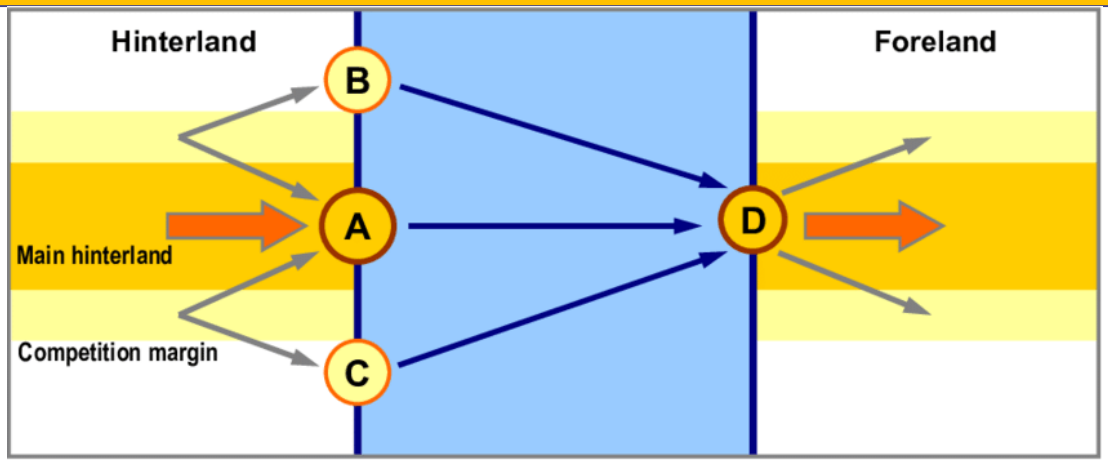
Politecnico di Torino

RUT International

The importance of port-hinterland transport connections to improve supply chains performances



Dr. **Claudia CABALLINI**

DIATI - Dipartimento di Ingegneria dell'Ambiente, del Territorio e delle Infrastrutture

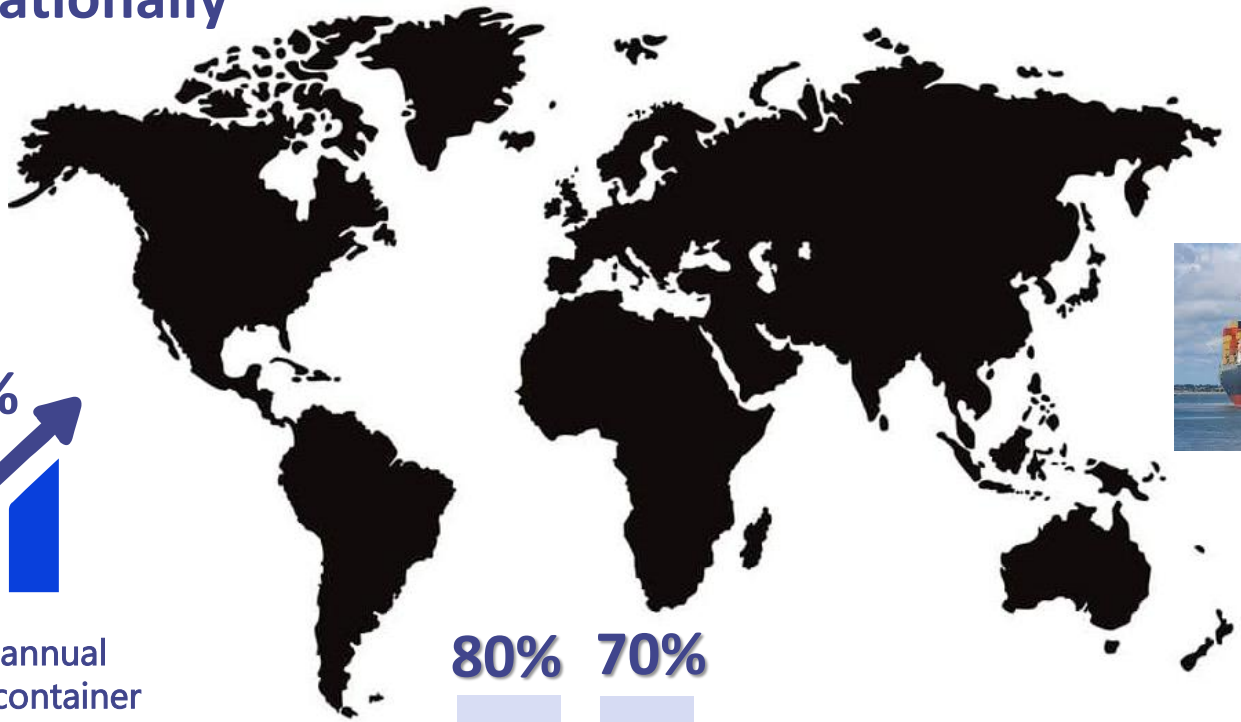
Politecnico di Torino

AGENDA

- The shipping sector
- The role of seaports
- Port-hinterland connectivity

Maritime transport DEMAND

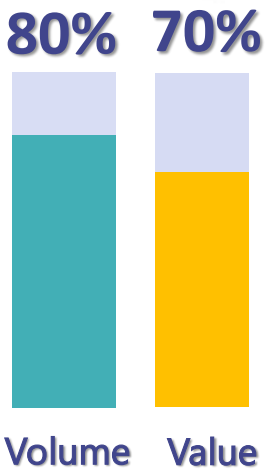
Seaborne transportation carries the **majority of goods traded internationally**

