

# The Geography of Transport Systems

FIFTH EDITION

Jean-Paul Rodrigue

# Transport Planning and Policy

## CHAPTER 9

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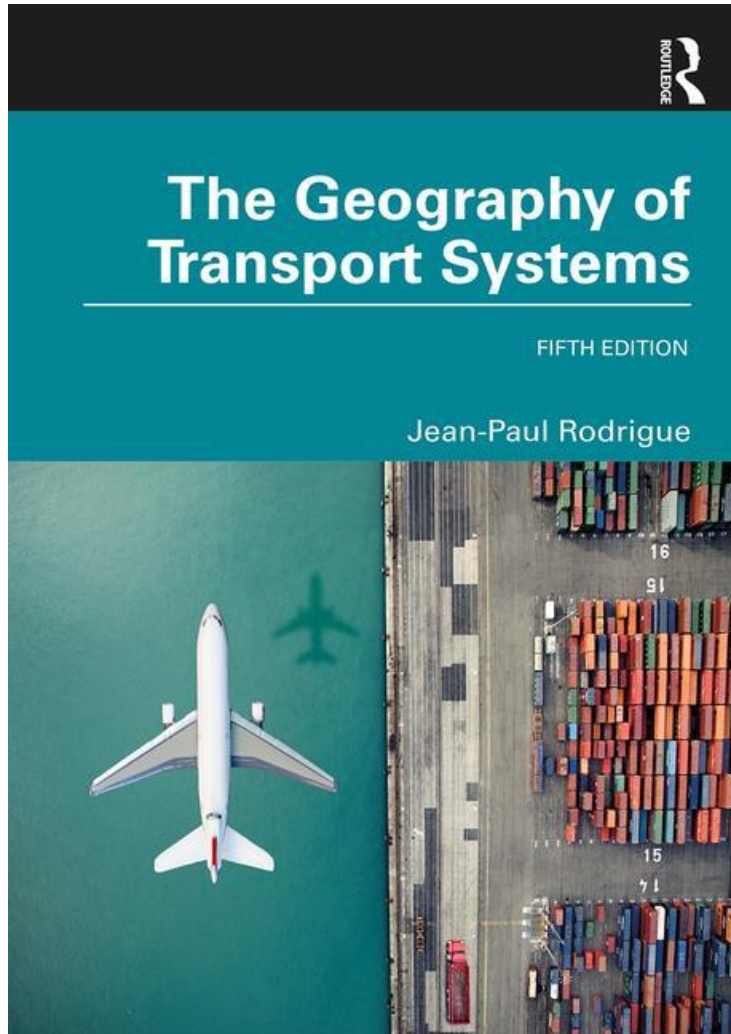
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# Table of Contents

- The Nature of Transport Policy
- Transport Planning and Governance
- Transport Safety and Security
- Transportation and Disasters



# The Nature of Transport Policy

# Main Involvement Sectors for Public Policy

Sector	Categories
Regulatory Policy	Financial regulation; Antitrust laws and regulations; Effective legal enforcement; Product liability laws; Tort law; Ease of doing business
Infrastructure Policy	Water; Transportation; Electric; PPP; Broad investment support
Labor Policy	Wages; Benefits; Labor unions; Workplace safety; Discrimination; Severance; Worker rights
Science & Technology	Intellectual property; Information security; Technology transfers; Investment & support
Economic Development	Export-import bank; Export incentives/restrictions; Strategic industries; Small & medium-sized enterprises; Special economic zones
Energy & Environmental Policy	Conventional energy; Alternative energy; Energy efficiency; Energy security; Environmental regulation and compliance
Tax Policy	Corporate taxes; Individual taxes; Dividend and capital gains taxes; Tax incentives; Value-added taxes; Offshore taxes
Trade Policy	Trade agreements; Tariffs, taxes, quotas & duties, Single window trade system
Education, Talent & Innovation	Investment/support for science; Visas and immigration; Labor retention; Training; Certification
Healthcare	Access to healthcare

# Transport Regulations

## Economic Regulations



- Investments in transportation infrastructure (modal and intermodal).
- Control of routes, ports of entry, pricing, scheduling.
- Level of ownership and competition.

## Safety Regulations



- Safety and operation regulations (speed and design).
- Labor regulations (work hours).
- Security (passengers and cargo).

## Environmental Regulations



- Transportation of hazardous materials (HAZMAT).
- Pollutant emissions.

# Some Legislations in the Deregulation of Transport in the United States and Canada

Year	Country	Legislation
1967	Canada	National Transportation Act
1977	USA	Air Cargo Deregulation Act
1978	USA	Aviation Deregulation Act
1980	USA	Staggers Act; Motor Carrier Act
1982	USA	Bus Regulatory Reform Act
1984	USA	Ocean Shipping Act
1987	Canada	National Transportation Act; Shipping Conference Exemption Act; Motor Vehicle Transport Act
1991	USA	Intermodal Surface Transportation Efficiency Act
1995	USA	Interstate Commerce Commission Termination Act
1996	Canada	Canada Transportation Act
1998	USA	Ocean Shipping Reform Act
1998	Canada	Canada Marine Act
2001	Canada	Canada Shipping Act

# Main Transport Policy Instruments

## Public Ownership



- Full or partial (PPP) ownership of transportation modes (e.g. public transit) or assets (e.g. roads and bridges).

## Subsidies & Taxation



- Funding for transport infrastructure and modes.
- Taxation on fuel and transactions.

## Regulatory Control



- Technical standards for transport modes and assets.
- Entry and competing conditions.

## Research & Development



- Funding research improving the technical, economic and environmental performance of transportation.

## Labor Regulations



- Standards such as certification, working conditions and compensation and benefits in the transport sector.

## Safety & Standards



- Operational standards for transport modes and assets such as speed and weight limits.



# Regulations over Freight Transport Operations

## Vehicles

- Registration
- Weight and size restrictions
- Emission standards

## Facilities

- Zoning and permissible locations
- Technical standards

## Goods

- Perishable goods (sanitary standards)
- Dangerous goods (safety standards)

## Labor

- Certification
- Working conditions
- Compensation and benefits

## Finance

- Insurance requirements and liability
- Financing sources and conditions

# Rationale of Transport Privatization

## Favoring Privatization

- Improve efficiency and performance of transport assets.
- New and additional financial resources for development and maintenance.
- Strengthen entrepreneurial and managerial capacity.
- Relieve public financial and administrative burden.
- Eliminate or minimize bureaucratic and political influence over transport management and operation.
- Reduce the power of public sector unions.







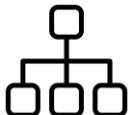
## Impairing Privatization

- Loss of public service or social functions of transport.
- Potential higher tolls or fares.
- Public monopoly turned into a private monopoly.
- Poorer coordination of investments and operations.
- Discriminatory treatment of transport users.
- Requirement of expensive improvement of transport assets prior to privatization.
- Loss of public land.

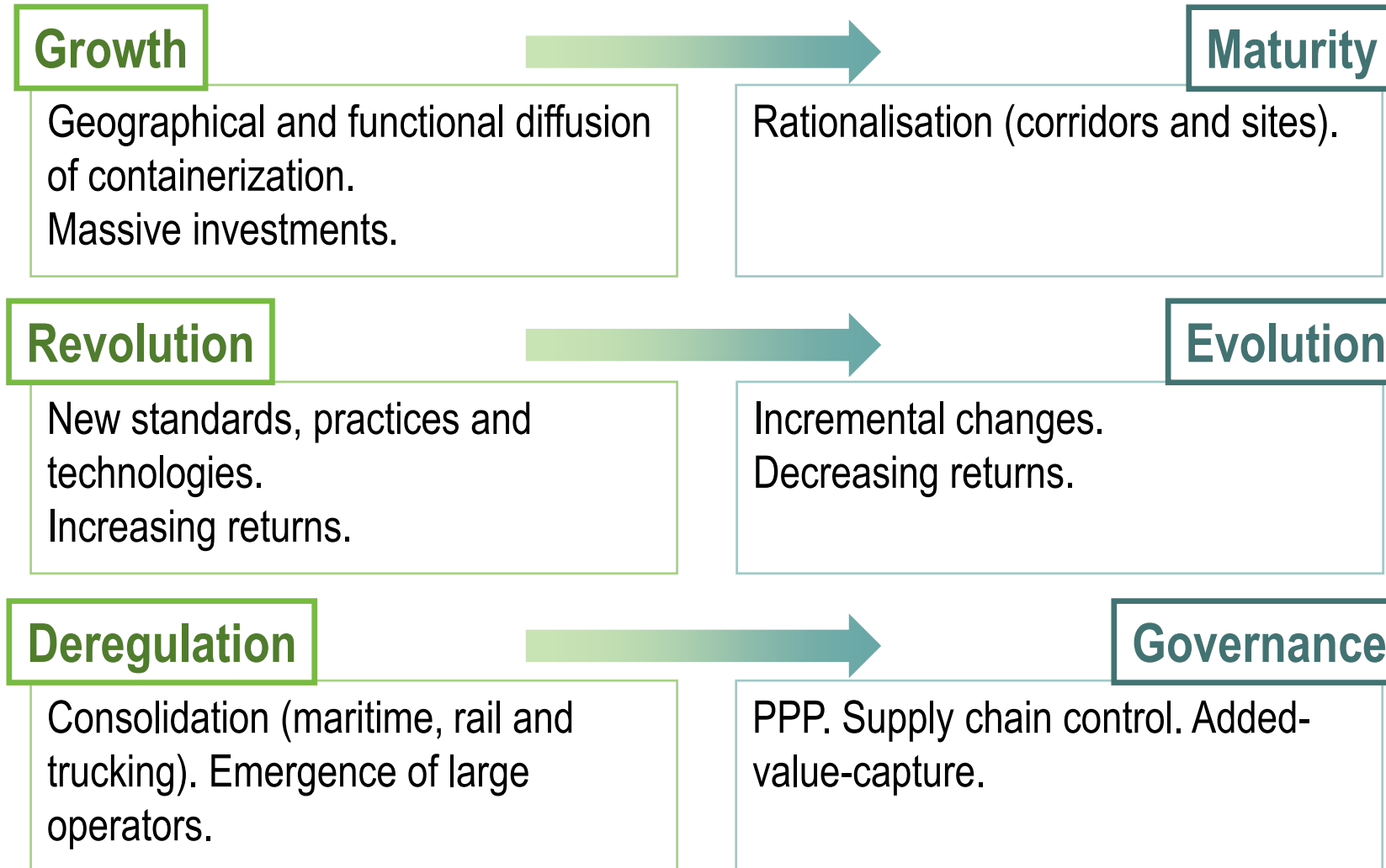
# The Jones Act and International Maritime Markets

Issue	Jones Act Market	International Market
Vessel ownership	US nationality	Any (large shipping companies)
Vessel registration	USA	Any (flags of convenience)
Shipyard	US located	Any (mainly Asia)
Vessel crew	US citizens	Any (developing countries)
Vessel type	Mostly coastal and river	Mostly deepsea
Vessel trading privilege	Cabotage within USA	International shipments
Legal jurisdiction	US federal courts	Country of registry
Taxation	US corporate taxation system	Mostly offshore
Barriers to entry	Very high	Low
Competition	Statutory protection against foreign players	Intensive / Oligopolistic

# Shift in Public Transport Policy Perspective

		<b>Conventional</b>	<b>Emerging</b>
<b>Modes</b>		Independent Modes	Intermodal Systems
<b>Scale</b>		Local Economies	Regional / Global Economies
<b>Jurisdiction</b>		Independent Jurisdictions ("turf wars")	Coalitions / Consensus
<b>Provision</b>		Build (infrastructure provision)	Manage (optimization of existing resources)
<b>Funding</b>		Publicly Funded	Public / Private partnerships
<b>Revenue</b>		Users (public subsidy)	Customers (revenue generation)
<b>Framework</b>		Plan (regulations; compliance)	Market (deregulations; price signals)

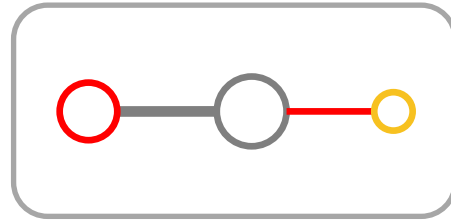
# Shifts in the Intermodal Transport Industry



# Common Problems Linked with Government Intervention

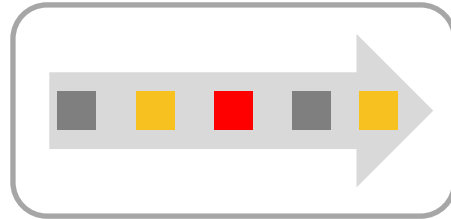
<b>Bureaucracy</b>	Regulatory reflex. Heavy administrative burden. Slow to respond, adapt and change.
<b>Irresponsibility</b>	Limited accountability for wrong policies. The blaming game.
<b>Misallocations</b>	Accumulation (diversion) of scarce capital in non-productive assets. “Pork barrel” politics. Parasitical stance on the productive economy.
<b>Corruption</b>	Using public power to regulate, coerce and confiscate. Privileging politically connected firms. Regulating competition out to protect special interests.
<b>“Magic wand” syndrome</b>	Belief that any problem can be fixed by an appropriate government policy and intervention.

# Logistics Policy Bottlenecks



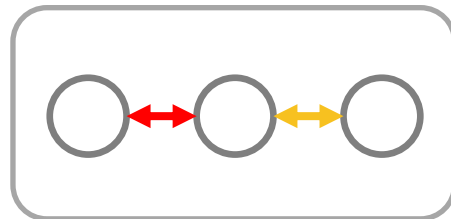
## Capacity Bottlenecks

Lack of terminal or connector capacity.  
Lack or absence of intermodal options.



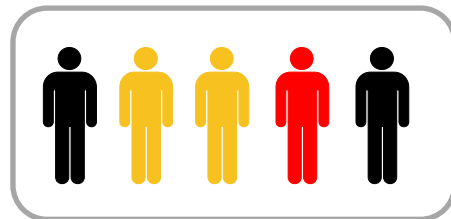
## Operational Bottlenecks

Lack of logistical services.  
Lack of logistical performance (cost, time and reliability).



## Institutional Bottlenecks

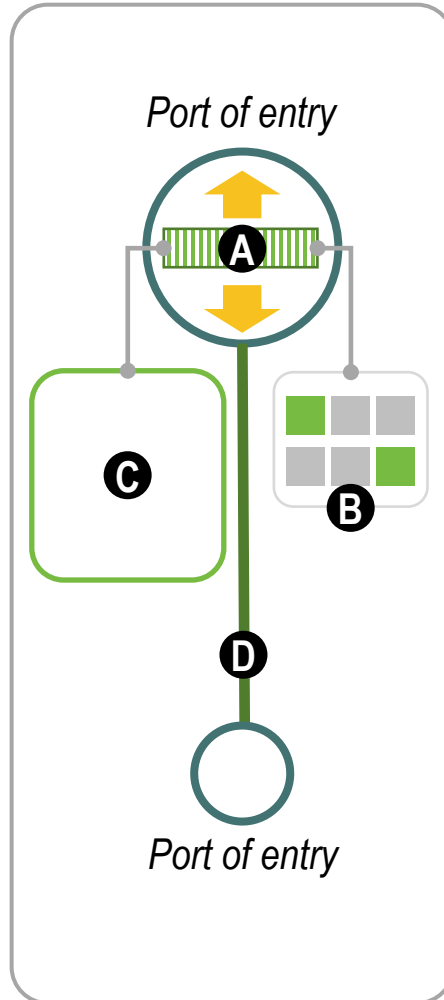
Lack of clear mandate and jurisdiction.  
Lack of coordination and cooperation.



## Skills Bottlenecks

Lack of managerial capabilities.  
Lack of qualified labor.  
Lack of training programs.

