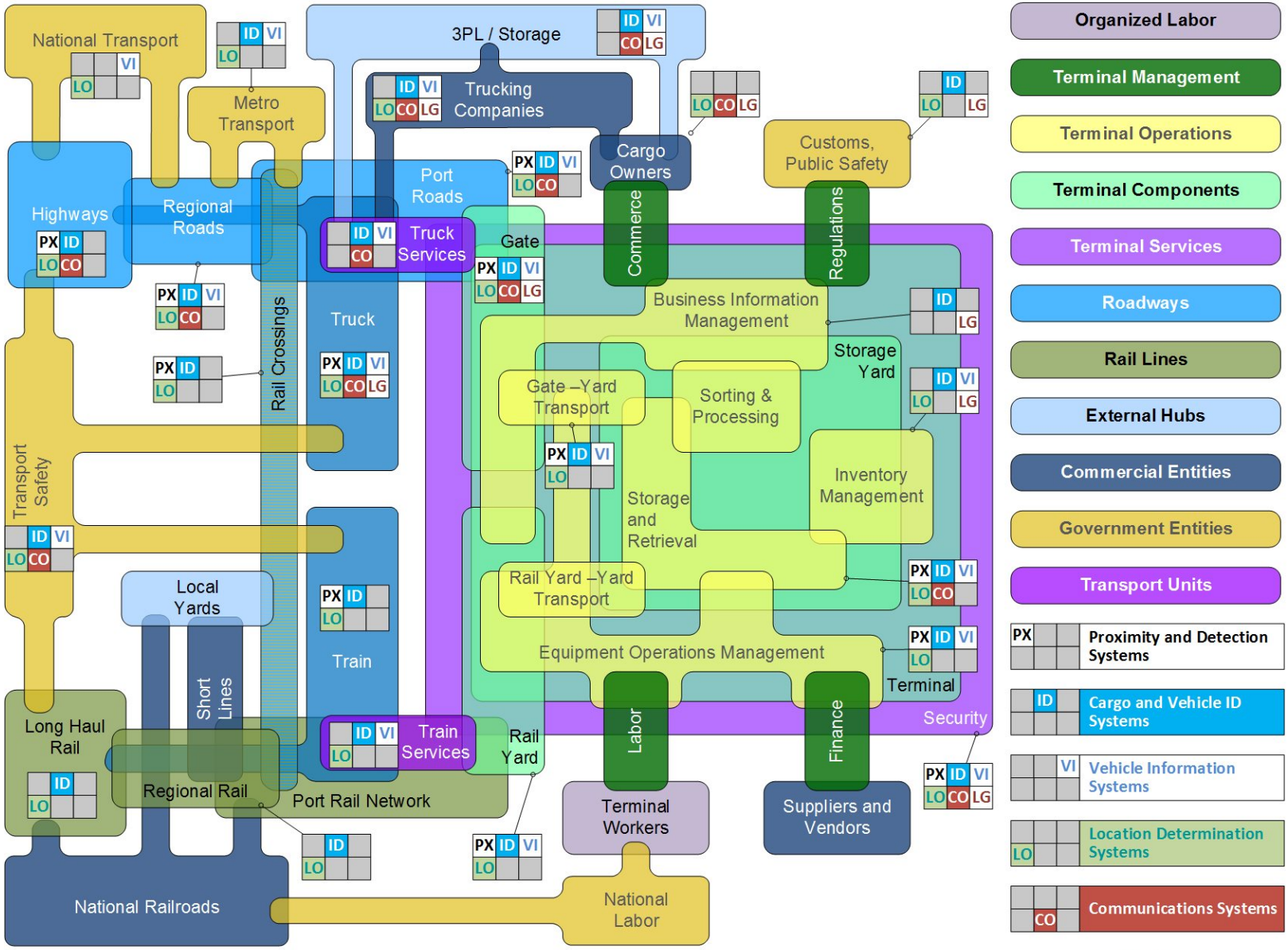
CO Communications Systems

- Cellular Communication - **4GC, 5GC**
- Dedicated Short Range Communications

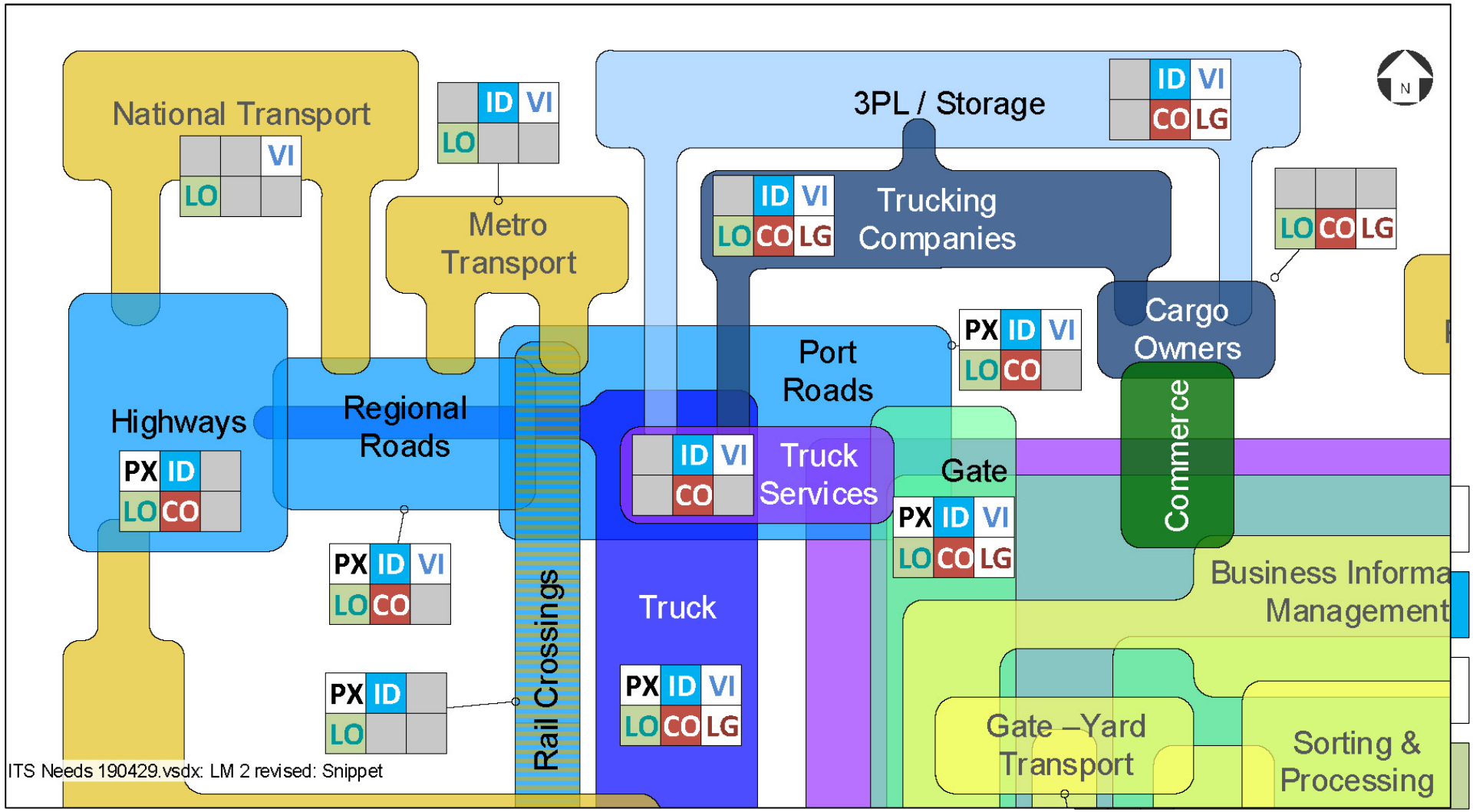
LG Logistics Management Systems

- Electronic Data Interchange - **EDI**
- Internet of Things - **IOT**
- Cloud Data and Processing
- Blockchain

Technology Interactions



Technology Interactions – Road and Gate



ITS Applications

Local/Regional

- Connected, Automated and Autonomous Vehicles
- Platooning Systems
- Route Guidance

Combination

- Geo-Fencing
- Freight Signal Priority
- Rail Yard Integration
- Integrated Community Portal
- Freight Advanced Traveler Information System (FRATIS)
- Traveler Information Reporting

Port-Specific

- Intelligent Recognition and Imaging Software
- Equipment Tracking System
- Terminal Operating System
- Gate Operation System
- Terminal Status Reporting
- Gate Queue Reporting
- Truck Appointment Systems
- Street Exchange Systems
- Automated Work Flow

A Recent Example

Mean Gate Wait Times (in minutes - past 5 days)

TIME	WED	THU	FRI	MON	TUE	TODAY
07:00	-	-	-	-	-	-
08:00	22.3	32.0	39.2	55.4	60.5	21.1
09:00	12.1	7.6	35.6	27.5	38.2	16.9
10:00	8.5	11.9	9.9	18.3	12.0	11.3
11:00	11.5	9.0	29.4	24.3	28.8	17.5
12:00	-	-	-	-	-	-
13:00	44.2	26.0	52.8	48.3	54.5	48.9
14:00	32.1	11.8	39.9	55.7	39.1	26.8
15:00	24.2	24.2	59.4	42.6	30.3	31.0
16:00	6.0	12.0	45.0	21.5	9.0	10.5