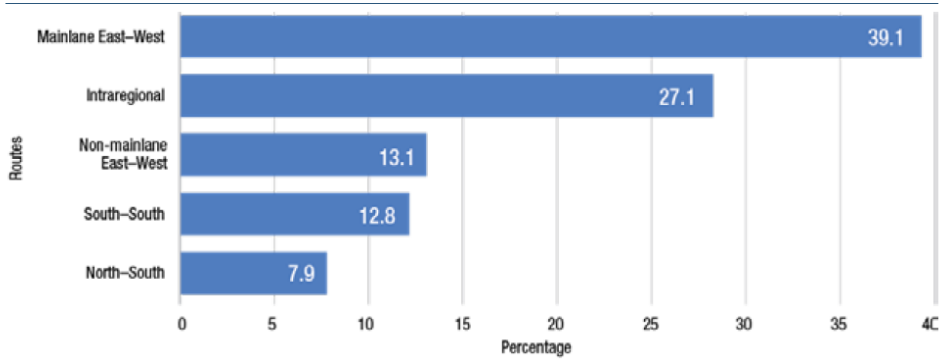


+ 8%

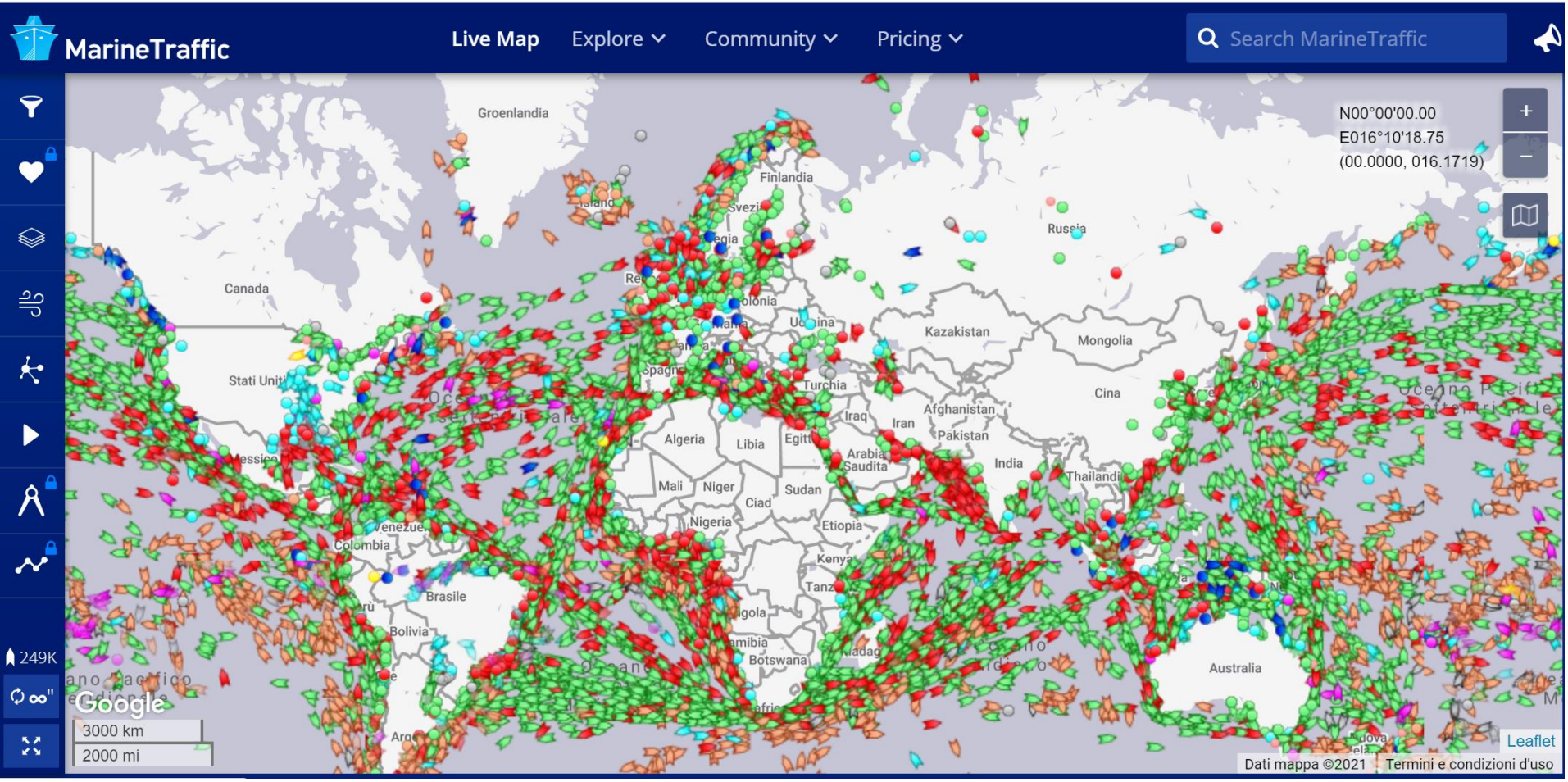
Average annual growth of container traffic since 1980

