Lecture 07: Modes of Transportation

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last updated: December 19, 2024

Outline

Key Ref.: [JC10] [Bal07] [CM07] [Goe11]

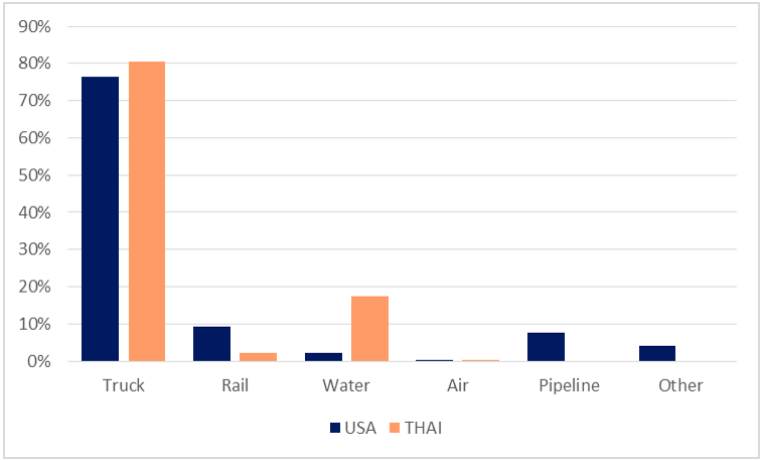
US Domestic Statistic 2013

Mode	Tons (million)	Value (billion $)	Ton-miles[07] (billion)	Percentage Tons	Percentage Value	Percentage Ton-miles[07]
Truck	13,732	10,841	2349	77%	75%	41%
Rail	1,681	424	1522	9%	3%	27%
Water	410	131	450	2%	1%	8%
Air	3	134	9	0%	1%	0%
Mail	459	1,695	469	3%	12%	8%
Pipeline	1,391	1,003	855	8%	7%	15%
Other	274	270	86	2%	2%	1%

source: US Bureau of Transportation

How about Thailand?

Mode	USA	Thailand
Truck	13,732	426.1
Rail	1,681	11.8
Water	410	91.7
Air	3	0.1
Pipeline	1,391	-
Other	733	-



source: US Bureau of Transportation and TH Ministry of Transportation

What do these data imply?

- $\exists$ relationship between mode and type of product
- preference of modes is difference by country (infrastructure)
- truck dominates last mile delivery, whereas sea dominates global trade

What is a suitable mode?

- **Air:** expensive, any where, quick, safely (e.g., CPU, produces)
- **Rail:** city-to-city, bulky (e.g., ores, coals, grains, automobiles)
- **Truck:** accessability, control, responsive
- **Water:** international, bulky, cheap, low emission (e.g., cargo)
- **Pipeline:** special infrastructure (e.g., oil, natural gas)
- **Parcel:** postal services (e.g., Dell computer, Amazon)
- **Intermodal:** more than one mode (e.g., rail+truck, water+rail)