# Coordination and Implementation of National Logistics Policies: Improving Trade Facilitation



## **A** Customs and cross-border management

- Faster customs clearance and improved time performance of supply chains.
- Improving supply chain security, such as with the use of scanning technologies.
- Cross-border agreements to develop cross-border logistics (land border).

## **B** Trusted trader program

- Reduction in the number of inspections for imported cargo and faster clearance.
- Exemptions from random non-intrusive inspections.
- Improved level of service for customs.

## **C** Free zones (Foreign trade zones)

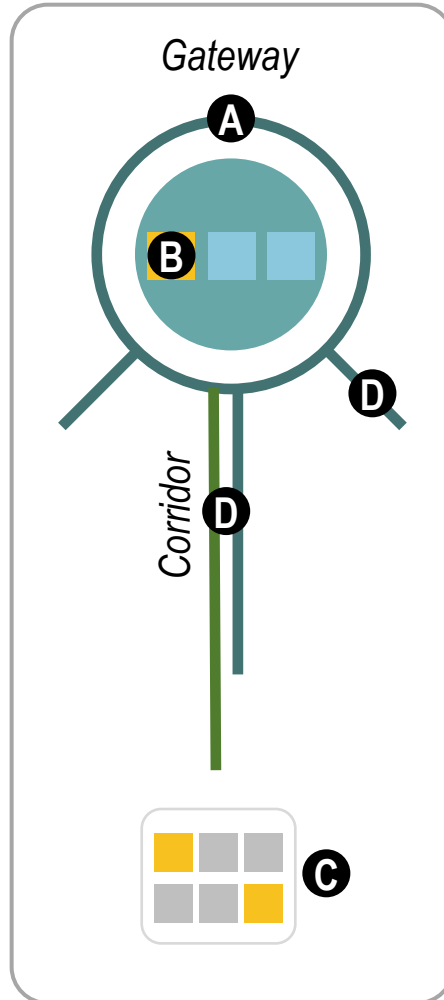
- Promotion of exports.
- Flexibility in the use of national customs regulations.
- Attract internationally focused logistics activities.

## **D** Customs corridors

- Better integration between major gateways such as ports and airports.
- Additional flexibility in supply chain management.



# Coordination and Implementation of National Logistics Policies: Improving the Global Interface of Logistics



## **A** National gateways

- Improve the capacity and throughput of ports or airports (new or existing facilities).
- Identify and coordinate transport infrastructure investment in gateway area.
- Facilitate modal shift and effective inland freight distribution.

## **B** Concessioning

- Improve the productivity of terminal operations.
- Better connectivity to global maritime shipping.
- Use and coordinate regional transportation more effectively.

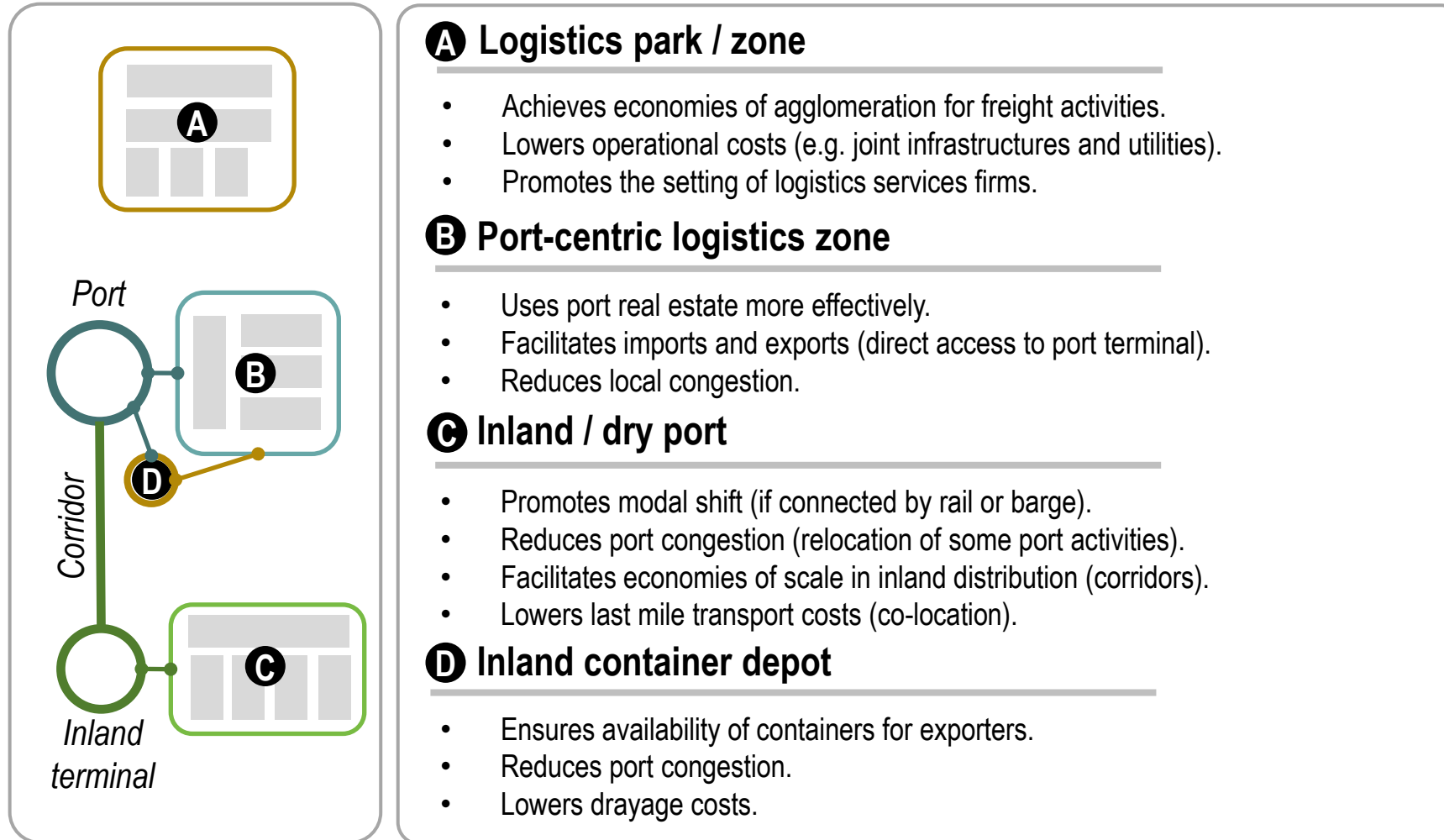
## **C** Privatization

- Improve the efficiency of the privatized firms.
- Enables the entry of new providers.
- Increase competitiveness.

## **D** Corridors and connectors development

- Improve key capacity bottlenecks.
- Coordinate the operations and investments of various stakeholders.
- Improve hinterland transport capacity, efficiency, and reliability.
- Facilitate better asset utilization and modal shift.

# Coordination and Implementation of National Logistics Policies: Providing a Land Base for Logistics Infrastructure and Activities



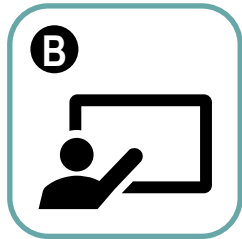
# Coordination and Implementation of National Logistics Policies: Developing Logistics Capabilities



## **A** Labor training and certification

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- Provide a labor pool to address expected demand.
- Increases labor productivity.
- Develops diversified skills.
- Attracts logistics firms.



## **B** Research centres

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- Identify trends, gaps and opportunities.
- Provide innovations suitable for the national market.
- Train researchers, consultants and managers.
- Collaborate with logistics firms.

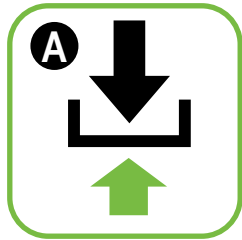


## **C** Logistics firms incubator

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- Develop entrepreneurial capabilities, particularly for new firms.
- Improve the provision of specialized logistics services, such as 3PLs and 4PLs.
- Improve the competitiveness of the logistics market.

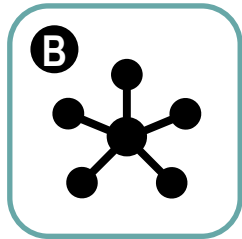
# Coordination and Implementation of National Logistics Policies: Digitalization



## **A** Freight portal

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- Improves the interactions between the providers and consumers of logistics services.
- Promotes a better usage of transport assets and facilities.
- Enables the participation of small and medium-sized firms.



## **B** Port community system

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- Promotes competitiveness in port-related services.
- Promotes coordination between freight actors to improve port area efficiency.
- Improves the tracking of freight and transport assets.

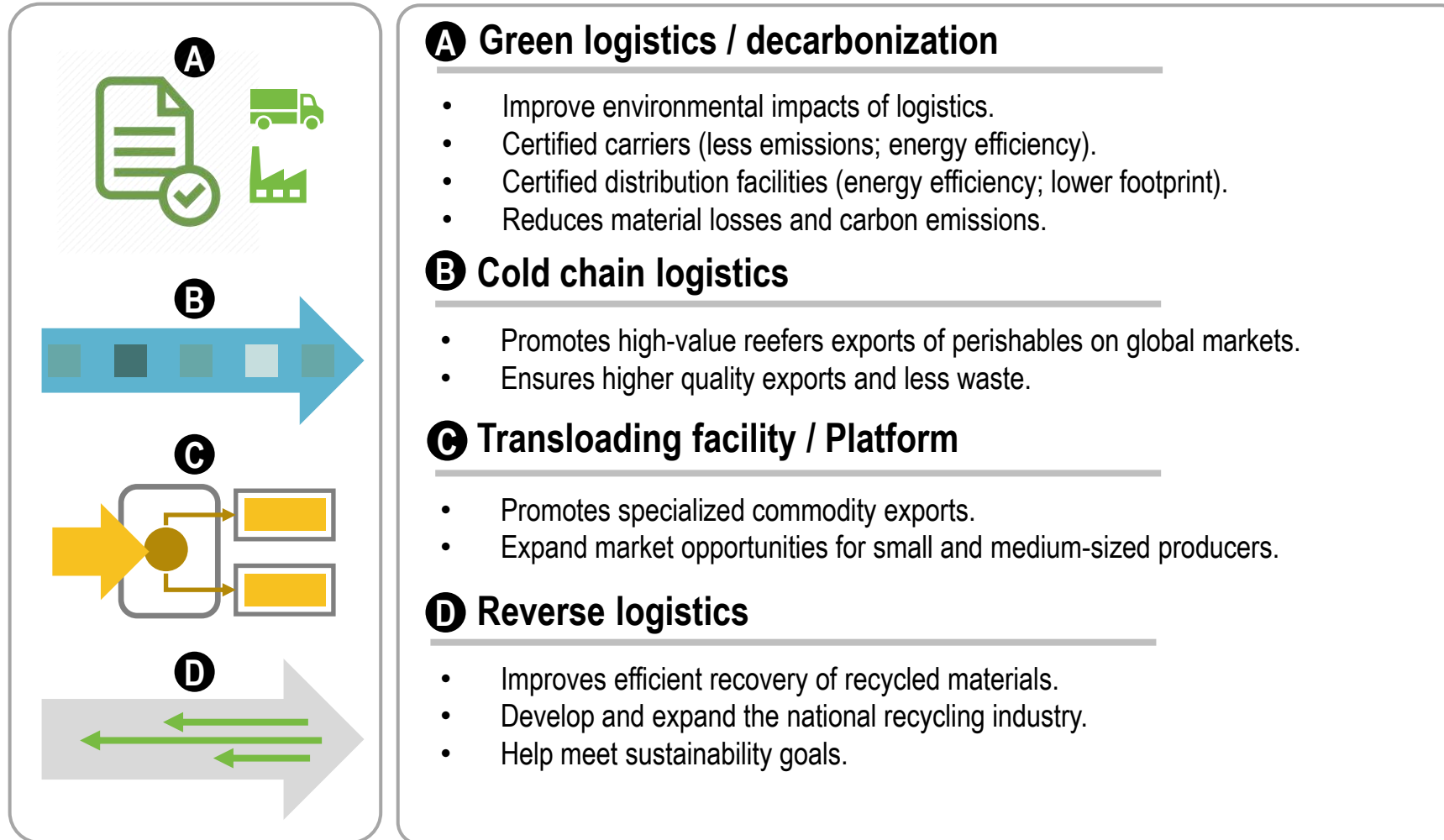


## **C** Logistics observatory

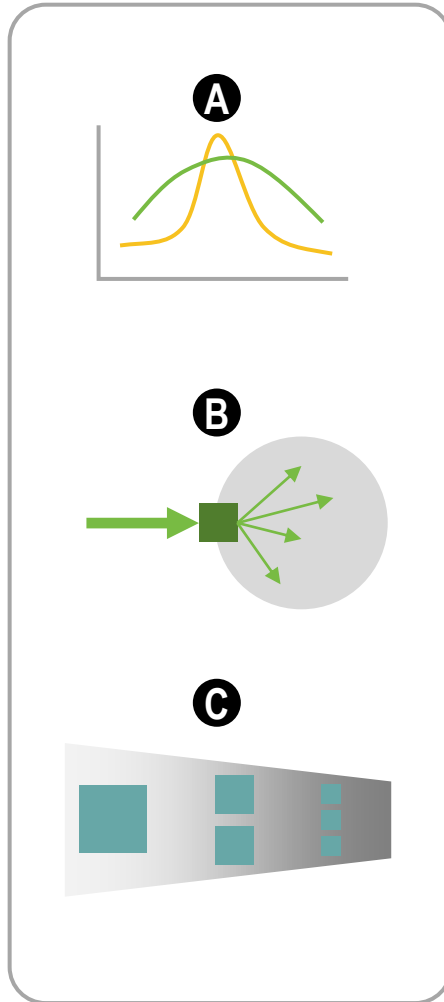
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- Collects information about logistics activities.
- Reports key performance indicators benchmarking the industry.
- Assesses the effectiveness of logistics policies.

# Coordination and Implementation of National Logistics Policies: Developing Niche Logistics



# Coordination and Implementation of National Logistics Policies: Improving Last Mile Logistics



## **A** Rationalization of deliveries

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- Improves use of existing transport assets.
- Matches trip sequences (deliveries and pickups).
- Reduces congestion.

## **B** Urban freight facilities

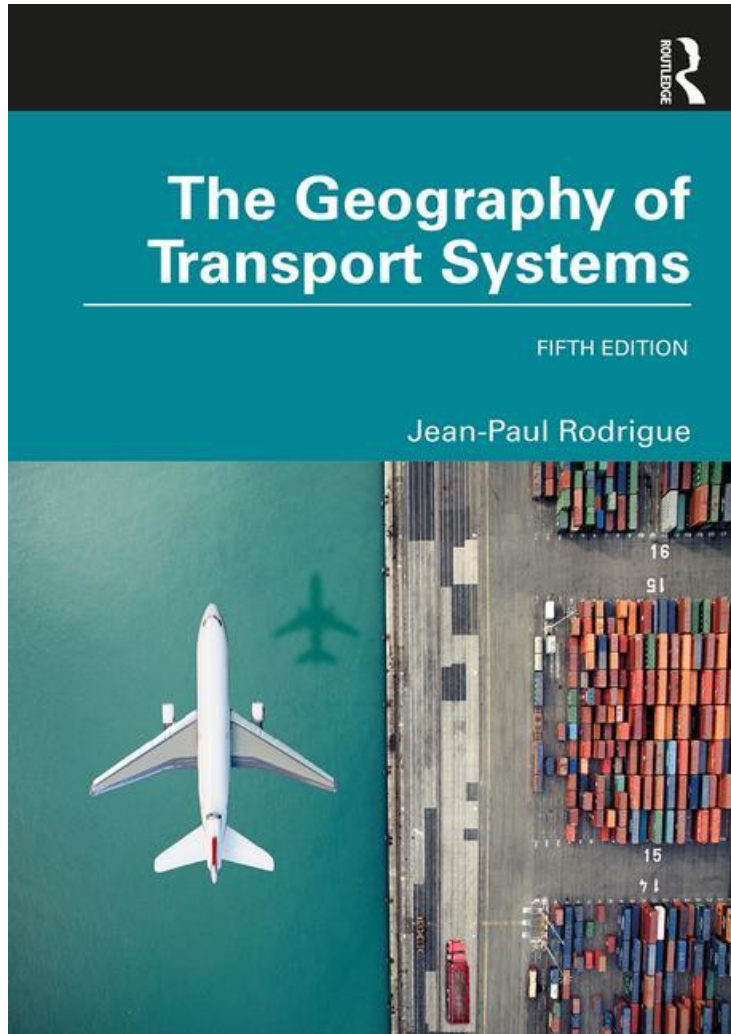
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- Promotes consolidation, sorting and deconsolidation in high density urban areas.
- Improves efficiency (time and energy) of urban deliveries.
- Supports the development of ecommerce.