In 2019: **11,8 billion tons** transported by sea



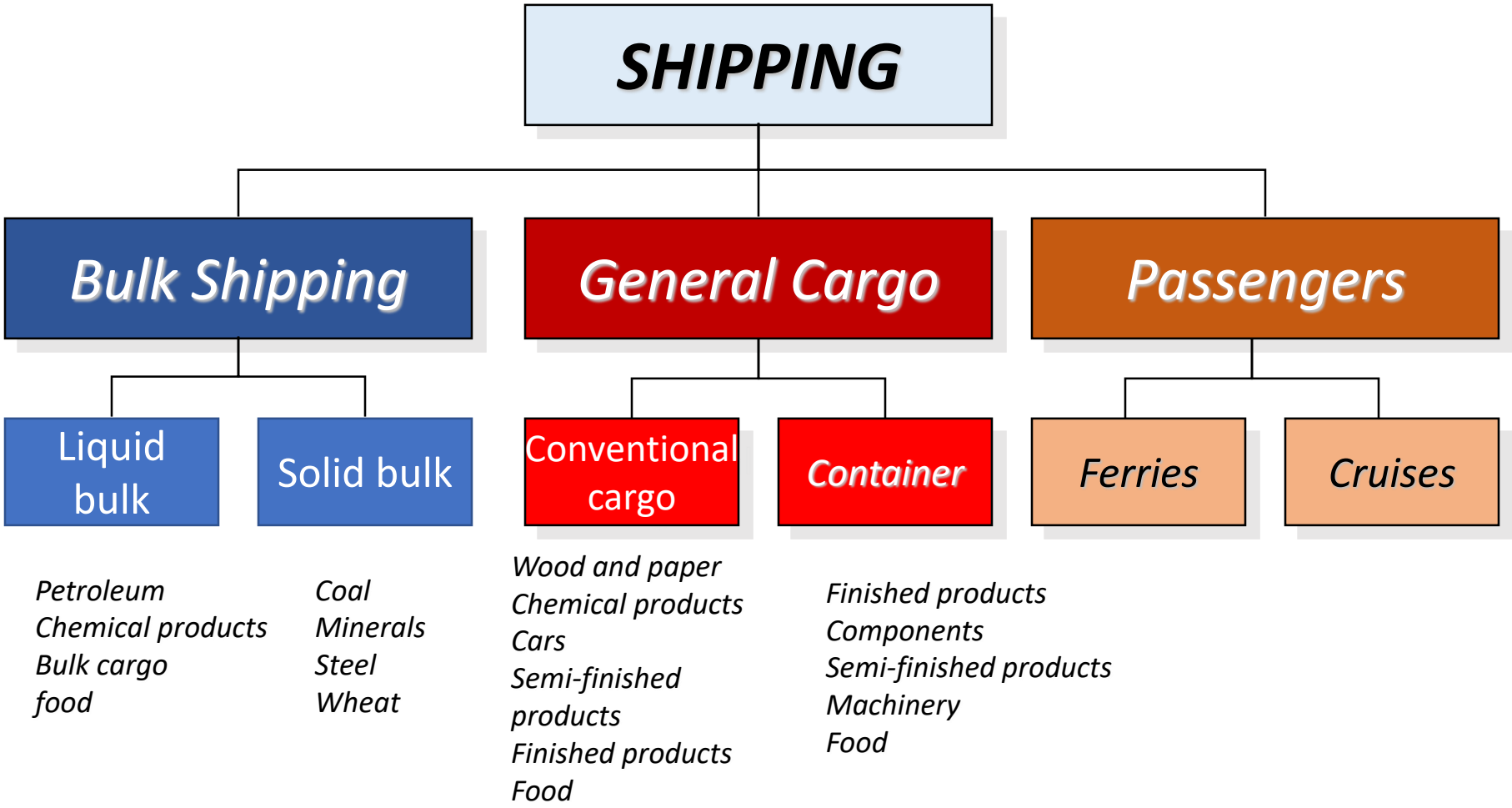


A snapshot of ships at sea on June, 1st 2021

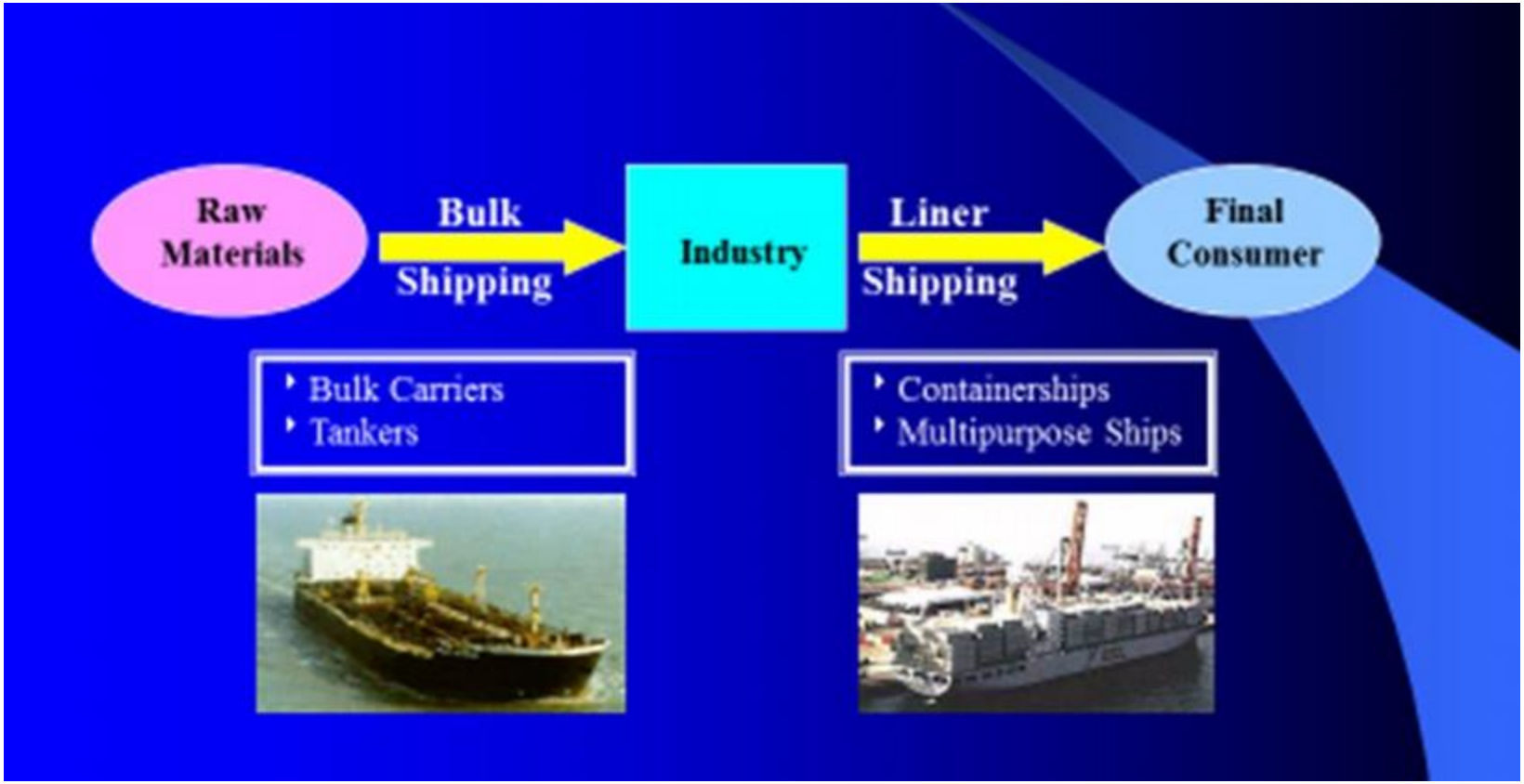


https://www.marinetraffic.com/en/ais/home/centerx:-55.7/centery:47.0/zoom:2

The business areas of shipping



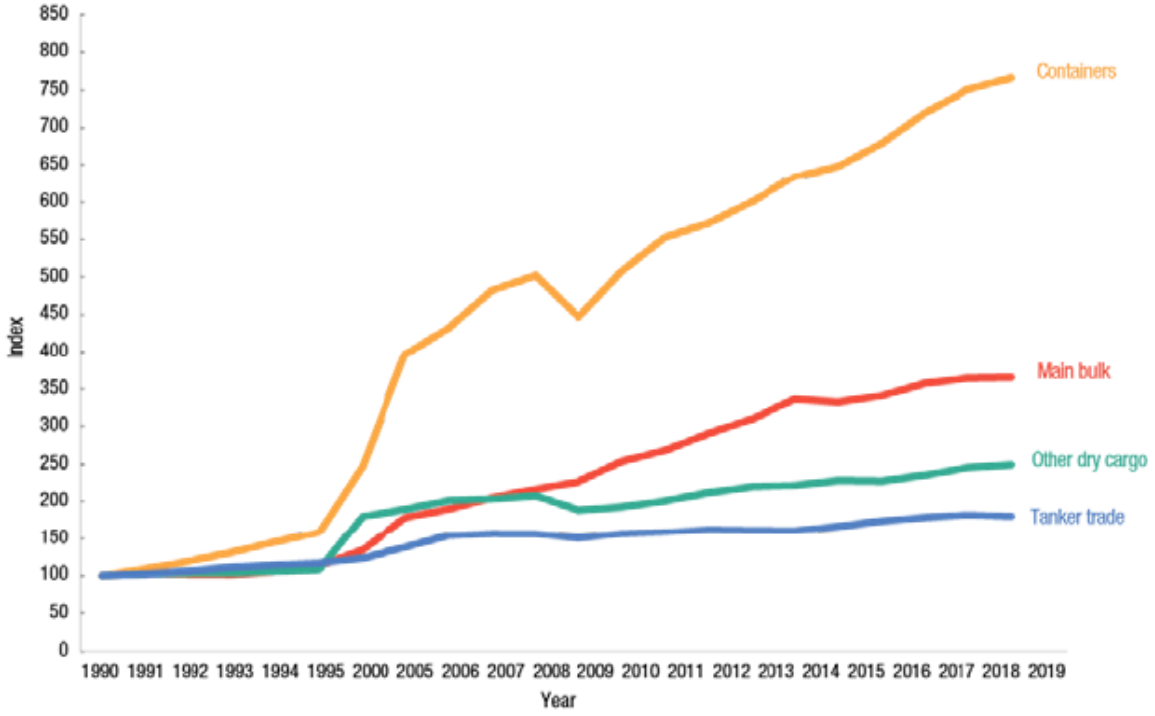