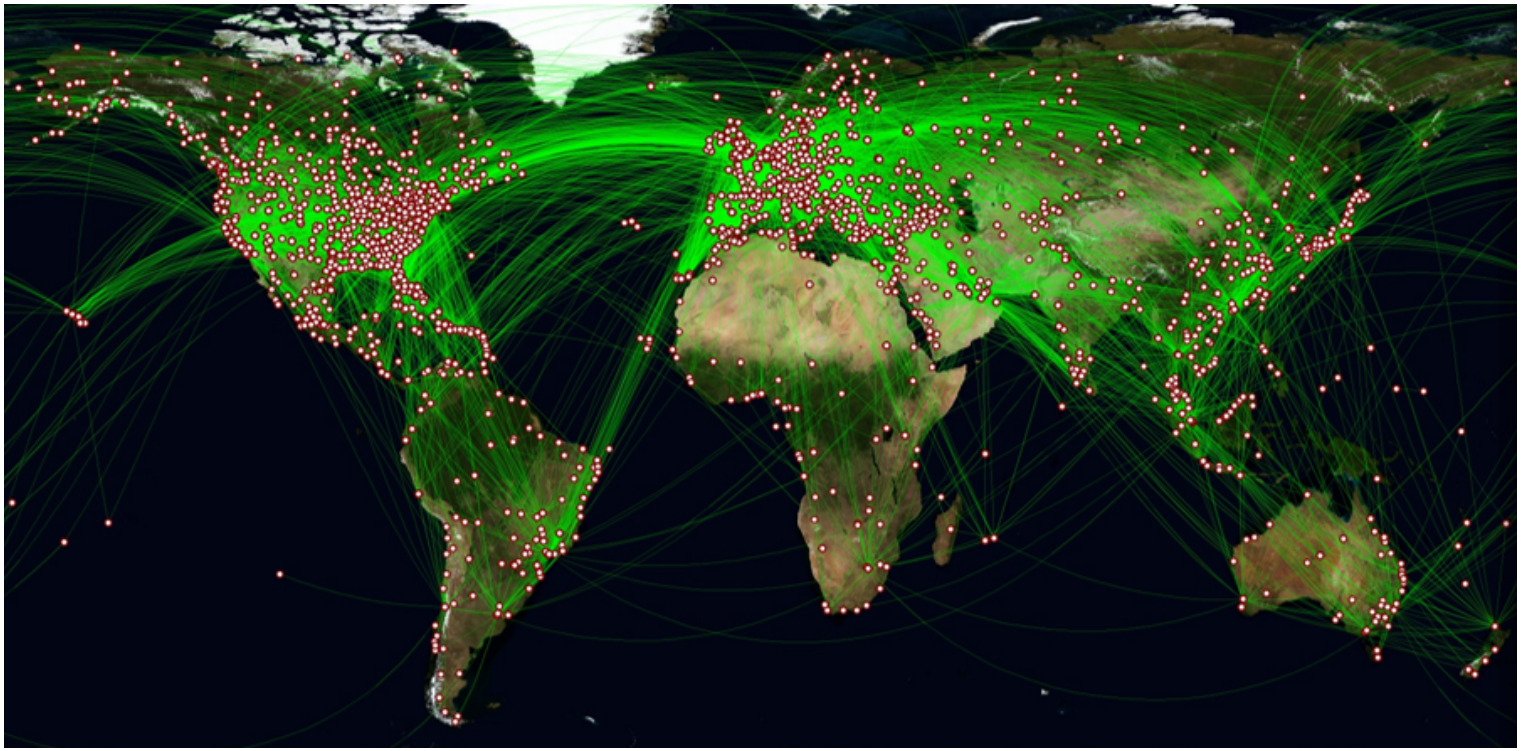
Modern Marvel: Delivery it

- **Story:** Extreme delivery and transportation
- **Observation:**
  - What is information necessary for planning and execute each type of delivery?
  - What are equipments and/or innovation in each type of delivery?
  - What are challenges in each type of delivery?

Air System: High speed and expensive

- **Historical:** recent last couple of decades
- **Concurrent Uses:** passenger, air mail, produces, electronic gadgets, jewelry
- **Opportunity:** passenge+cargo, revenue management
- **Issues:** security, hub location, crew scheduling, fuel consumption, maintenance
- **Carriers:** UPS, FedEx, TNT, carter flight