Mean Truck Service Times (in minutes - past 5 days)

TIME	WED	THU	FRI	MON	TUE	TODAY
07:00	-	-	-	-	-	-
08:00	37.6	26.6	44.2	28.2	29.6	17.9
09:00	39.2	22.0	36.1	37.4	27.0	31.2
10:00	21.2	27.4	34.9	40.4	37.9	28.1
11:00	20.1	21.8	55.3	28.4	43.7	13.3
12:00	-	-	-	-	-	-
13:00	22.6	25.9	38.1	21.1	45.7	27.3
14:00	27.6	25.1	38.1	23.8	21.8	33.2
15:00	33.2	16.4	35.0	18.1	19.2	48.0
16:00	22.3	19.3	29.6	17.7	27.1	20.2

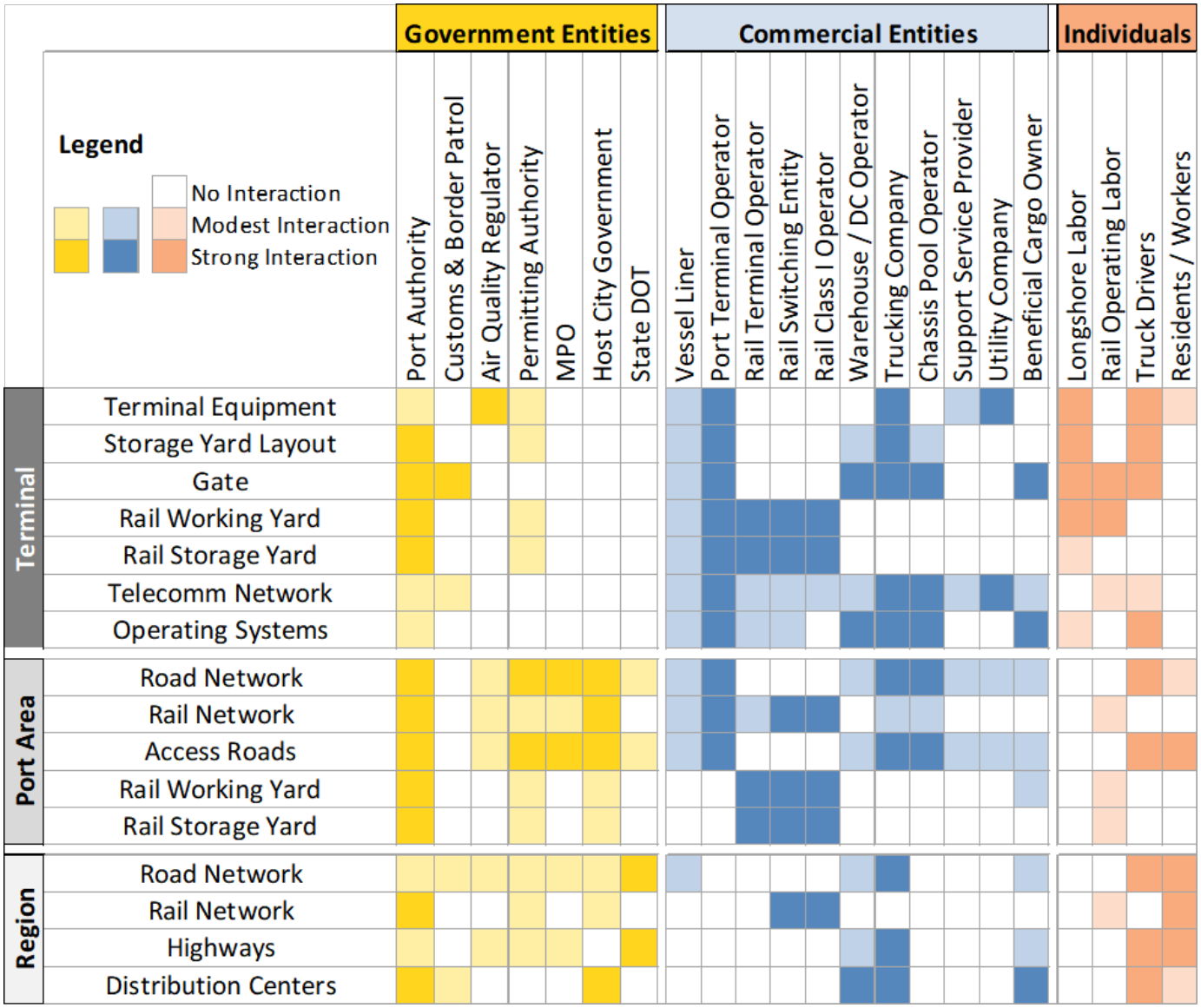
- A port authority bought extra *bridge toll tag* (RFID) readers and placed them at:
  - Tail of entry gate queues
  - Entry into the container yards
  - Exit from the terminals
- Time stamp readings for each tag, and some filtering, produced *gate queue* and *truck service* times
- Mean results are dynamically updated, in public, on the port's website