## **C** Modal adaptation

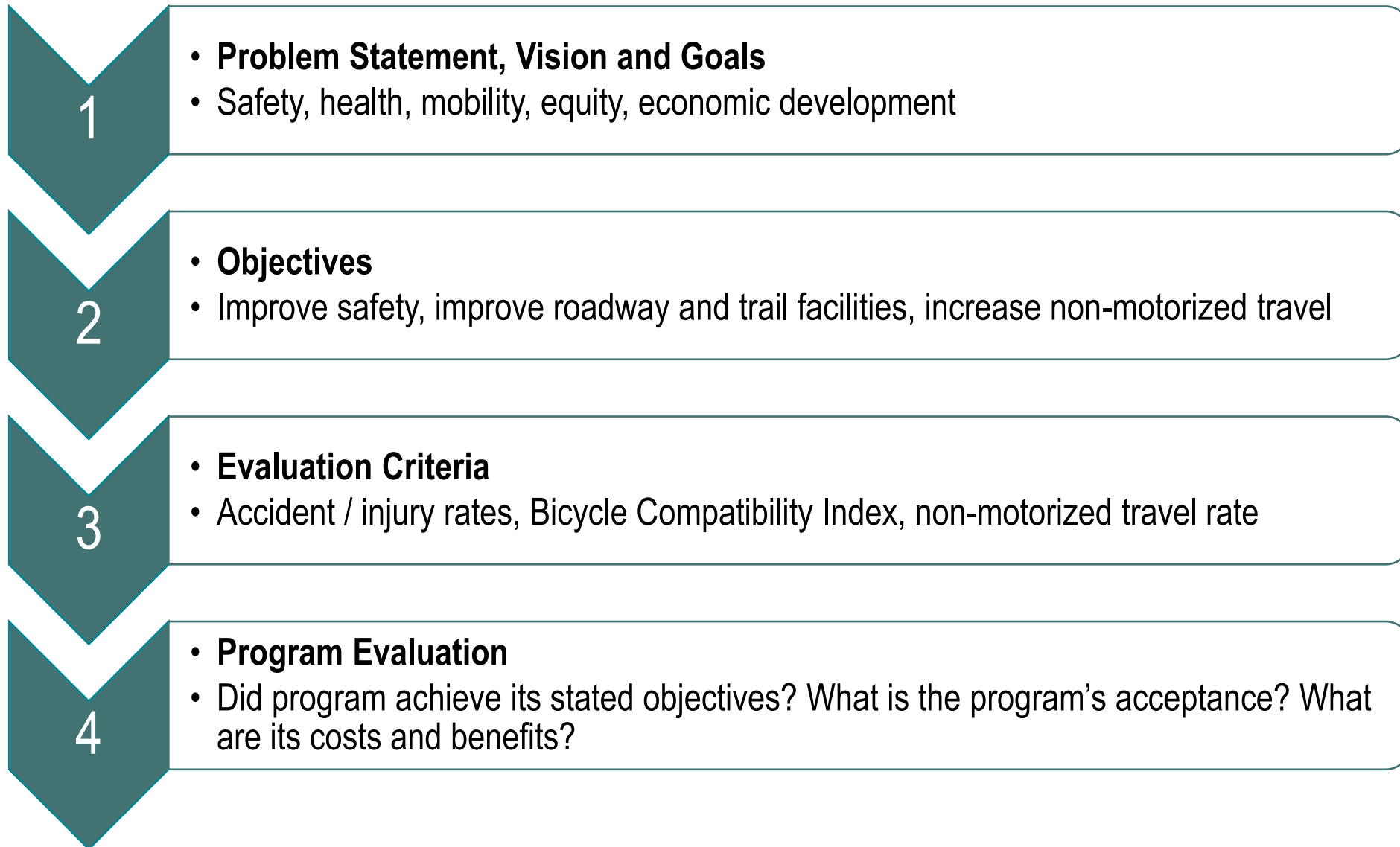
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- Reduces congestion and energy consumption.
- Reduces disruptions on local communities.

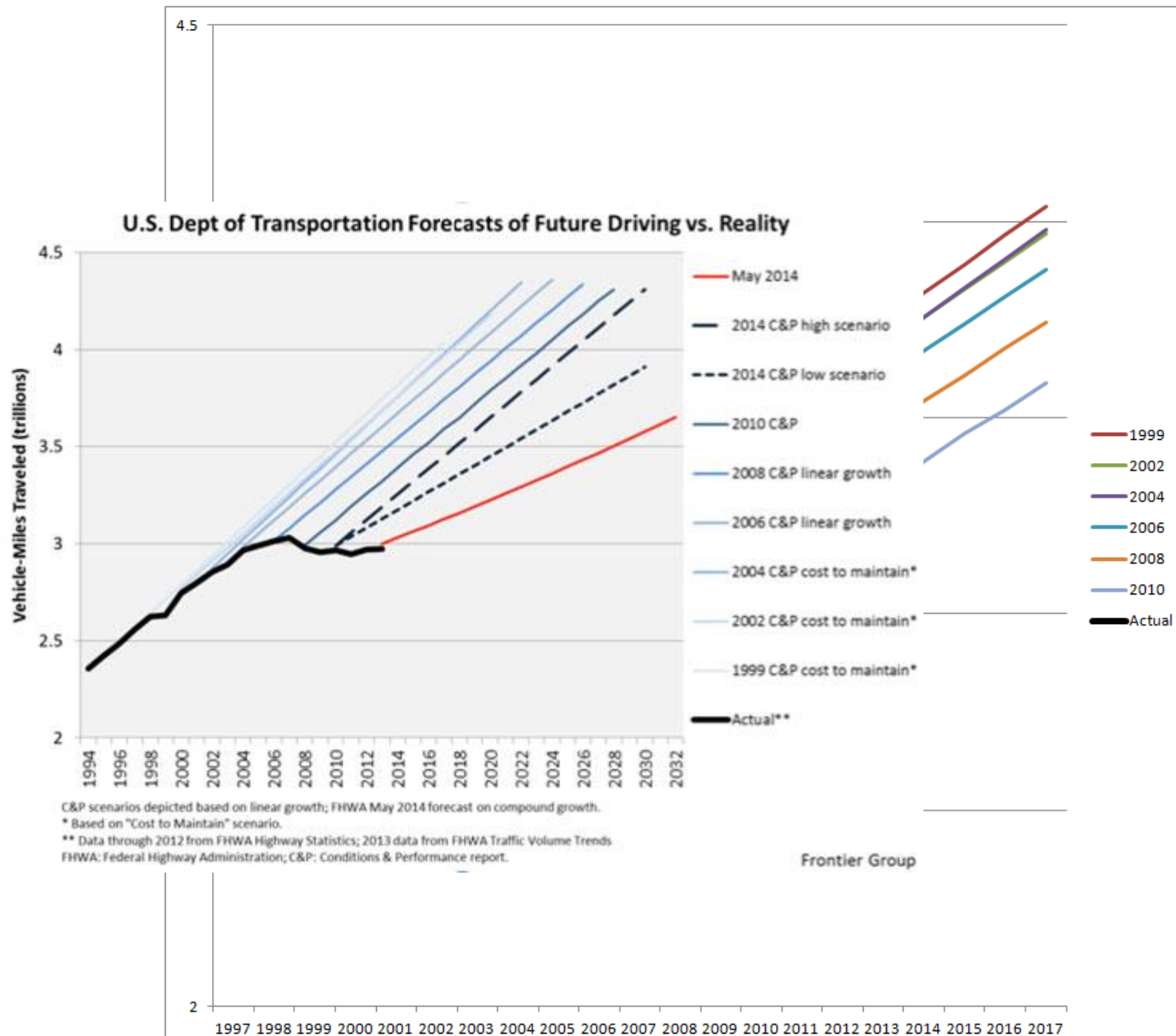


# Transport Planning and Governance

# Generic Planning Process



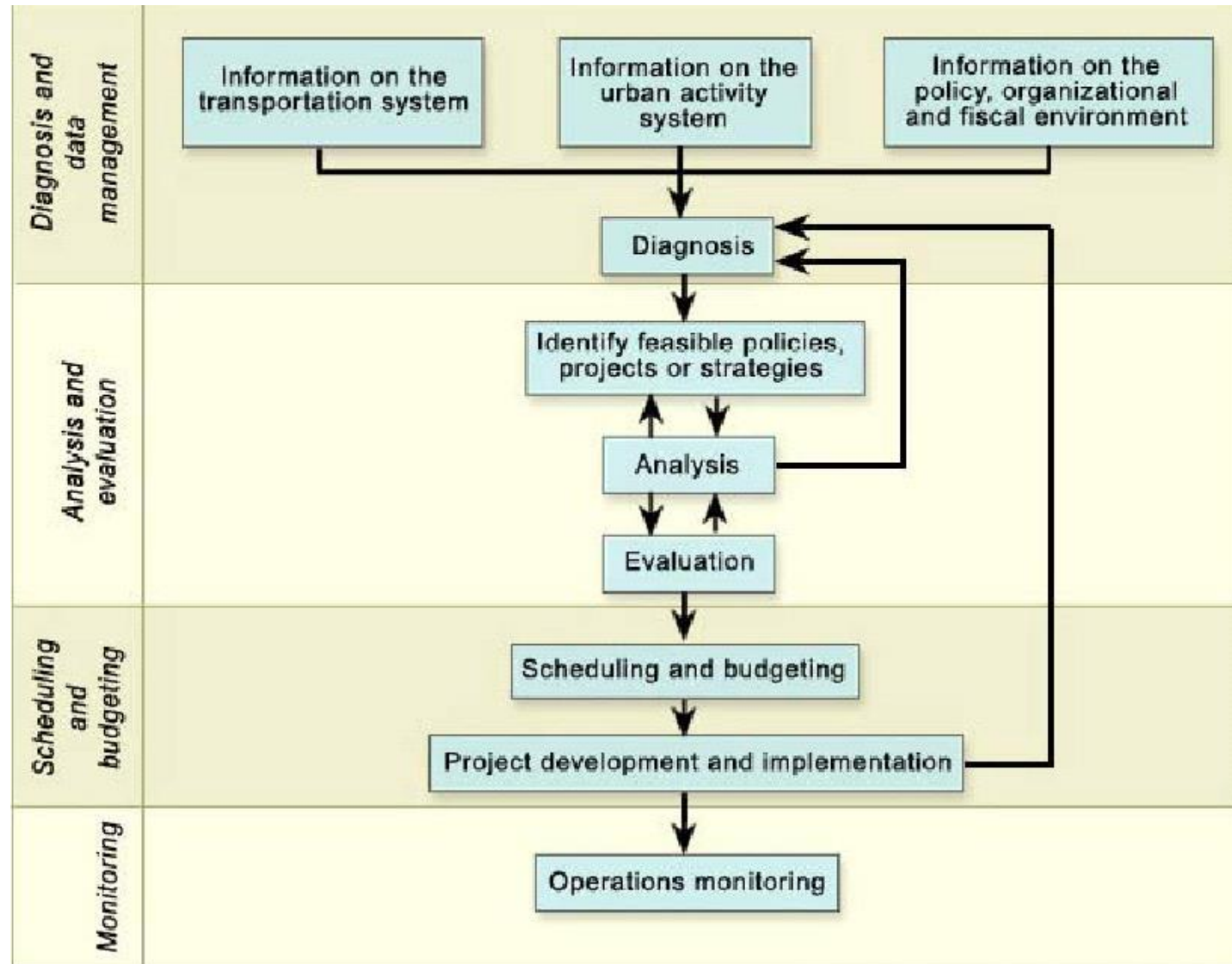




# Market Distortions Impacting the Automobile




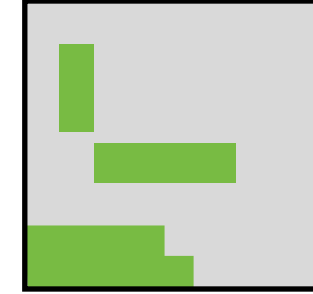
Nature	Description	Potential Reform
Consumer Options and Information	Markets often offer limited alternatives to automobile transportation and automobile-oriented location.	Recognize the value of alternative modes and more accessible development in planning decisions.
Underpricing	Many motor vehicle costs are fixed or external.	As much as feasible, convert fixed costs to variable charges and charge motorists directly for the costs they impose.
Transport Planning Practices	Transportation planning and investment practices favor automobile oriented improvements, even when other solutions are more cost effective.	Apply least-cost planning so alternative modes and management strategies are funded if they are the most cost effective way to improve transport.
Land Use Policies	Current land use planning policies encourage lower-density, automobile-oriented development.	Apply smart growth policy reforms that support more multi-modal, accessible land use development.