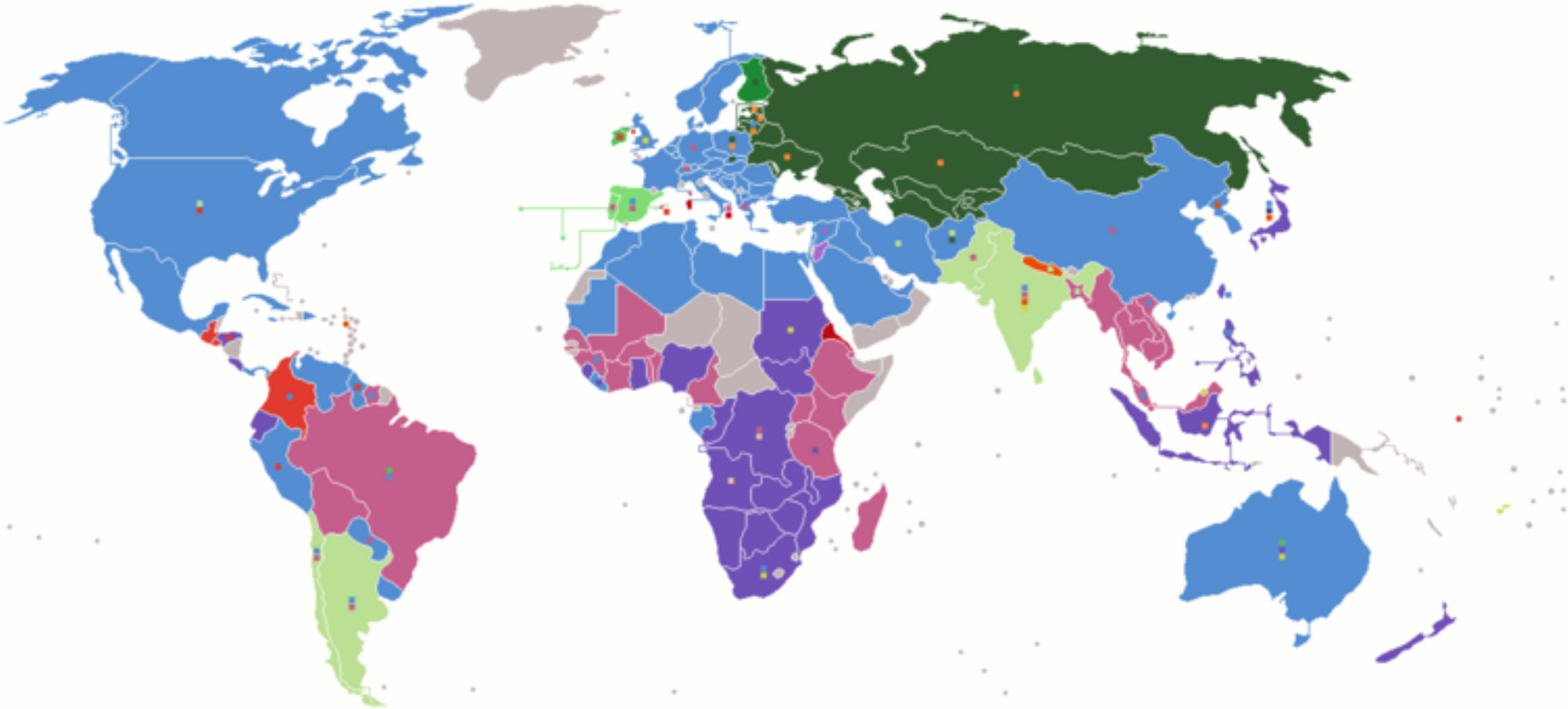
Main Air Shipping Routes



Rail System: Opportunity or Legacy

- **Historical:** key infrastructure, creating many metropolis
- **Pricing:** High fixed cost (locomotive, rail way)
- **Concurrent Uses:** vary depends largely on region
  - **Europe:** high-speed passengers
  - **N. America:** bulky freight + passengers
  - **Asia Pacific:** budget transportation for passengers
- **Opportunity:** intermodal transportation, landbridge
- **Issues:** locomotive management, inventory, scheduling, gauge
- **Carriers:** Norfolk Southern, CSX Transportation

Track gauge and Double Track



mm	1676	1668	1600	1524	1520	1435	1372	1067	1050	1000	950	914	762	750	610	600
ft in	5'6"	5'5.67"	5'3"	5'	4'11.8"	4'8.5"	4'6"	3'6"	3'5.3"	3'3.4"	3'1.4"	3'	2'6"	2'5.5"	2'	1'11.6"