Maritime transportation and production process

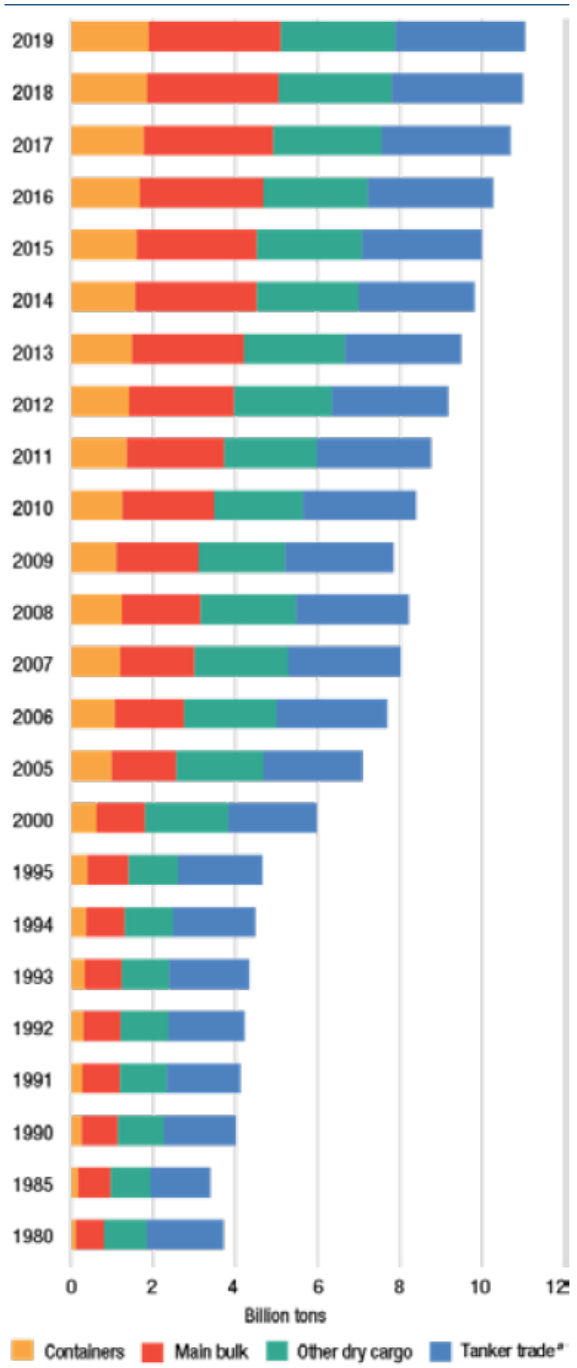


Source: Haralambides, Hercules E. "Gigantism in container shipping, ports and global logistics: a time-lapse into the future." (2019): pp. 1-60.

International maritime trade by cargo type

(millions of tons loaded)