Vehicle to Everything (V2X) and IOT Communications

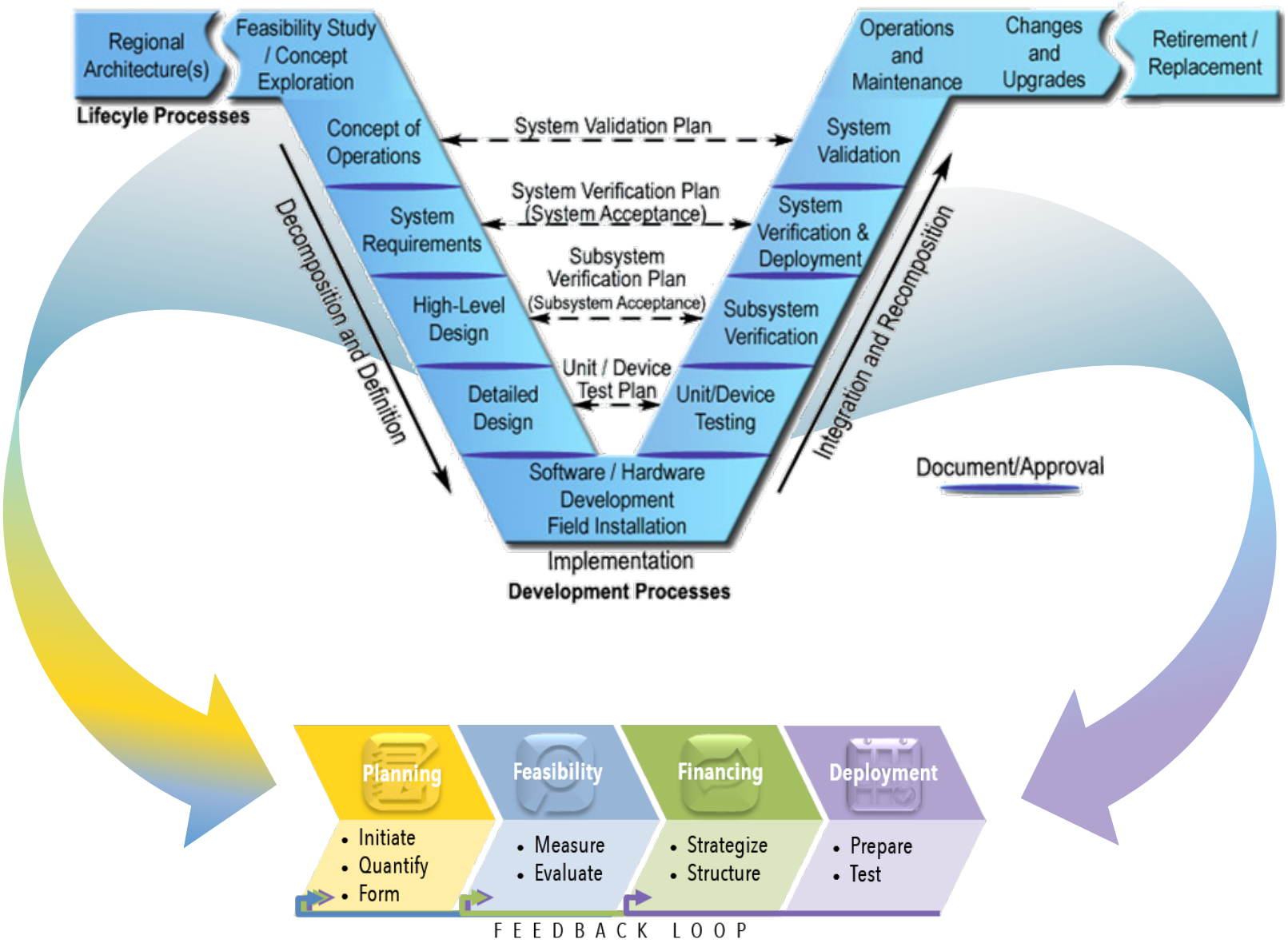
Service Improvement	V2X and IoT Communications Technology				
	Vehicle / Vehicle	Vehicle / Infrastructure	Vehicle / Device	Vehicle / IoT	IoT Platform
Safety & Reliability	Avoid port-area collisions, goods movement accident losses, hazardous material releases.				
	Port equipment position and routing.	Speed constraints, variant road conditions, construction areas, queue conditions, congestion, weights in motion.	Downstream congestion, speed reduction warnings, signal conditions, rail crossing condition, truck trailer basic safety message.	Trip timing or routing to avoid incidents, hazardous material conditions, expected rail movements and road blockages.	Vehicle maintenance tracking, inspection tracking and reporting, driver / vehicle qualifications.
Resilience	Mitigate the impact of disruptive events, such as extreme weather or geological events.				
	Engine conditions / flooding, mass vehicular stalls, emergency vehicle movements / warnings, utility vehicle proximity.	Road, rail, tunnel, and bridge closures; route damage; route reversals / alternatives.	Freezing / icing, stream conditions, power grid conditions, signal system disruption.	Rerouting directions, evacuation warnings, loss-of-service messages, emergency transport protocols.	Impact predictions, weather paths, flood surge modeling, seismic damage mapping.
Cargo Visibility & Reliability	Improve the reliability and timeliness of cargo transport, and improve the responsiveness of service providers.				