Types of Rail Car

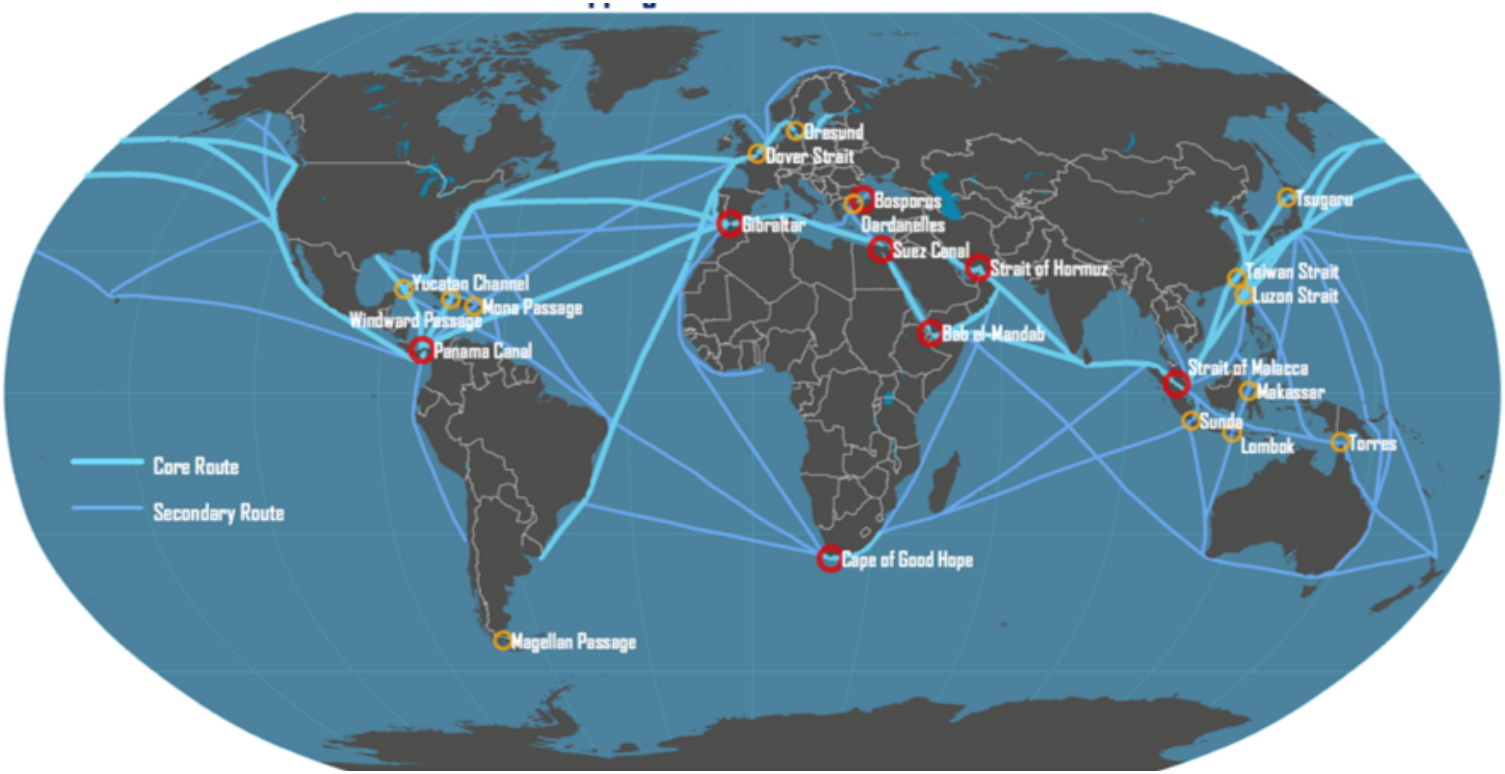
Truck System: Dominated Mode

- **Classification:** less-than truckload (LTL), Full truckload (TL)
- **Pricing:** weight, weight-distance, area
  - **weight:** TL **VS** LTL
  - **distance:** national **VS** regional
  - **class:** hazard, special equipment
- **Opportunity:** network design, consolidation, realtime management
- **Issues:** fleet management, gas price, backhaul
- **Carriers:** Schneider National, JB Hunt, Ryder Integrated