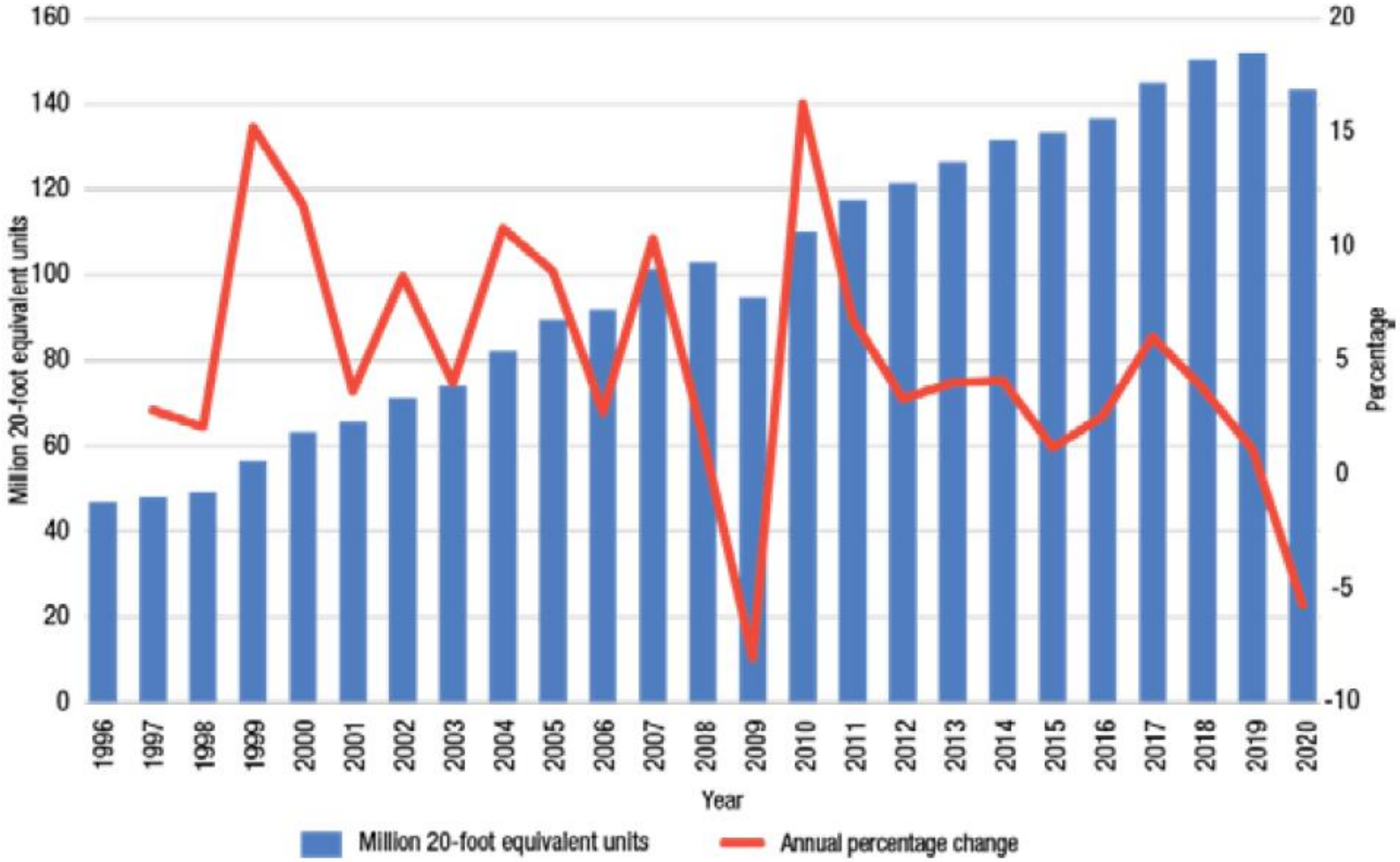




Source: Review of Maritime Transport 2020, UNCTAD

Global containerized trade, 1996–2020

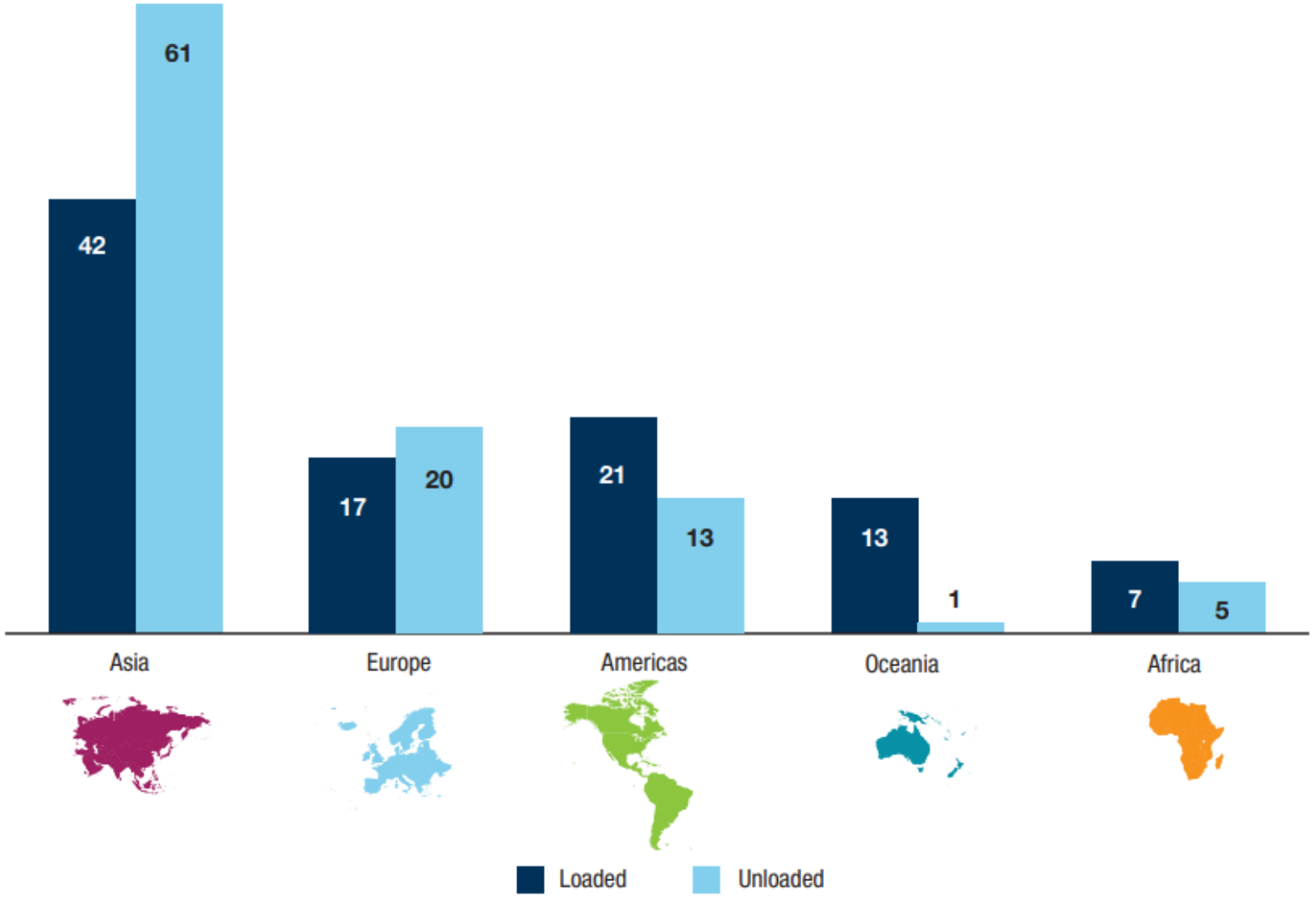
(Million 20-foot equivalent units and annual percentage change)



Source: UNCTAD calculations, based on data from MDS Transmodal, 2020b, 19 August.