	Peloton / convoy, multi-shipment manifest coordination, trailer size/ configuration.	Weights and weight limitations, construction areas, operational conditions that increase delays, truck parking tracking.	Vehicle characteristics, shipment location, transport unit location and condition, geofencing, net velocity, driver safety conditions, truck parking info. management system (TPIMS) availability.	Route recalculation, scheduled route interruptions, vehicle / signal synchronization, variable priority movements, TPIMS synchronization.	Congestion tracking and projection, route balancing and load sharing, dynamic proactive route optimization, TPIMS optimization.
Vehicle Efficiency & Mobility	Reduce travel time, reduce queueing and idling, maintain network fluidity, and improve transport workforce efficiency.				
	Peloton coordination, driver load splitting, driver team condition / coordination.	Signal pattern reporting, speed monitoring, geofence population tracking, dedicated lane / route indication.	Signal coordination conditions, speed enforcement, geofenced population management, dedicated lane / route utilization.	Queueing information, congestion reporting, priority path use, dynamic tolling, congestion pricing.	Dynamic modeling of transport space, movement optimization, congestion avoidance.
Gate Efficiency	Reduce queuein				or.
	Multi-unit manifest coo team-wide transport m and coordination.				sactions to e availability, y controls, est, transactions.
Terminal Yard Efficiency	Improve density				estion.
	Equipment queue mana report truck wait times, over-stows of moves in				nment vareness of s to avoid over- ontrol operations.
Port Efficiency	Improve the effi				
	Train positioning and ro vessel-lift bridge coordi				s management, ment, rail car ain scheduling e timing.