# Transport Planning (under construction)



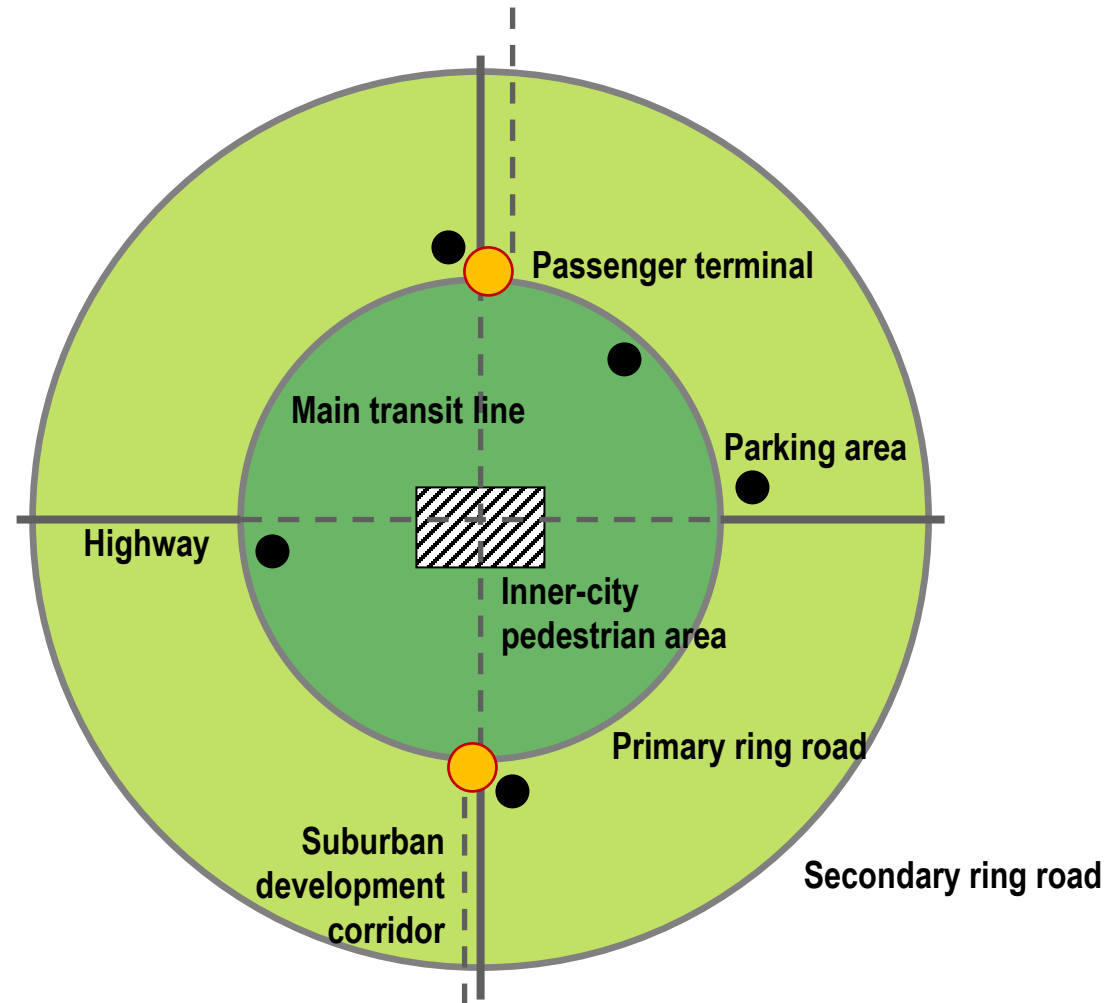
*From textbook by Meyer and Miller*

# Types of Land Use Zoning

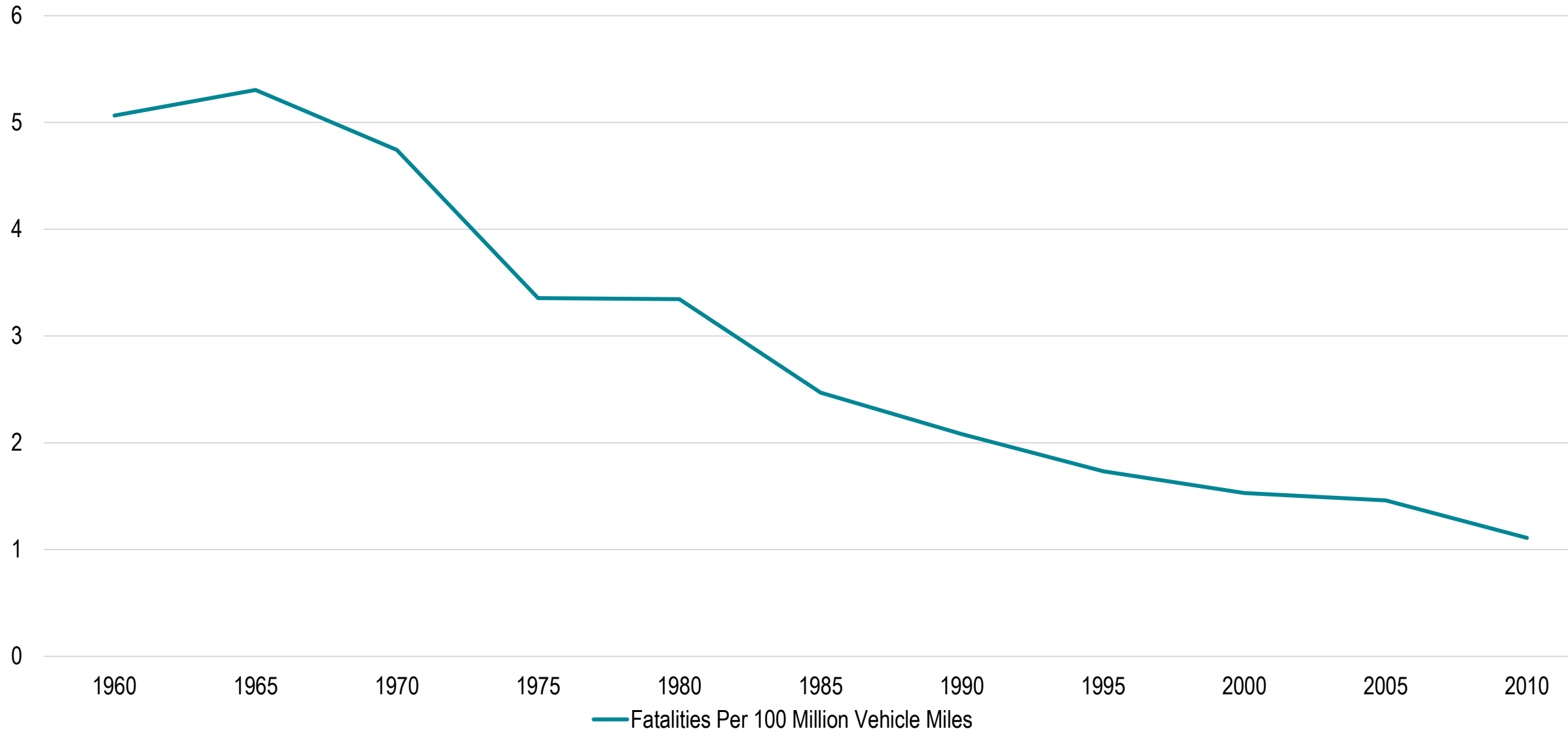
Functional Zoning	Form-Based Zoning	Intensity Zoning	Incentive Zoning
			
<ul style="list-style-type: none"><li>▪ A zone for each type of land use.</li><li>▪ Land use zones subject to different regulations.</li></ul>	<ul style="list-style-type: none"><li>▪ Focuses on physical characteristics.</li><li>▪ Defined as a form of urban identity.</li></ul>	<ul style="list-style-type: none"><li>▪ Sets land use intensity restrictions.</li><li>▪ Flexibility in forms and functions of land use developments.</li></ul>	<ul style="list-style-type: none"><li>▪ Rewards for development in defined areas.</li><li>▪ Incite the provision of amenities.</li></ul>
<hr/> <ul style="list-style-type: none"><li>■ Commercial</li><li>■ Administrative</li><li>■ Residential</li><li>■ Industrial</li><li>■ Green space</li></ul>	<hr/> <ul style="list-style-type: none"><li>■ Downtown</li><li>■ Uptown</li><li>■ East Side</li><li>■ Historical district</li><li>■ Manufacturing district</li></ul>	<hr/> <ul style="list-style-type: none"><li>■ High density</li><li>■ Average density</li><li>■ Low density</li><li>■ No development</li></ul>	<hr/> <ul style="list-style-type: none"><li>■ Incentives</li><li>■ No incentives</li></ul>

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# Integration of Urban Transportation Modes



# U.S. Traffic Fatalities, 1960-2010

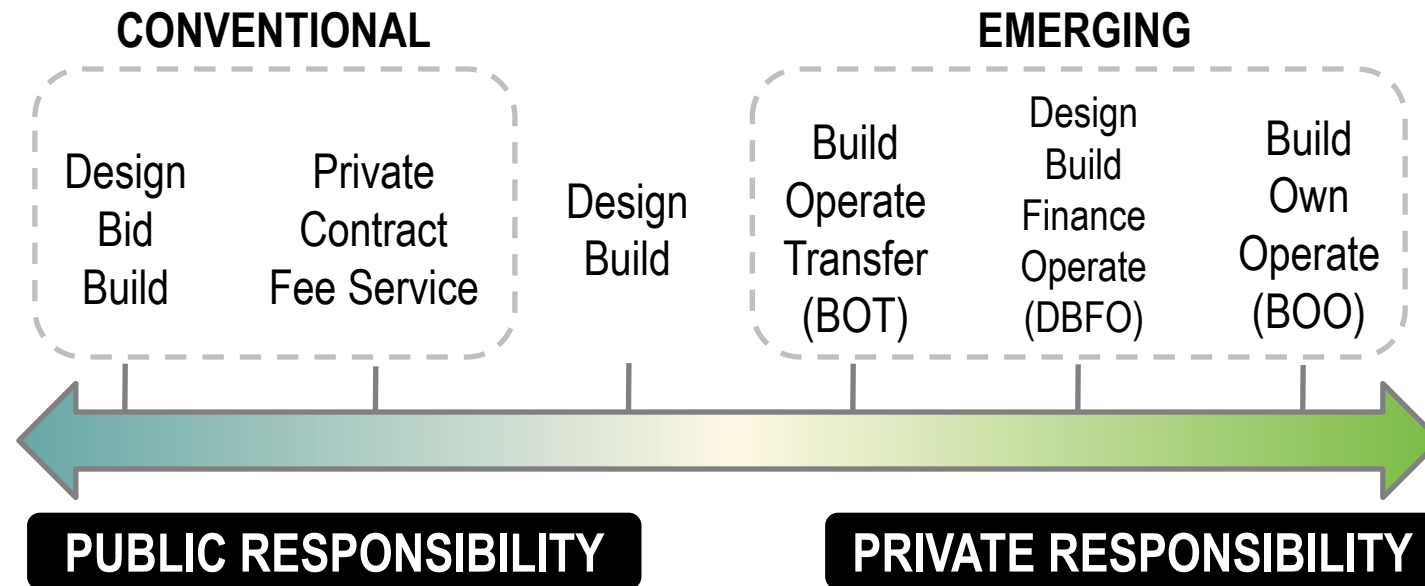


# Regulation of Freight Transportation in the United States

## Who Regulates Freight Transportation Services

MODE	Domestic – U.S.	International
<b>Air Service</b>	<ul style="list-style-type: none"> <li>• Federal Aviation Administration</li> <li>• Environmental Protection Agency</li> </ul>	<ul style="list-style-type: none"> <li>• Federal Aviation Administration</li> <li>• International Air Transport Assoc.</li> <li>• International Civil Aviation Org.</li> <li>• U.S. Customs Service</li> <li>• U.S. Immigration and Naturalization Service (for imports)</li> </ul>
<b>Truck Service</b>	<ul style="list-style-type: none"> <li>• Federal Highway Administration</li> <li>• Environmental Protection Agency</li> <li>• Occupational Safety and Health Administration</li> <li>• Surface Transportation Board</li> <li>• State and Local Safety and Tax Officials</li> </ul>	<ul style="list-style-type: none"> <li>• U.S. Customs Service</li> <li>• U.S. Immigration and Naturalization Service (for imports)</li> <li>• Requirements of foreign country where truck is being operated</li> </ul>
<b>Rail Service</b>	<ul style="list-style-type: none"> <li>• Federal Railroad Administration</li> <li>• Surface Transportation Board</li> <li>• Environmental Protection Agency</li> </ul>	<ul style="list-style-type: none"> <li>• U.S. Customs Service</li> <li>• U.S. Immigration and Naturalization Service (for imports)</li> <li>• Requirements of foreign country where train is being operated</li> </ul>
<b>Barge</b>	<ul style="list-style-type: none"> <li>• U.S. Coast Guard</li> <li>• Environmental Protection Agency</li> <li>• Surface Transportation Board</li> </ul>	<ul style="list-style-type: none"> <li>• U.S. Customs Service</li> <li>• U.S. Immigration and Naturalization Service (for imports)</li> <li>• U.S. Coast Guard</li> <li>• Federal Maritime Commission</li> <li>• Requirements of foreign country where barge service is performed</li> </ul>
<b>Maritime</b>	<ul style="list-style-type: none"> <li>• U.S. Coast Guard</li> <li>• Federal Maritime Commission</li> <li>• Environmental Protection Agency</li> </ul>	<ul style="list-style-type: none"> <li>• U.S. Coast Guard (within U.S. territorial limits)</li> <li>• Federal Maritime Commission</li> <li>• U.S. Customs Service</li> <li>• U.S. Immigration and Naturalization Service (for imports)</li> <li>• Internal Maritime Organization</li> <li>• Requirements of foreign country where maritime service is performed</li> </ul>
<b>Pipeline</b>	<ul style="list-style-type: none"> <li>• Federal Energy Regulatory Commission</li> <li>• Office of Pipeline Safety of USDOT</li> </ul>	N/A

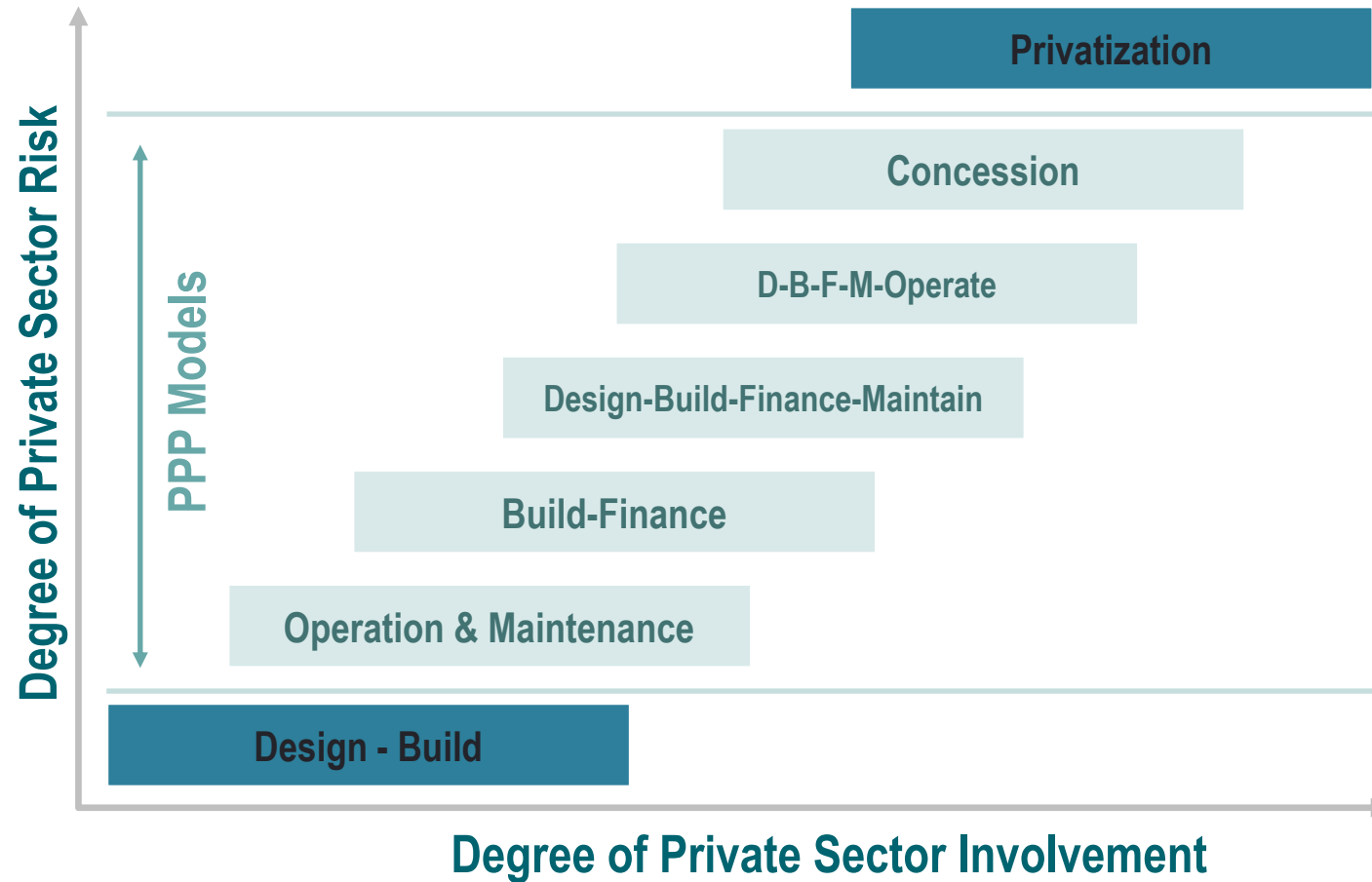
# Public / Private Partnership Options





- **Service Contracts:** Contracting services or outsourcing refers to delegation of non-core operations from public sector to a private entity that specializes in operation, maintenance or management of that activity.
- **Management Contracts:** Airport owners can contract out management and operation of parking facilities, terminal concessions, terminal operations, reliever airports or their entire airport system to private operators. Management contracts for parking operations are particularly prevalent.
- **Developer Financing and Operation:** There is a wide variety of developer financing and operation employed, including passenger terminals, parking garages, rental car facilities, fuel systems, cargo facilities, general aviation facilities, and other major facilities. Private sector can provide full-scale development, operation, and maintenance services and sometimes financing under long-term leases or concessions.
- **Long-term lease (or concession agreement):** airport owner grants full management and development control to private operator in return for operator undertaking capital improvements and other obligations (e.g., up-front payment, responsibility for outstanding debt, capital improvements).
- **Sale:** Airport is transferred on a freehold basis with requirement that it continue to be used for airport purposes.