World seaborne trade, by region

(percentage share in world tonnage)



Source: Review of Maritime Transport 2018, UNCTAD

Maritime traffic: forecast for the future

- **MEDIUM-LONG TERM FORECAST**: average **annual increase of 3,2%** between 2017 and 2022 which will cover all segments of maritime transport but in particular **containerized traffic** and **solid bulk cargoes**

- The **emerging economies** will continue to represent the most significant part of maritime transport by size

Forecasting entity	Annual growth (percentage)	Years	Source
UNCTAD	-4.1	2020	International Monetary Fund world GDP growth forecast
UNCTAD	4.8	2021	International Monetary Fund world GDP growth forecast
Clarksons Research Services	-4.0	2020	*Seaborne Trade Monitor,* October 2020
Clarksons Research Services	4.7	2021	*Seaborne Trade Monitor,* October 2020

Source: UNCTAD calculations, based on own analysis and forecasts published by the indicated institutions and data providers.

Source: Review of Maritime Transport 2020, UNCTAD

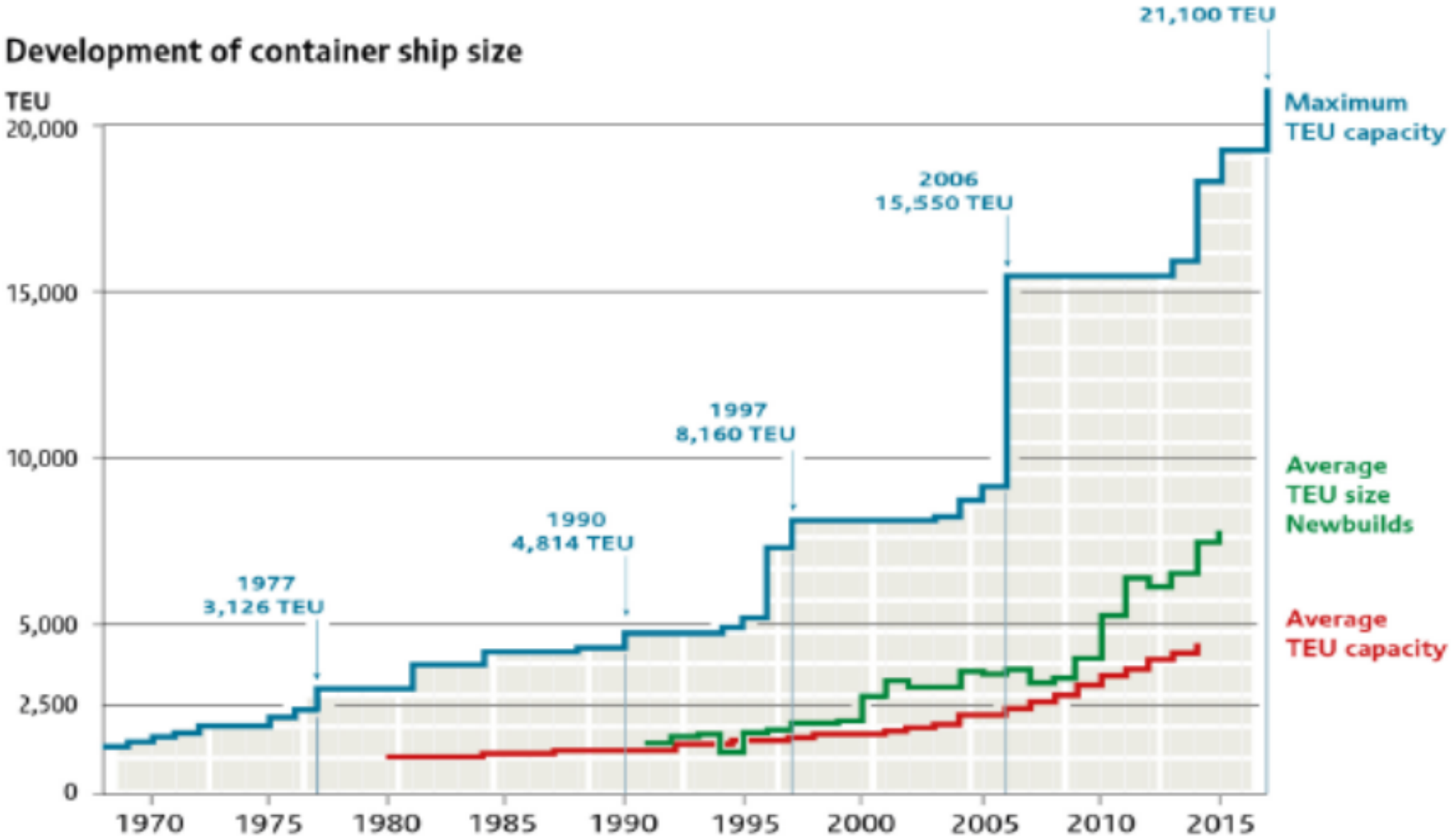