Improvement	Vehicle ↔ Device
Cargo Visibility & Reliability	Reliability, timeliness, responsiveness
	Vehicle characteristics, shipment location, transport unit location and condition, geofencing, net velocity, driver safety conditions, truck parking info. management system (TPIMS) availability.

Stakeholder Matrix



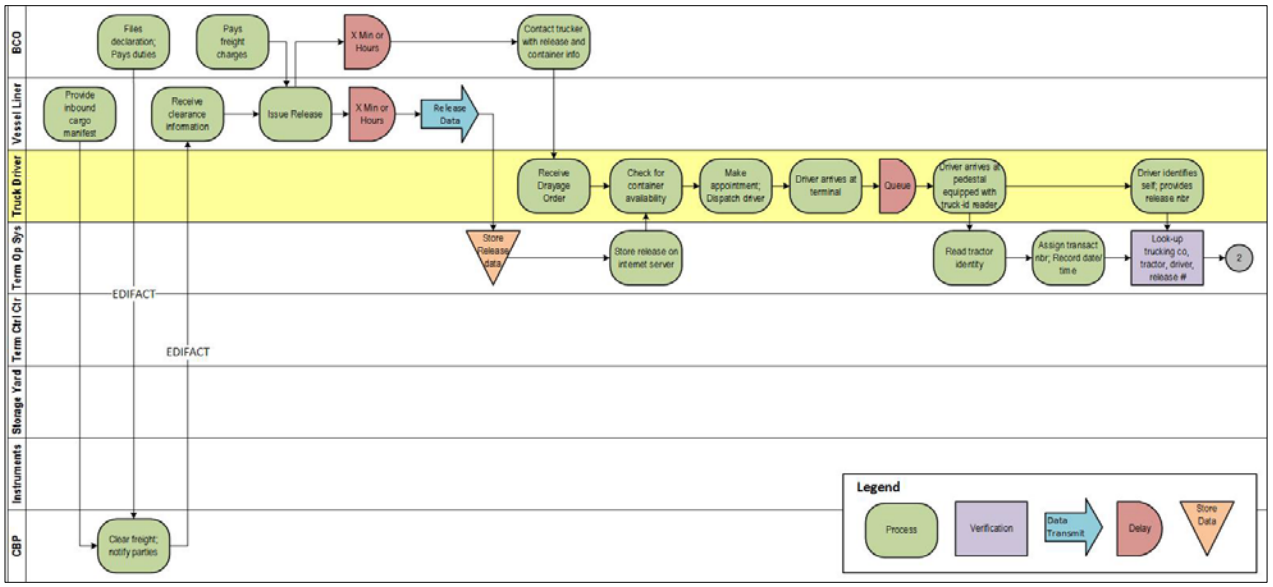
A Systems Engineering Approach

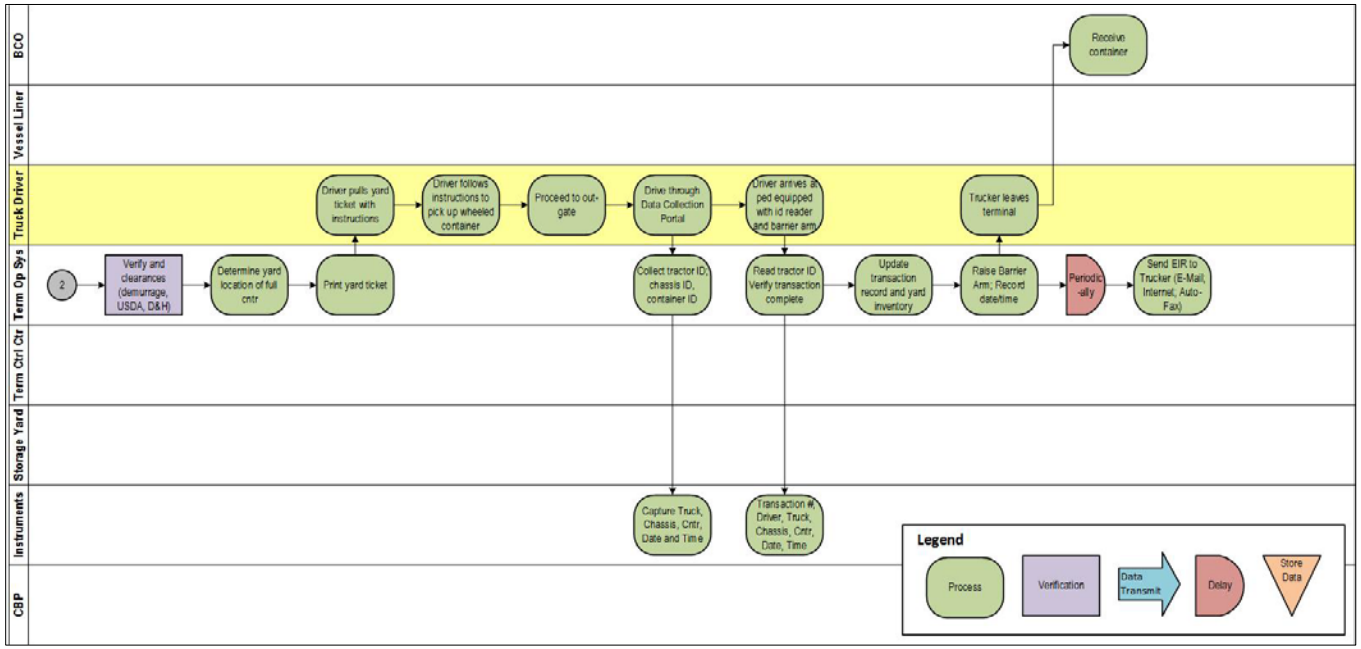


Planning

- Initiate
  - Set Goals and Objectives
  - Collect Data
  - Engage Stakeholders
- Quantify
  - Map Existing Conditions
  - Identify Needs and Drivers
- Form
  - Develop and Refine Alternatives
  - Analyze and Compare