# Risk Transfer and Private Sector Involvement in Public-Private Partnerships



Government owned/operated (US, Spain, Singapore, Finland, Sweden)

Government owned, privately operated<sup>4</sup> (US (via contracts), Chile, Hamilton {Canada?})

Major airports which have public-private partnerships in the form of BOO, BOT and management contract variants, such as in India

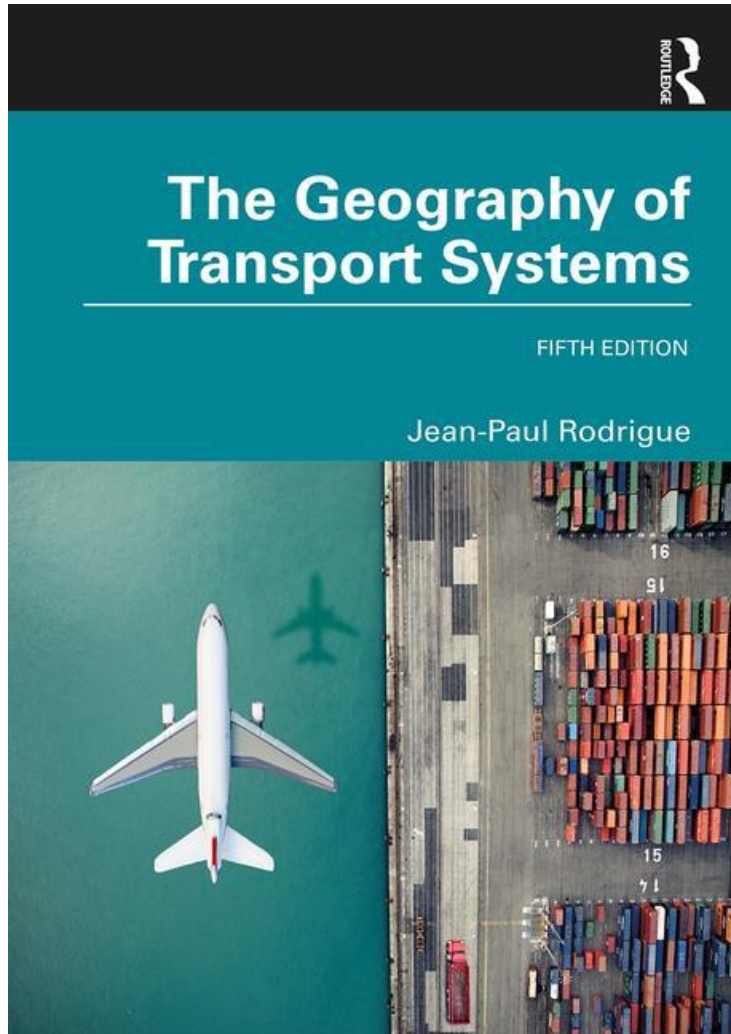
Independent not-for-profit corporations (Canada)

Fully private for-profit via IPO (Initial Public Offering) with stock widely held (originally BAA)

Fully private for-profit via trade sale with share ownership tightly held (Australia, New Zealand).

Partially private for-profit with private controlling interest (Denmark, Austria, Switzerland)

Partially private for-profit with government controlling interest (Hamburg Germany, France, China, Kansai Japan)

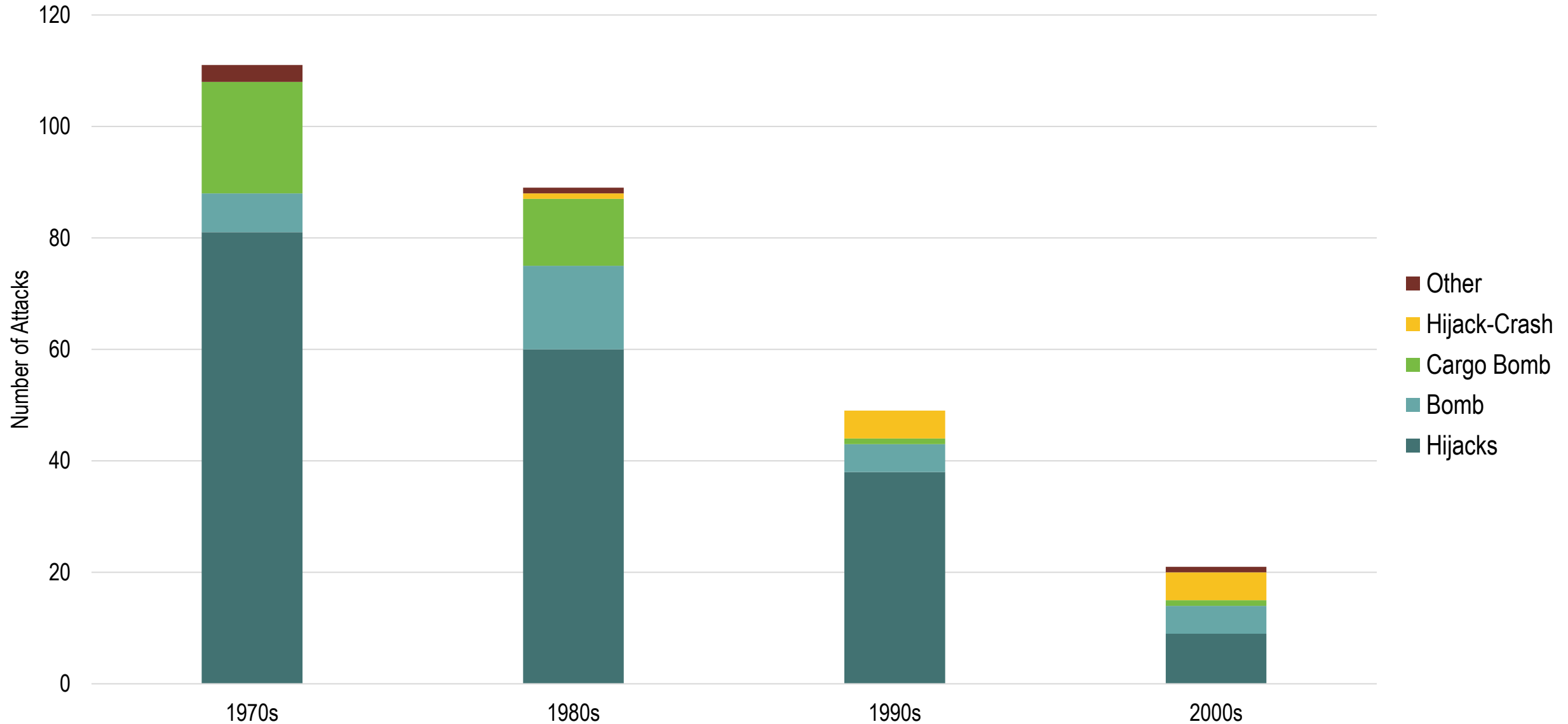


# Transport Safety and Security

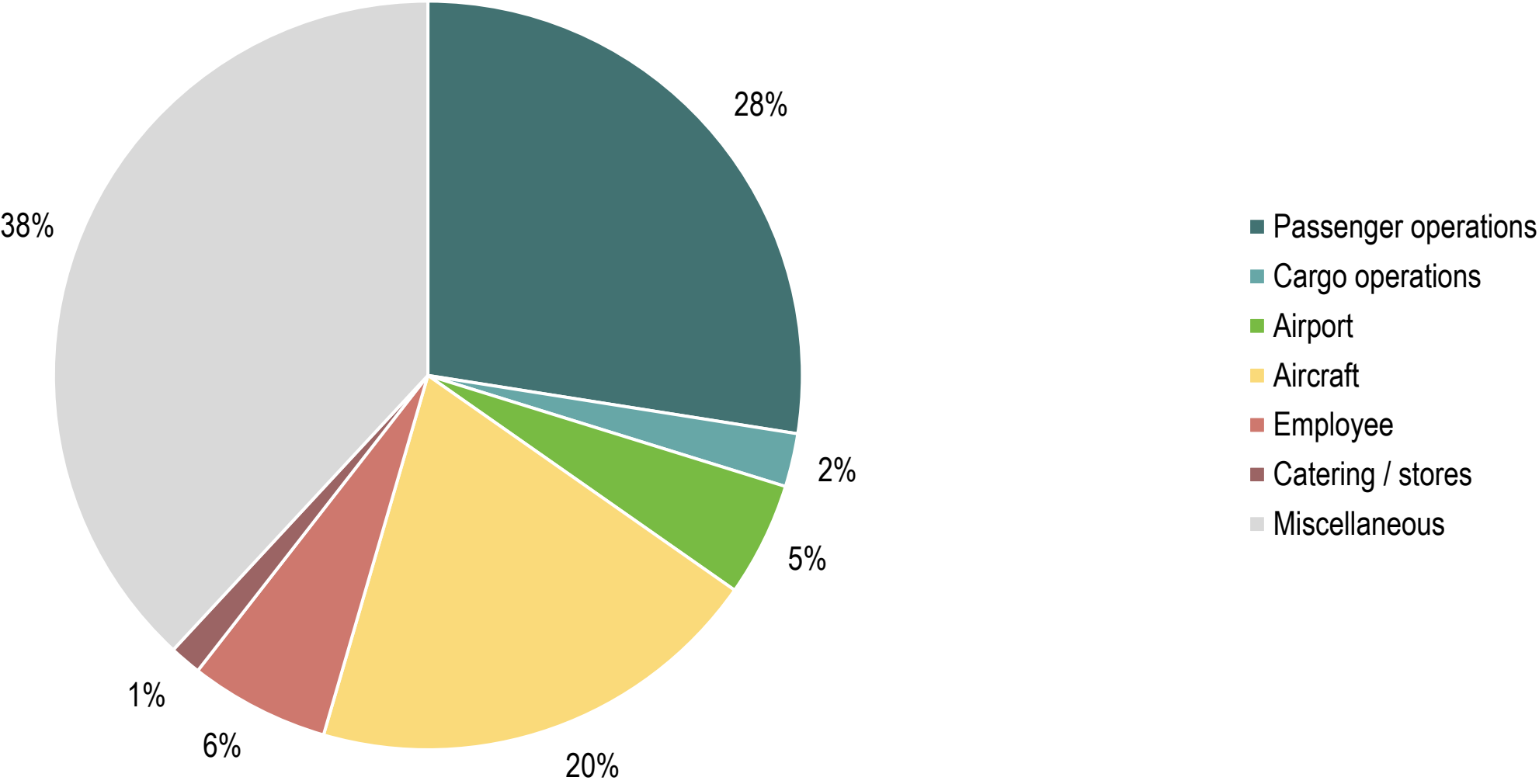
# Classification of Dangerous Goods

Class	Subclass
1 (Explosives)	1.1 - Explosives with a mass explosion hazard (nitroglycerin, dynamite) 1.2 - Explosives with a blast/projection hazard 1.3 - Explosives with a minor blast hazard (rocket propellant, display fireworks) 1.4 - Explosives with a major fire hazard (consumer fireworks, ammunition) 1.5 - Blasting agents 1.6 - Extremely insensitive explosives
2 (Gases)	2.1 - Flammable gas (acetylene, hydrogen). 2.2 - Non-flammable gases (nitrogen, neon). 2.3 - Poisonous gases (fluorine, chlorine)
3 (Flammable liquids)	(fuel oil, gasoline)
4 (Flammable solids)	4.1 - Flammable solids (nitrocellulose, magnesium) 4.2 - Spontaneously combustible solids (aluminum alkyls, white phosphorus) 4.3 - Dangerous when wet (sodium, calcium, potassium)
5 (Oxidizing agents and organic Peroxides)	5.1 - Oxidizing agent (calcium hypochlorite, ammonium nitrate, hydrogen peroxide) 5.2 - Organic peroxide oxidizing agent (benzoyl peroxides, cumene hydroperoxide)
6 (Toxic and infectious substances)	6.1 - Poison (potassium cyanide, pesticides) 6.2 - Biohazard (virus cultures, used intravenous needles)
7 (Radioactive)	(uranium, plutonium)
8 (Corrosive)	8.1 - Acids (sulfuric acid, hydrochloric acid) 8.2 - Alkalis (potassium hydroxide, sodium hydroxide)
9 (Miscellaneous)	(asbestos, air-bag inflators, dry ice)

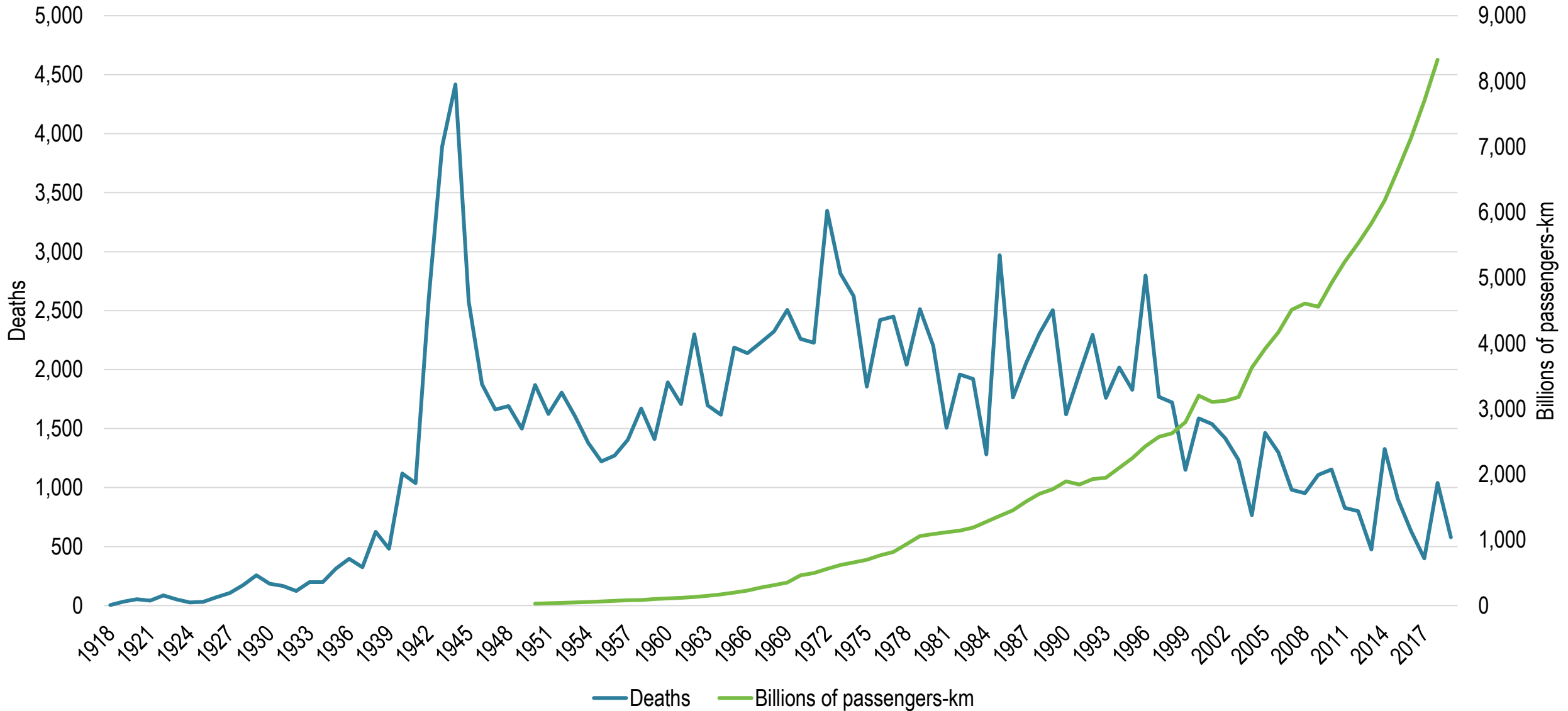
# Worldwide Attacks Inside an Aircraft by Type, 1970-2009