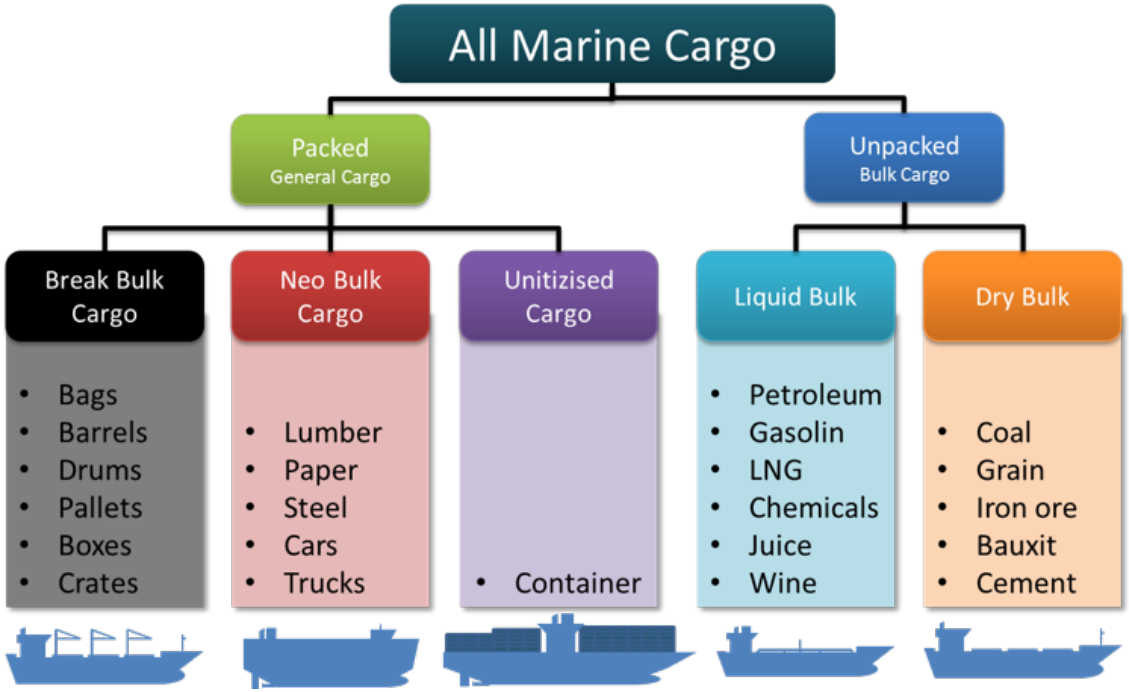
Water System: international trade

- **Important:** dominated international trade
- **Pricing:** volume, class, term (e.g., FOB)
- **Opportunity:** efficiency, environmental friendly, safety
- **Issues:** fleet management, pirate, capacity, leadtime
- **Carriers:** Maersk Sealand, Evergreen, Hanjin Shipping Co
- **nautical VS statute mile** 1.0 nautical mile/hr = 1.0 knot = 1.8 km/hr

Main Maritime Shipping Routes



General type of marine vessels [**IE**]



source: shippipedia.com

Type of vessels by freight [**IE**]

Tanker	DWT	Bulker	DWT	Container	TEU
Seawaymax	10.0k–60.0k	Handysize	10.0k–35.0k	Panamax	4.5k–5.0k
Panamax	60.0k–80.0k	Handymax	35.0k–59.0k	New Panamax	5.0k–10.0k
Aframax	80.0k–120.0k	Panamax	60.0k–80.0k	Suezmax	10.0k-15.5k
Suezmax	120.0k–200.0k	Capesize	80.k +		
Speed	10-15 knots		12-15 knots		15-25 knots