Cross-functional flow diagrams

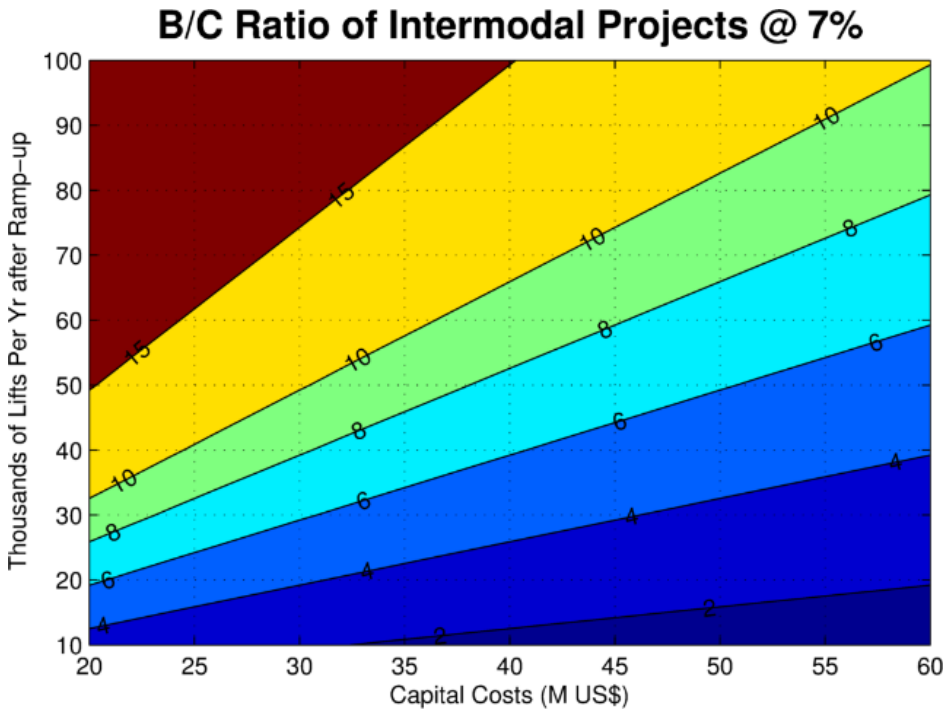




Feasibility

Assess

- Potential Performance
- Human Resource Needs
- Impacts
- Risks



Evaluate

- Criteria
- Prioritization
- Scoring & Selection

Account Element	Weight 1 - 10	Normalized/Assigned Scores Alt. 1	Alt. 2	Alt. 3	Total Score Alt. 1	Alt. 2
Operational Performance	*32.0*				*283*	*268*
Capacity at Site Buildout	8.5	10.00	8.00	8.67	85	68
Berth Productivity at Buildout	9.5	10.00	8.75	9.06	95	83
Gate Truck Cycle Time	7.0	8.33	10.00	9.09	58	70
Intermodal Service	7.0	*6.3*	*6.7*	*6.7*	44	47
Development	*22.0*				*193*	*168*
Suitability for Phased Implementation	7.0	*9.0*	*8.0*	*7.0*	63	56
Development Complexity	7.0	*8.7*	*7.7*	*7.3*	61	54
Risk of Delay	8.0	*8.7*	*7.3*	*6.0*	69	59
Financial	*26.5*				*225*	*235*
Net Present Value of Costs ($M)	9.0	8.24	9.33	10.00	74	84
Initial (5-year) Capital Outlay ($M)	9.5	10.00	8.57	7.50	95	81
Unit Operating Cost	8.0	7.00	8.75	10.00	56	70
Workforce	*15.0*				*109*	*118*
Worker Safety	8.0	*6.3*	*8.3*	*9.3*	51	67
Skilled Workforce Availability	7.0	*8.3*	*7.3*	*8.0*	58	51
Optimization of Workforce	7.5	10.00	7.50	5.00	75	56
Environmental	*30.5*				*217*	*259*
Carbon Fuel Consumption	6.5	3.33	10.00	6.67	22	65
Noise Pollution	5.0	*5.0*	*8.0*	*9.0*	25	40
Light Pollution	4.0	*5.0*	*8.0*	*9.0*	20	32
Total Energy Consumption	7.0	10.00	8.33	8.06	70	58
Land Utilization	8.0	10.00	8.00	8.67	80	64