# Air Transportation Security Costs

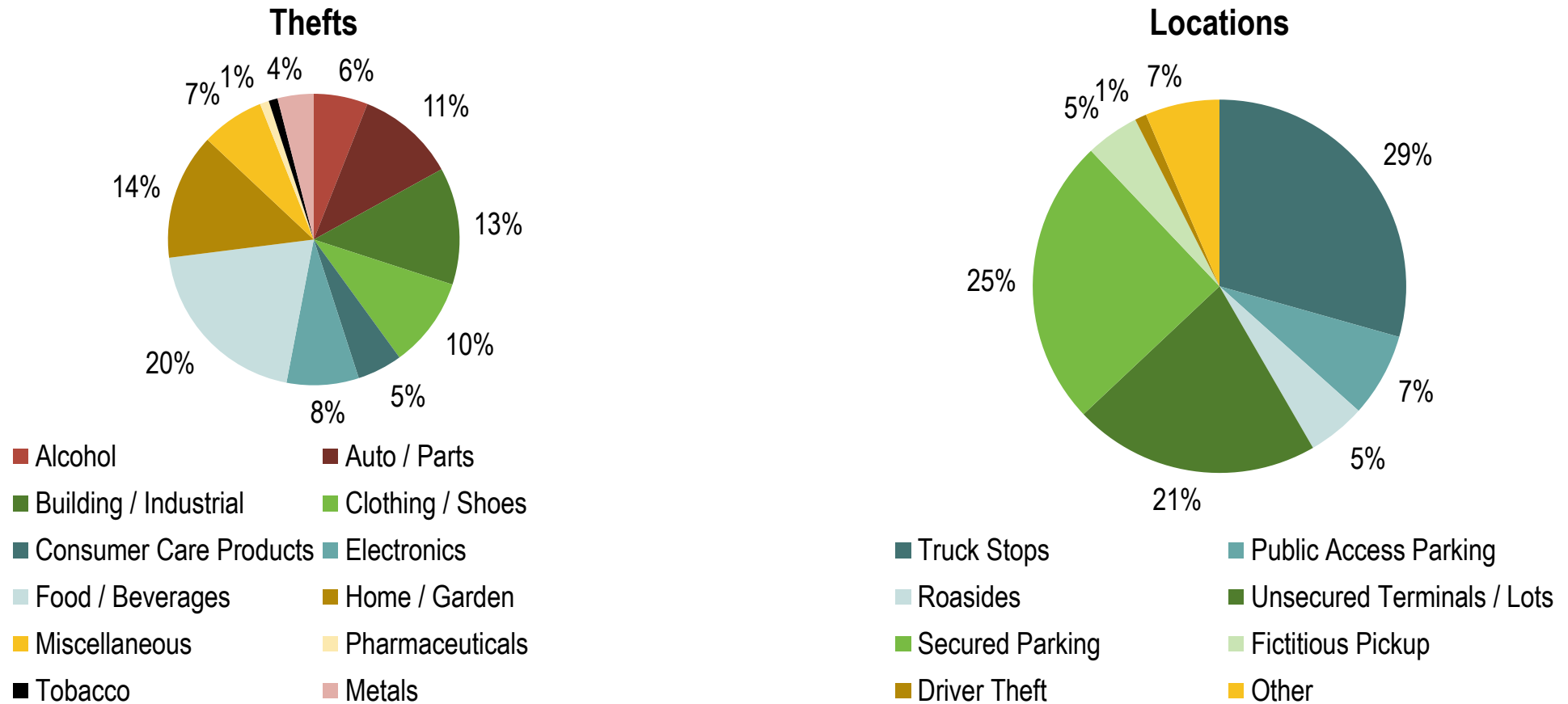


# Number of Yearly Fatalities due to Air Transport Crashes, 1918-2019

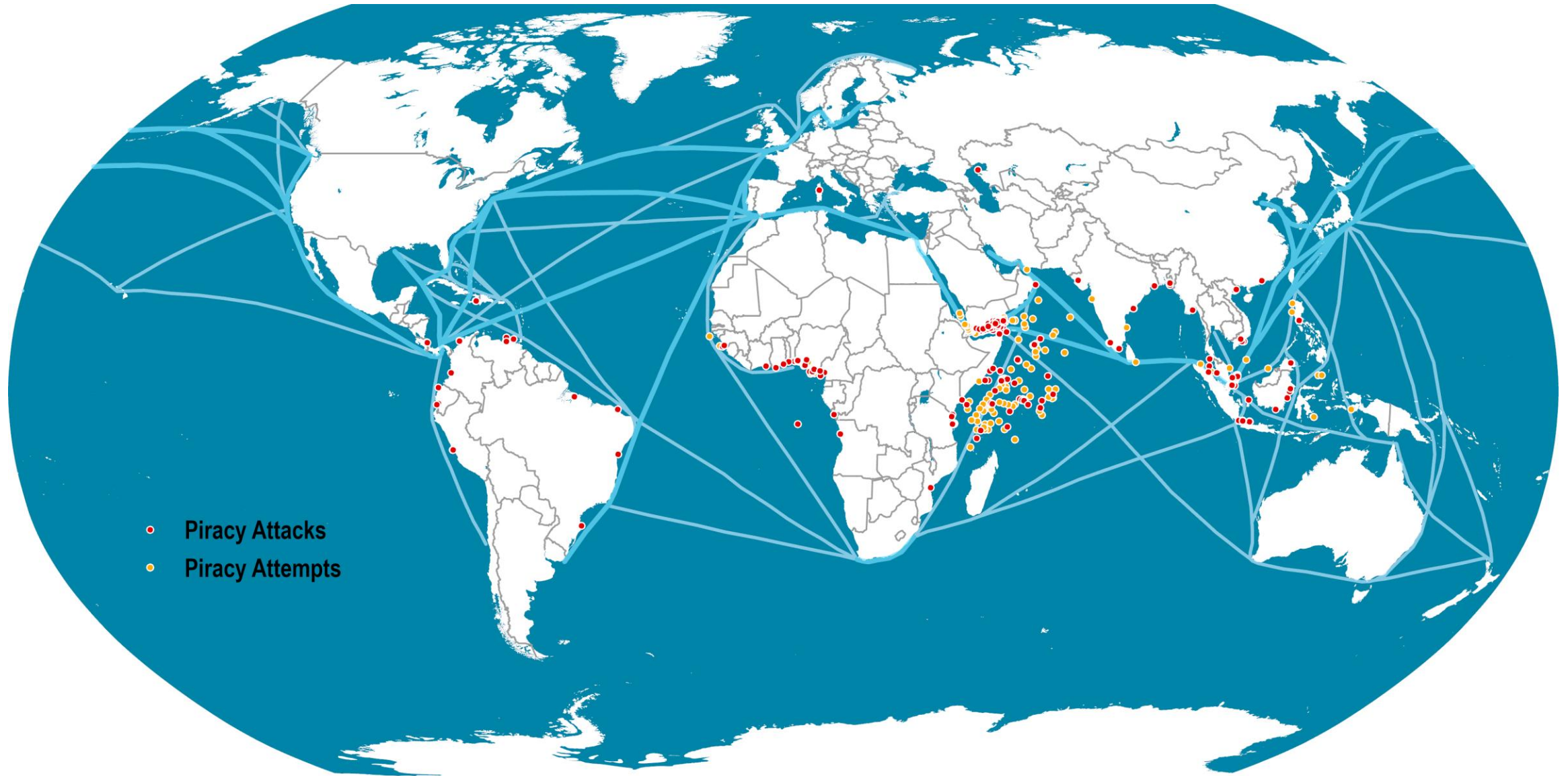




# Thefts by Type of Cargo and Location, United States, 2016



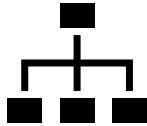
# Global Maritime Piracy, 2008-2009



- Piracy Attacks
- Piracy Attempts

# Transport Security Dimensions

## Contents



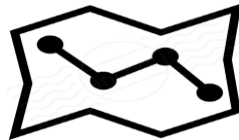
- Contents consistent with the bill of lading or list of passengers.
- May involve direct or remote inspection.
- Cross-referencing with manifest.

## Integrity



- Contents remain unchanged from origin to destination.
- Detect unauthorized access.
- Any change monitored and recorded (locks, alarms or sensors).

## Route



- No deviation from the scheduled route.
- Cargo or passengers remain within secure modes and locations (terminals and distribution centers).

## Information



- Authenticated and verifiable information about cargo or passengers.
- Information cannot read or modified without credentials.

# Transport Security Measures

## Procedural



- Access to modes and facilities recorded.
- Insuring security operations along the transport chain (monitoring and inspections).

## Physical



- Secure facilities (terminals, distribution centers) and conveyances (modes).
- Security equipment (scanners, CCTV).
- Identification for access.

## Labor



- Labor subject to screening and background checks.

## Information



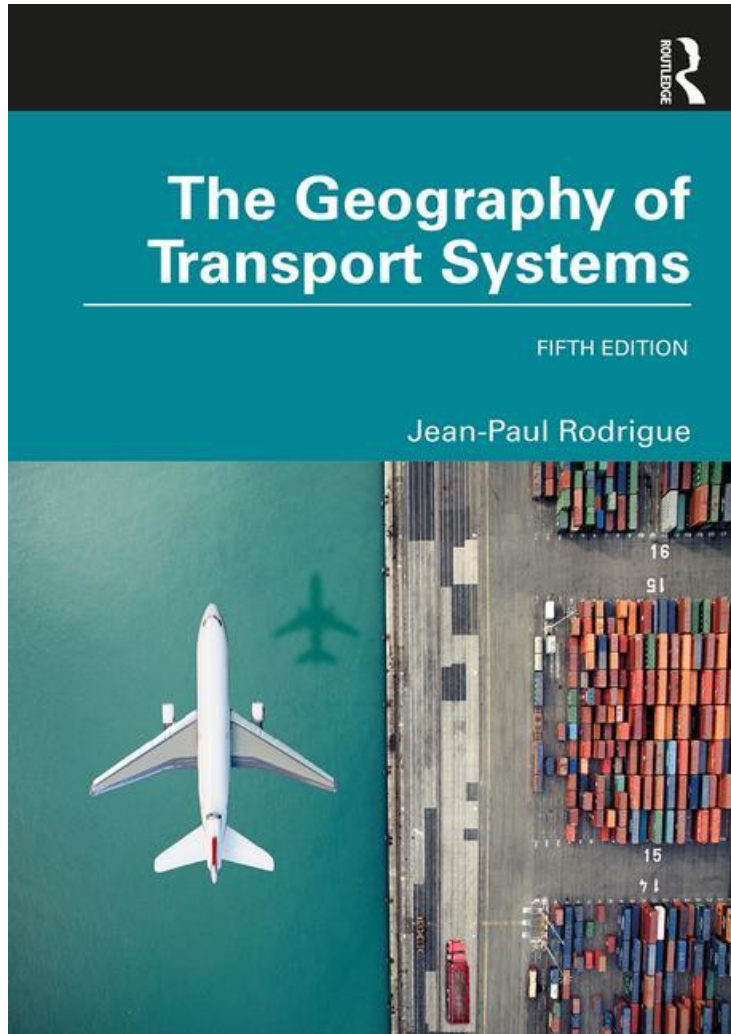
- Protection of the integrity of information.
- Tiers for information access.
- Secure transactions.

# Post-9/11 Legislations Relevant to Maritime Transportation System Security

Legislation	Purpose
Aviation and Transportation Security Act (2001)	Gave the federal government broad authority in transportation security for all modes.
Maritime Transportation Security Act (2002)	Required the U.S. Department of Homeland Security to create the National Maritime Security Plan. Outlines the coordinated action and incident-response plans between federal, state, and local governments to respond to security incidents involving maritime assets and infrastructure. Establishment of transportation worker identification cards, maritime safety and security teams, port security grants, and enhancements to maritime intelligence and matters dealing with foreign ports and international cooperation.
Critical Infrastructure Information Act (2002)	Created the framework that allows private-sector entities and others to voluntarily submit information regarding critical infrastructure/key resources in their possession to the U.S. Department of Homeland Security, with the assurance that this information will not be publicly available.
The Intelligence Reform and Terrorism Prevention Act (2004)	Required the development of the National Strategy for Transportation Security. This strategy is a classified document, but it is known that this document provides the framework for the federal government, working with state, local, and tribal governments and private industry, to secure the national transportation system and to prepare to respond to terrorist threats or attacks to transportation infrastructure.
Security and Accountability for Every Port Act (2006)	Required the secretary of homeland security, in coordination with relevant federal, state, local, and tribal government authorities and the private sector and international community, to develop and implement a strategic plan to “enhance the security of the international supply chain.”