source: shippipedia.com

Main seaports in Thailand

Name	type	maxDWT	Type	DWT per docking
ท่าเรือกรุงเทพ	Gov	12,000	HandySize	10,000-12,000
ท่าเรือแหลมฉบัง	Gov	80,000	Postpanamax	1,000-80,000
ท่าเรือน้ำลึกระนอง	Gov	12,000	HandySize	12,000
ท่าเรือน้ำลึกมาบตาพุด (ระยอง)	Gov	120,000	Capesize	2,000-120,000
ท่าเรือน้ำลึกประจวบคีรีขันธ์(บางสะพาน)	Gov	100,000	Postpanamax	20,000-100,000
ท่าเรือน้ำลึกสงขลา	Gov	140,000	Capesize	9,000-140,000
ท่าเรือน้ำลึกปาบารา (สตูล)	Gov	70,000	Panamax	65,000-70,000
ท่าเรือน้ำลึกภูเก็ต	Gov	20,000	HandySize	20,000
ท่าเรือน้ำลึกเกาะสีชัง (ชลบุรี)	Gov	10,000	HandySize	10,000
ท่าเรือน้ำลึกศรีราชาฮาร์เบอร์	Priv	100,000	Postpanamax	3,000-100,000
ท่าเรือน้ำลึกสยามซีพอร์ต	Priv	45,000	Supramax	500-60,000
ท่าเรือน้ำลึกสยามเคอรี่ซีพอร์ต	Priv	120,000	Capesize	3,000 -120,000

source: Thailand Marine Department (http://www.md.go.th/md/)

Package Carriers: eCommerce backbone

- **Important:** light ($\leq$ 60kg), consolidation, multiple-mode
- **Pricing:** weight, class, destination
- **Opportunity:** responsive
- **Issues:** transit facility
- **Carriers:** UPS, FedEx, DHL, USPS, Kerry, Flash, J&C

Other Systems

Pipeline:

- **Important:** dominated by crude petroleum, refined petroleum products, natural gas
- **Issues:** security, environmental, construction cost, inventory

Intermodal:

- **Important:** multiple-mode to avoid bottleneck in network
- **Combination:** Train-Truck, Water-Train-Truck
- **Opportunity:** high profit margin, unitization
- **Issues:** communication, Land bride and Containerization

Mode Comparison

	Road	Rail	Air	Water	Pipeline
$/ton-mile	medium	low/med	high	low/v. low	v. low
Speed (mph)	0-60	0-50	0-600	0-20	0-5
Frequency	v.good	good	good	limited	continuous
Network	extensive	limited	limited	restricted	dedicated
Security	good	average	average+	poor	good
Reliability	v.good	good	v.good	limited	v. good
Advantage	mixed/# vehicle	heavy load	low inv.	cost	continuous
Limitation	• loading	• connectivity	• cost	• min qty	• liquid
	• dimension	• network	• weather	• speed	• capital
	• capacity		• capacity	• seasonality	

source: Adopted from *Frazelle* 2001.

Article: The Threat of Global GridLock

[**IE**]

- **Purpose:** warning about transportation infrastructure
- **Infrastructure:** truck, rail, ship, air
- **Effects to company:** SC is longer and more complex $\rightarrow$ severe congestions
  - delay has cascade effect
  - distant souring is deterred by high fuel cost
  - rapid change product $\rightarrow$ "double dips"
- **Remedies:** goal is to maximize profit, not minimize costs
  - cost **VS** time
  - premium service ("hot-hatching", door-to-door, reserve cap)
  - source closer, using Air, using best practice

Pipeline Network in Thailand [**IE**]

Pipeline Network in Thailand

- **Background:** Thappline (1990; former subsidiary of PTT)
- **Products** mixed product (GB-1, GB-2, ULG, & HSD) in single pipe
- **Piping Tech:** 24"-12" diameter; 76 Block Valve Station
  - *Open Cut:* removing soil surface 1.5m before place pipe for general
  - *Bored Crossing/Pipe jacking:* pushing pipeline underground for small intersection
  - *Horz Drilling:* several drilling deep with guide sys for river
- **Piping Route:** existing major road and railway

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