Port ITS Considerations

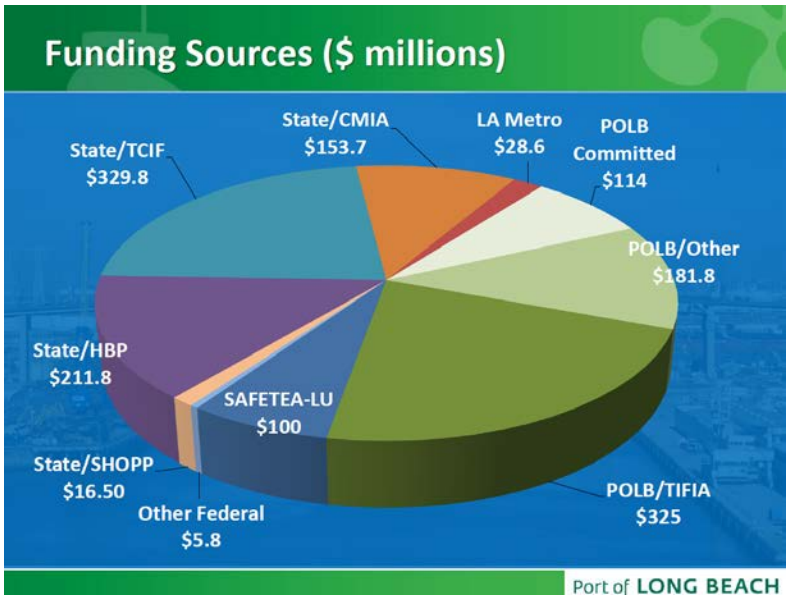
- Responsibility & Authority
  - Many stakeholders
  - "Ownership" keeps shifting
  - Many drivers, few controls
- Random Demand
  - Ports serve the fickle sea
  - The landside isn't much better
- Transactional Error
  - Freight moves neither faster nor better than its supporting data
- Labor
  - Bound by contract
  - Bound by tradition
  - Imbalances in power, control
- Freight Security
  - Avoid theft, damage, pilfering
- Transportation Security
  - Keep the Bad **Guys** out
  - Keep the Bad **Stuff** out
  - Find the Bad Stuff before it becomes **Really** Bad Stuff
- Cybernetics
  - Who ***ARE*** those Bad Guys?

Cybersecurity and Resiliency

- **Vehicle** – NHTSA
  - Harden the vehicle's electronics against potential attacks and ensure appropriate response.
- **Infrastructure** – NIST + USDOT
  - *Framework for Improving Critical Infrastructure Cybersecurity*
- **Integration** – USDOT ITS JPO et al
  - Research, develop, and educate on cybersecurity technical and policy mitigations.
  - Pursue a unified approach to vehicle, device, and infrastructure security for connected vehicles
- **Navigation** – USCG
  - Information, resources concerning maritime cybersecurity: USCG Homeport - Cybersecurity.
- **Vessels and Ports** – ABS
  - Guidance Notes on cybersecurity & resiliency matters.
  - FCI Cyber Risk™ algorithm at ABS Maritime Cyber Security.
- **Ships at Sea** – IMO
  - Recommendations on maritime cyber risk management for shipping: Guidelines on Maritime Cyber Risk Management
- **Homeland** - DHS
  - US Computer Emergency Response Team (US-CERT)
  - Industrial Control Systems Cyber Emergency Response Team (ICS-CERT)
  - US-CERT Resources, ICS-CERT Resources.
- **Maritime** - MARAD's
  - Office of Security coordinates to issue US Maritime Alerts and US Maritime Advisories

Financing

- Strategize
  - Low cost, high return on investment
  - Identify funding opportunities and alternatives
- Structure
  - Federal funding sources
  - State and local sources
  - Private funding sources



External Funding Sources

- Federal Programs
  - Discretionary Grants
  - Federal-Aid Grants
  - Federal Loans
  - Private Activity Bonds (PAB)
- State, Regional, Local
- Private

Govt. Program	Summary Description
ATCMTD	Competitive grant for deployment of deploy advanced transportation and congestion management technologies.
ITS	Funding for the development of ITS infrastructure, equipment, and systems; and ITS research initiatives, exploratory studies, and a deployment support programs.
BUILD	Competitive grant for enhancement of surface transportation infrastructure at local and regional level.
INFRA	Competitive grant or credit assistance for highway and freight projects of national or regional significance.
STBG	Formula funding for States and MPOs for priority transportation projects.
NHFP	Formula funding for States to improve movement of freight on National Highway Freight Network.
CMAQ	Formula funding for States, MPOs and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act.
TIFIA	Financing assistance for ITS and surface transportation projects, certain freight rail projects, intermodal freight transfer facilities, and certain projects inside a port terminal.
RRIF	Financing assistance for railroad equipment, facilities and infrastructure including positive train control systems.
PABs	Tax-exempt financing issued through a public conduit for privately developed infrastructure.

Deployment

- Prepare
  - Procurement Method
  - Deployment Plan
- Verify
  - Field Operational Tests
  - Key Performance Indicators
  - Demonstrations
  - Go-Live Checklist