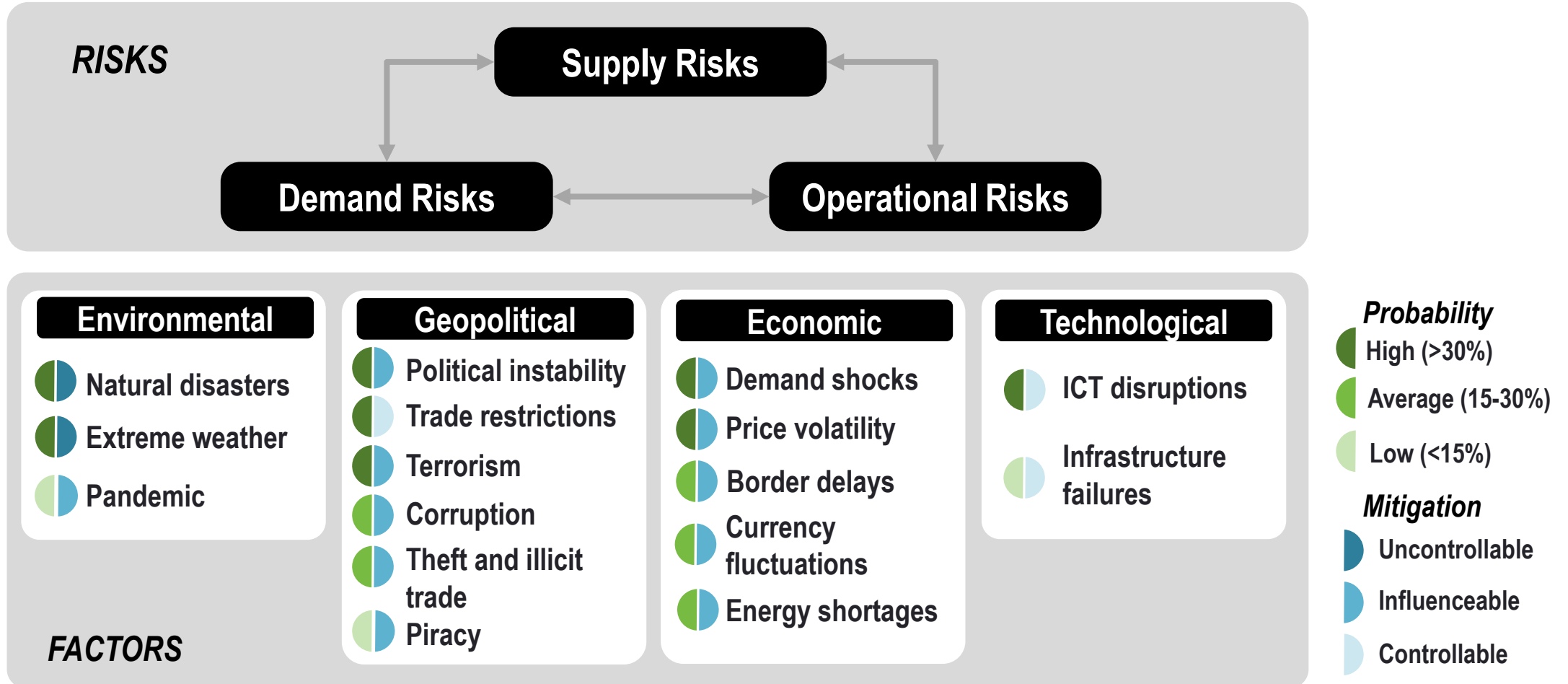
# Maritime Security Initiatives Implemented by the United States or the European Union

Initiative	Type	Year	Description
Automated Targeting System (ATS)	Cargo screening	1999	Weighted model applied to inbound cargo manifests to assign risk factors.
Customs-Trade Partnership Against Terrorism (C-TPAT)	Certification	2001	Transferring some of the Customs responsibilities to importers and exporters to reinforce overall security levels. Benefits include reduced likelihood that containers of participating firms will be examined.
Container Security Initiative (CSI)	Cargo tracking and screening	2002	Increasing security related to ocean going containers by targeting and screening high risk containers bound for the US in a foreign port before they are loaded.
Megaports initiative	Cargo tracking and screening	2003	Installation of radiation detection equipment in key foreign ports. Reducing the illicit trafficking of nuclear and other radiological materials.
24 hour rule	Advance cargo information	2003	Implementing the cargo-related information at least 24 hours before a container is loaded aboard the vessel at the last foreign port.
Standards to Secure and Facilitate Global Trade (SAFE)	Certification	2005	Implementing C-TPAT and CSI security practices with foreign trade partners.
EU Authorized Economic Operator (AEO)	Certification	2008	Identifying reliable traders and providing them with trade facilitation measures.
Importer Security Filing and Additional Carrier Requirements (ISF, 10+2)	Advance cargo information	2009	Implementing the collection of cargo-related information by requiring information from both the importer (10 information elements) and the carrier (2 information elements) to be transmitted at least 24 hours before the goods are loaded.
EU Pre-arrival and Pre-departure	Advance cargo information	2009	Advance information on goods brought into, or exported from the Customs territory of the EU (perimeter).
100% scanning	Cargo screening	2012	Non-intrusive inspection of 100% of all inbound cargo containers.



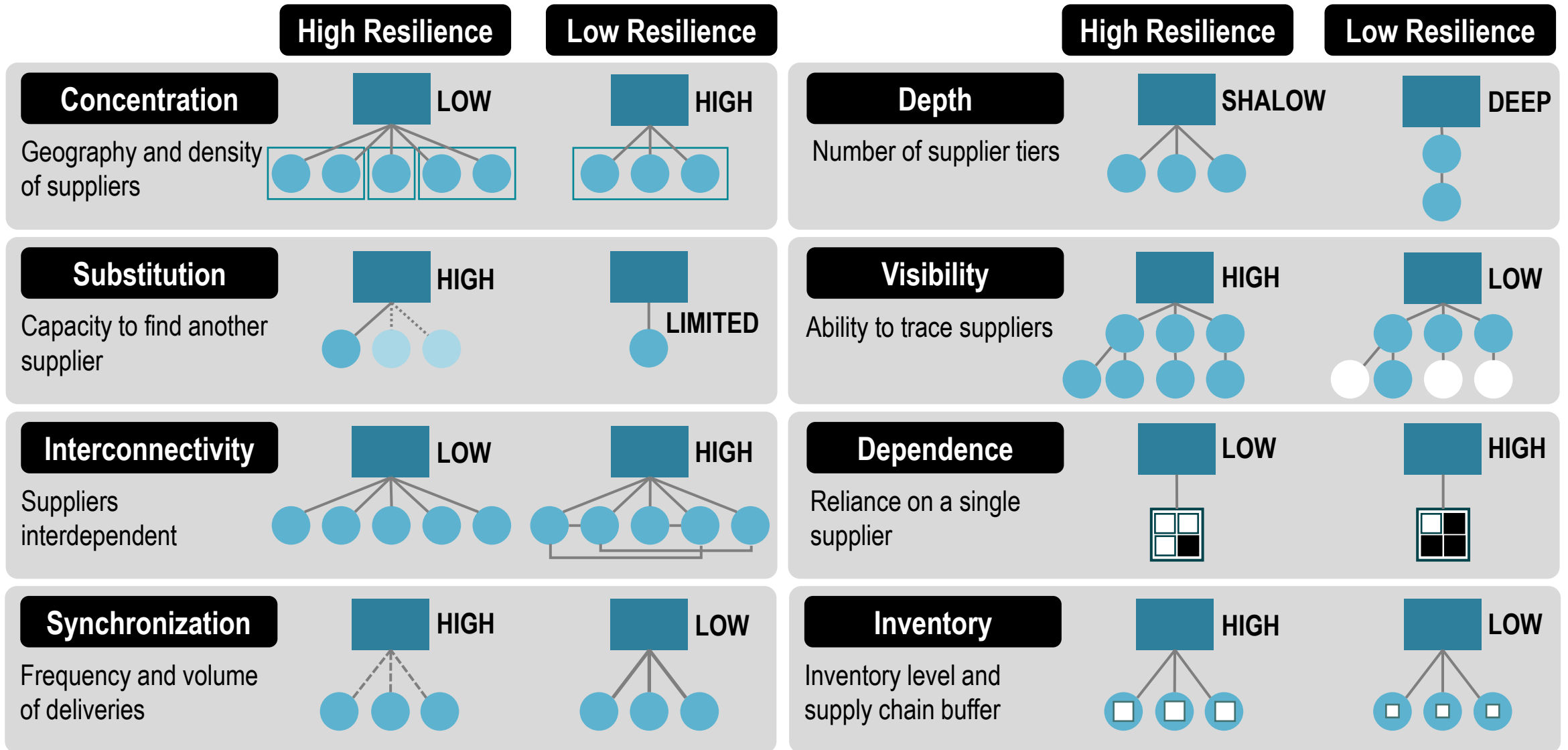
# Transportation, Disruptions and Resilience

# Risks in Global Supply Chains



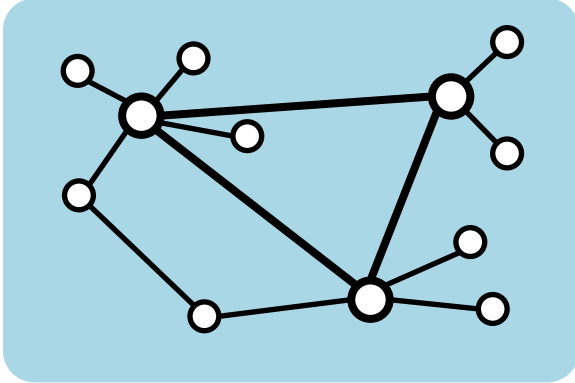


# Types of Supply Chain Risks and Their Resilience



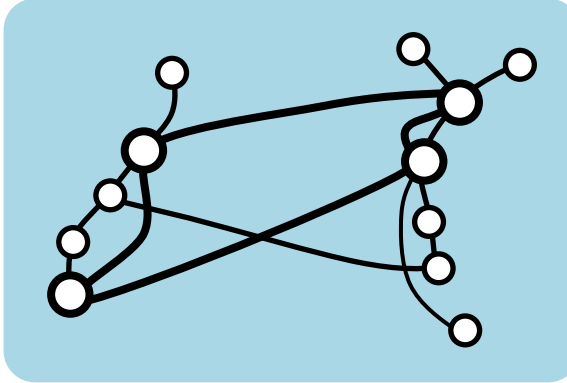
# Types of Transportation Networks and Vulnerabilities

## Air Networks



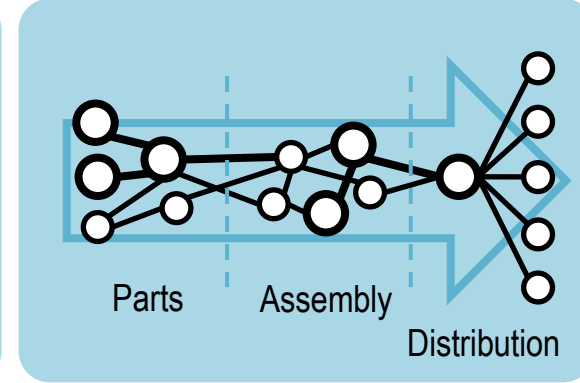
Nodal hierarchy (hub-and-spoke)