Maritime OFFER: naval gigantism

WOOCLAP 1

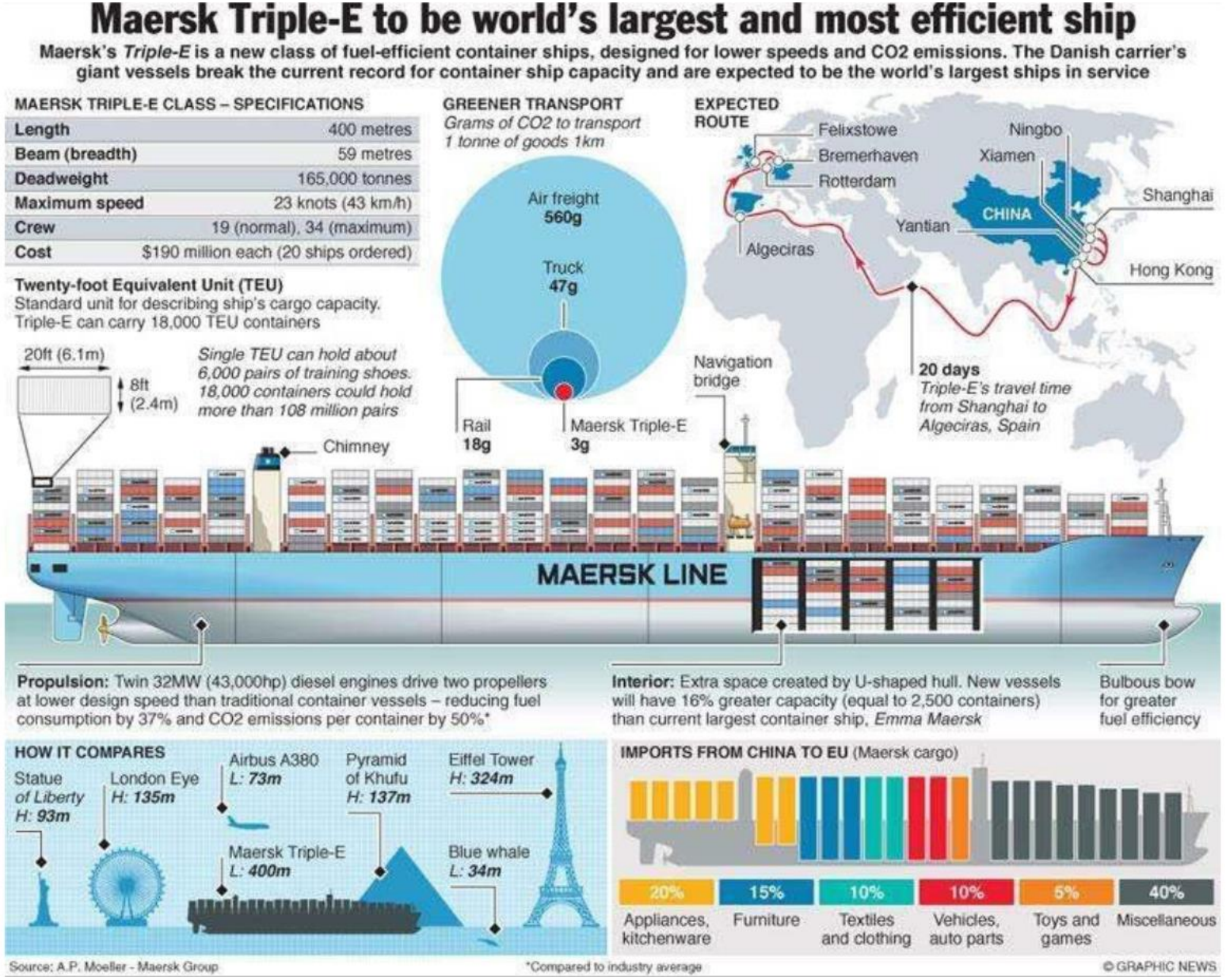
Since the start of containerization vessels have kept growing in size.

Source: www.agcs.allianz.com

The naval gigantism

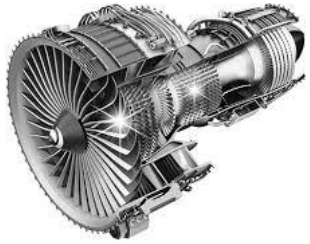


The naval gigantism



Why is it necessary to move products from one end of the world to the other?

WOOCLAP 2



- Absence of material or product
- absence or partial presence of design, production or maintenance skills
- Cost/profit difference

The demand of maritime transport

- It is a **derived demand**
- **Many factors** can influence the trend of shipping:

✓ **geo-political scenario**

✓ **global GDP (*Gross Domestic Product*) trend**

✓ **international trends:**

- ➔ Expansion of **e-commerce**
- ➔ processes of **fragmentation of production/delocalization**
- ➔ the development of **global supply chains**
- ➔ the characteristics of **naval transport**, **port infrastructure**, **ships and routes**
- ➔ increasing **concentration in the liner shipping sector**
- ➔ **Digitalization and innovation** in the port sector
- ➔ ….