## Maritime Networks



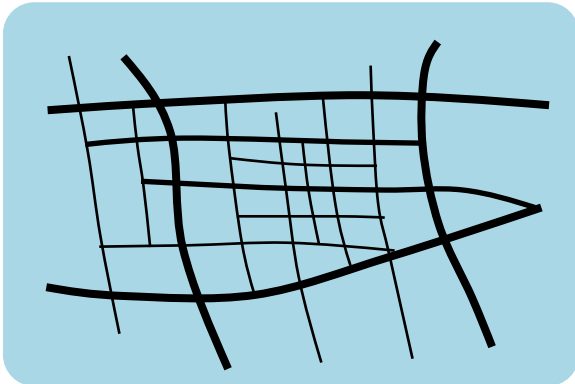
Circuitous nodal hierarchy

## Logistical Networks



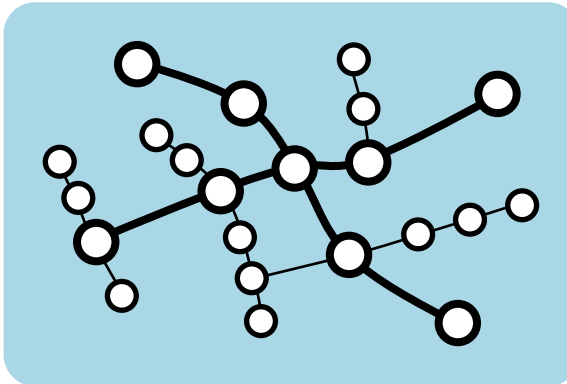
Sequential multi-nodal hierarchy

## Road Networks



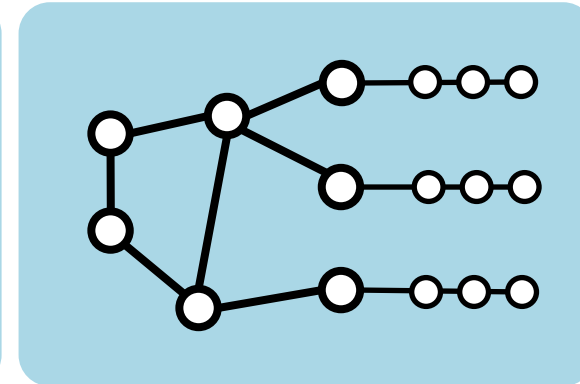
Hierarchical meshes

## Rail Networks



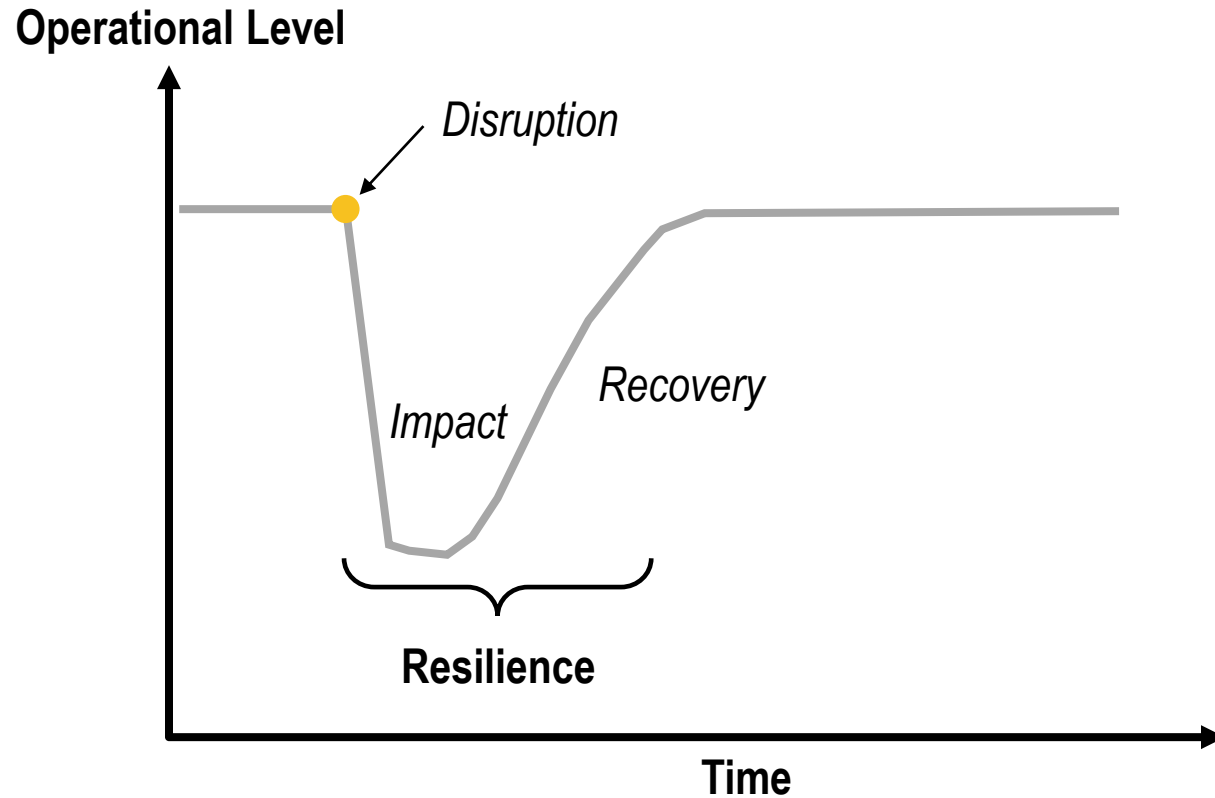
Linear nodal hierarchy

## Power Grids

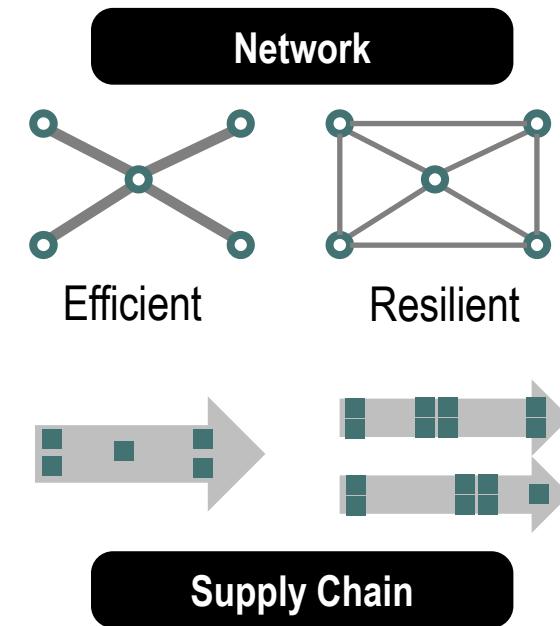


Sequential linear hierarchy

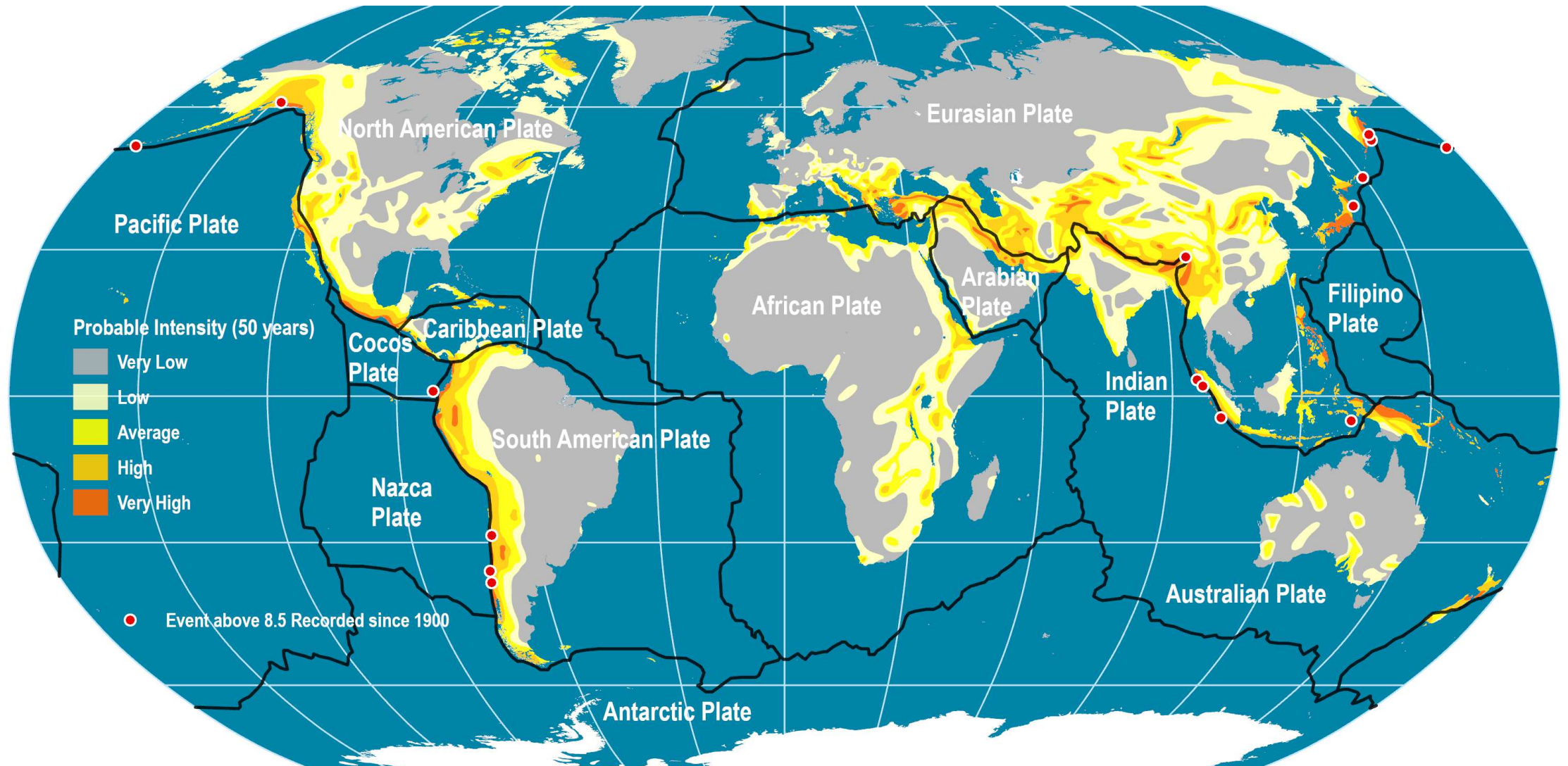
# Resilience of Transportation Systems



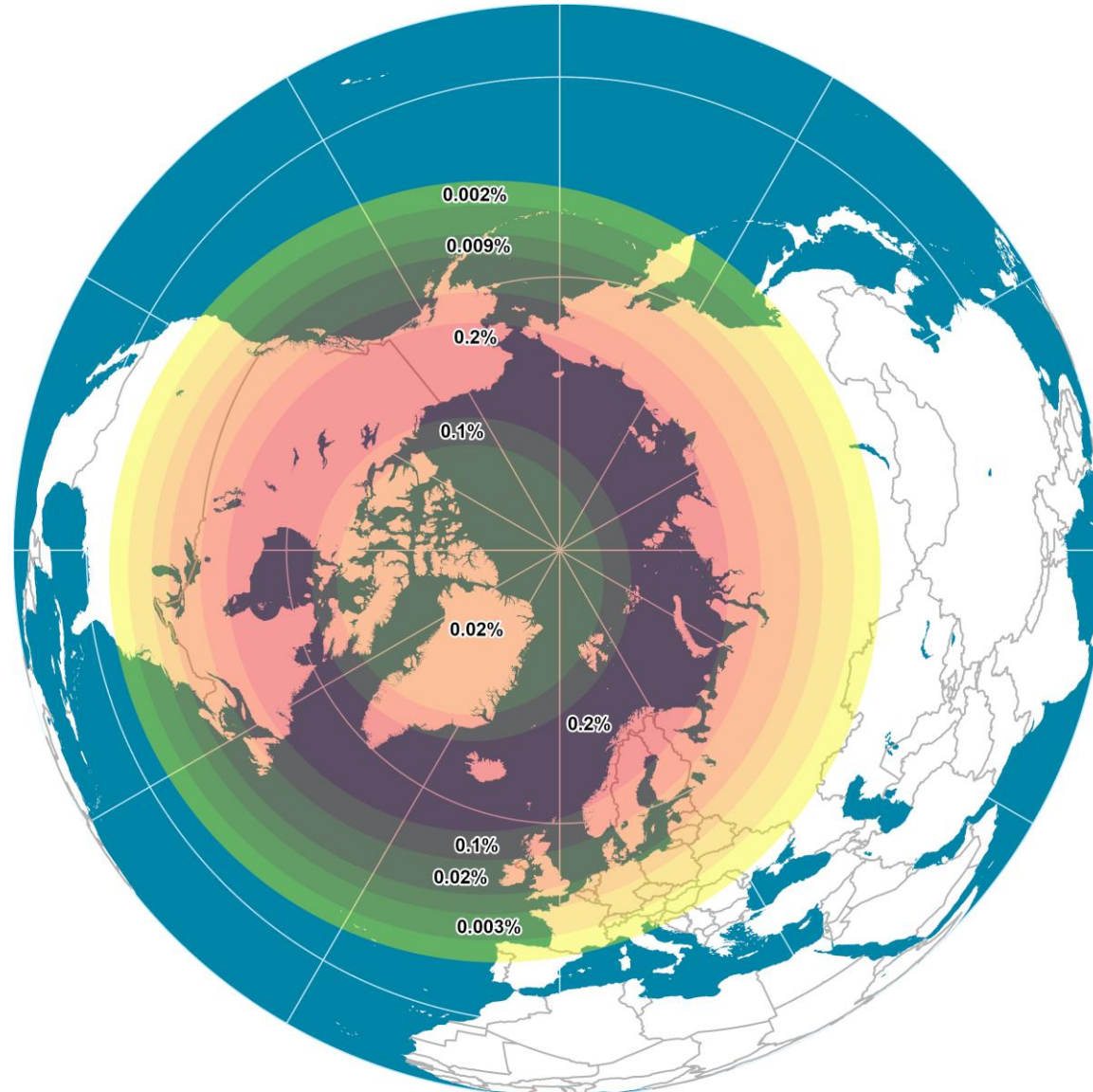
## Forms of Resilience



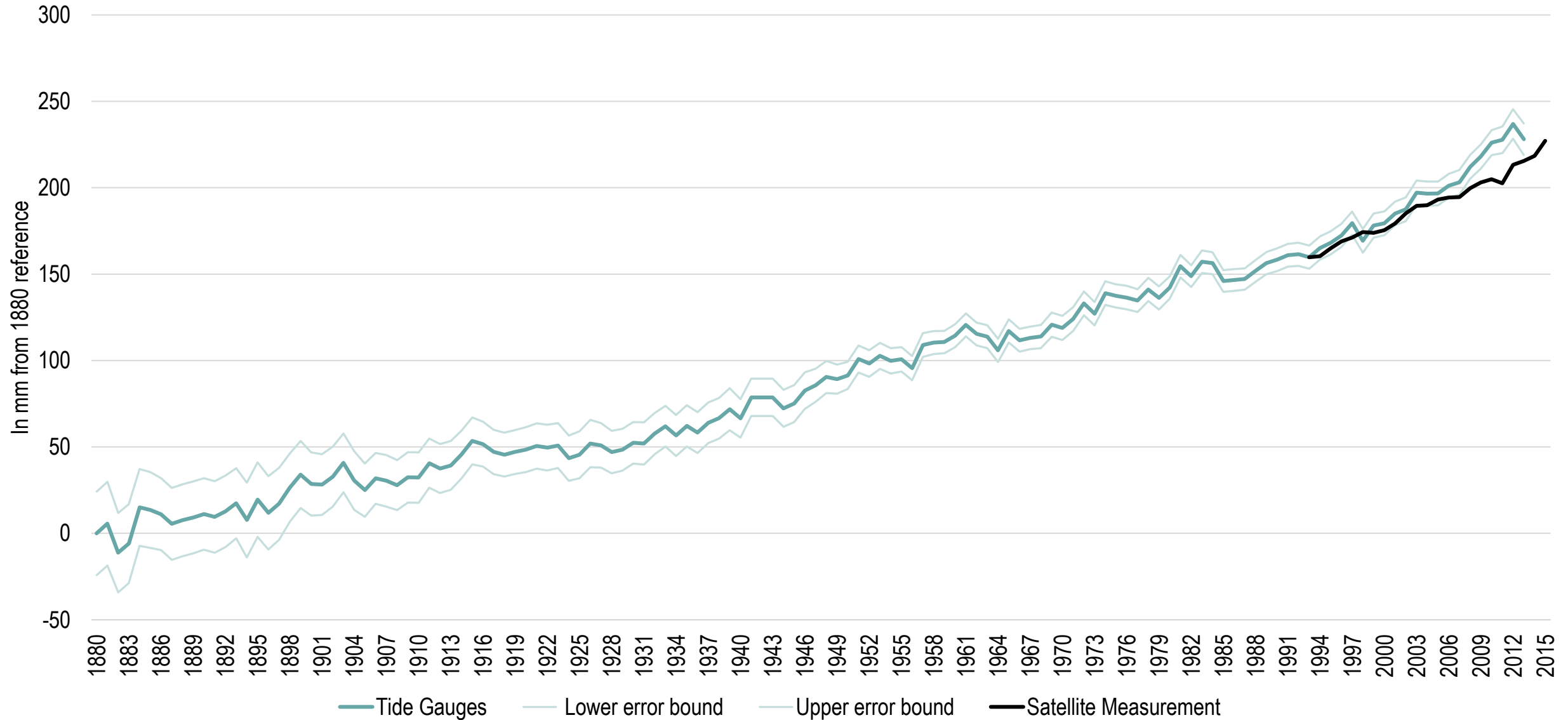
# Global Plate Tectonics and Seismic Activity



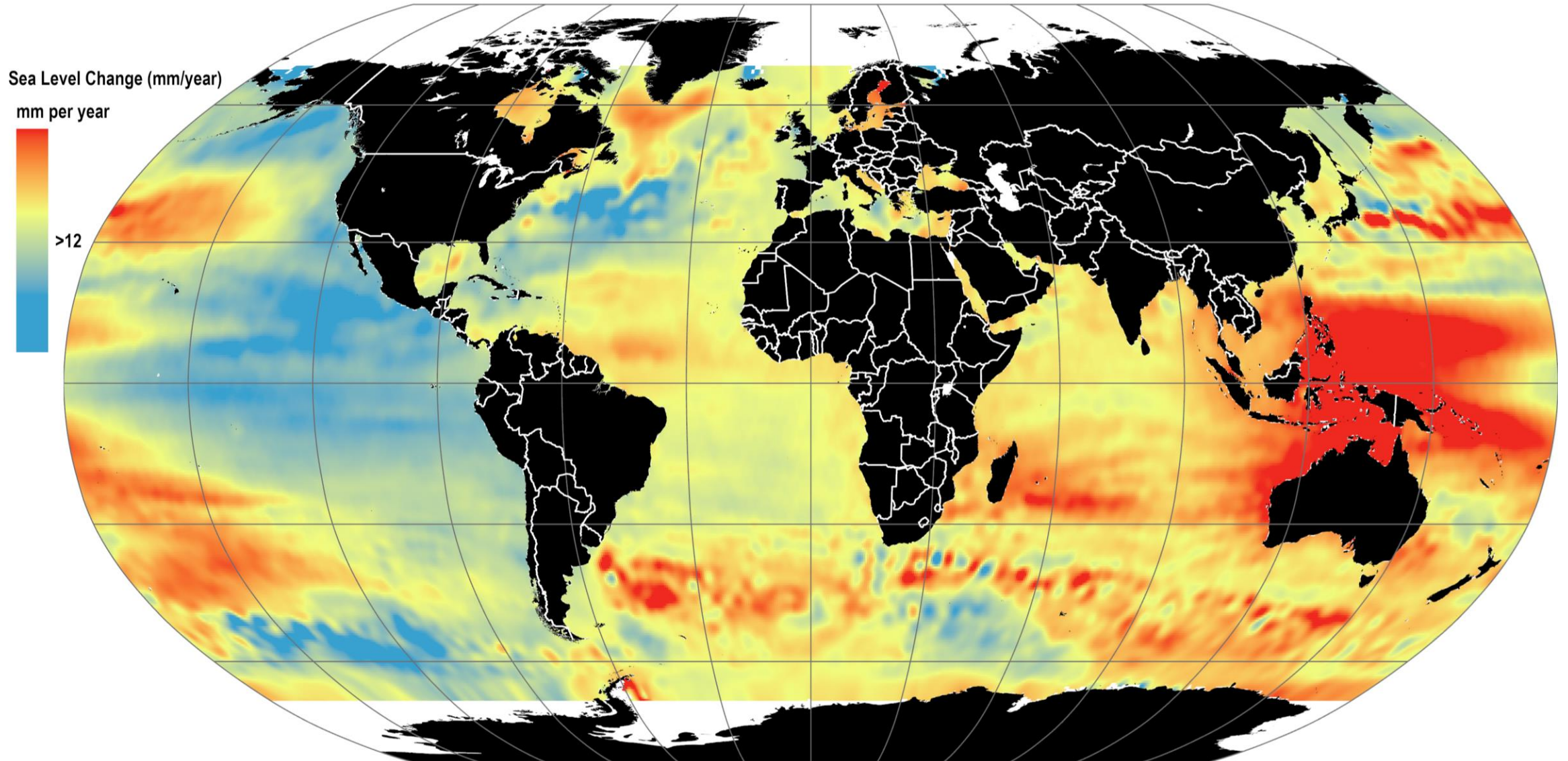
# Probability of a Geomagnetic Storm with a Field Change Greater than 300 Nanoteslas per Minute (22-year cycle)



# Global Mean Sea Level Change, 1880-2015



# Remotely Sensed Sea Level Change, 1992-2012



# Number of Atlantic Tropical Cyclones by Month (1851-2018)