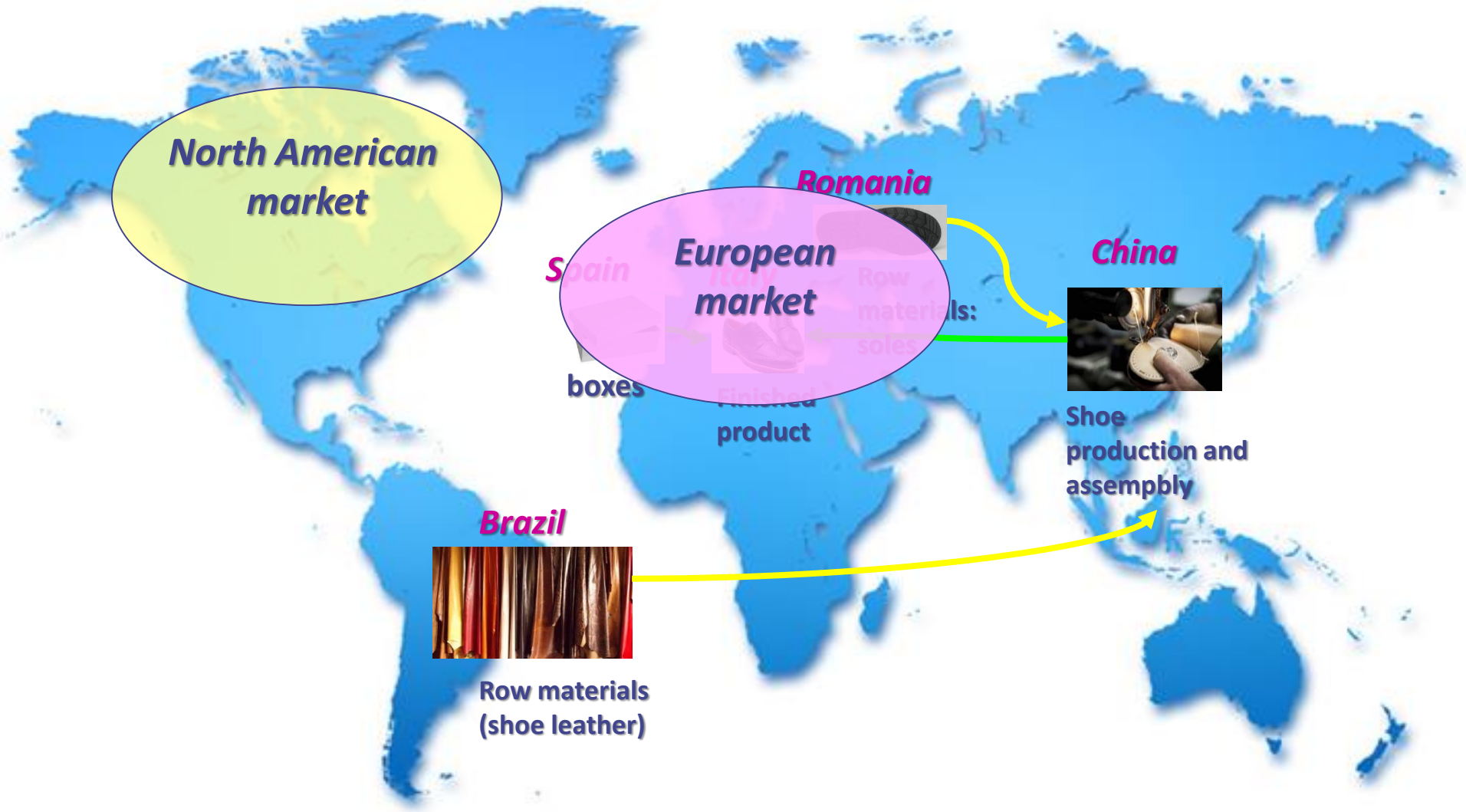
Shipping is part of the global supply chain → it can be considered a "**barometer**" of the **international economy**.

Supply chains evolution

YESTERDAY…

Supply chains evolution

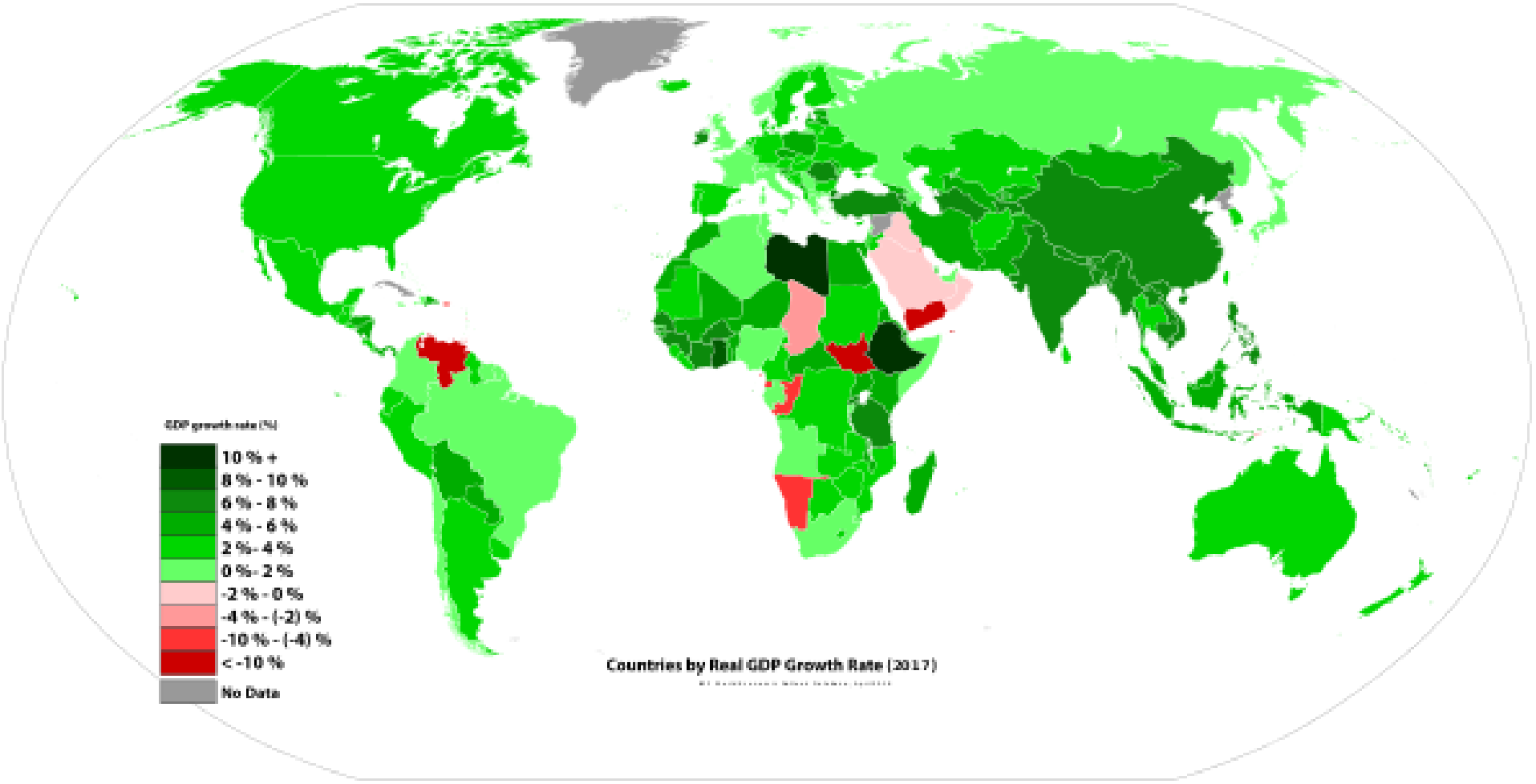
…TODAY



Yesterday's NUTELLA supply chain

Today's NUTELLA supply chain

GDP growth rate



Much of this growth is driven by **emerging developing economies** such as Brazil, China, India and those of the Middle East.

Annual % change in world GDP, international trade and maritime trade

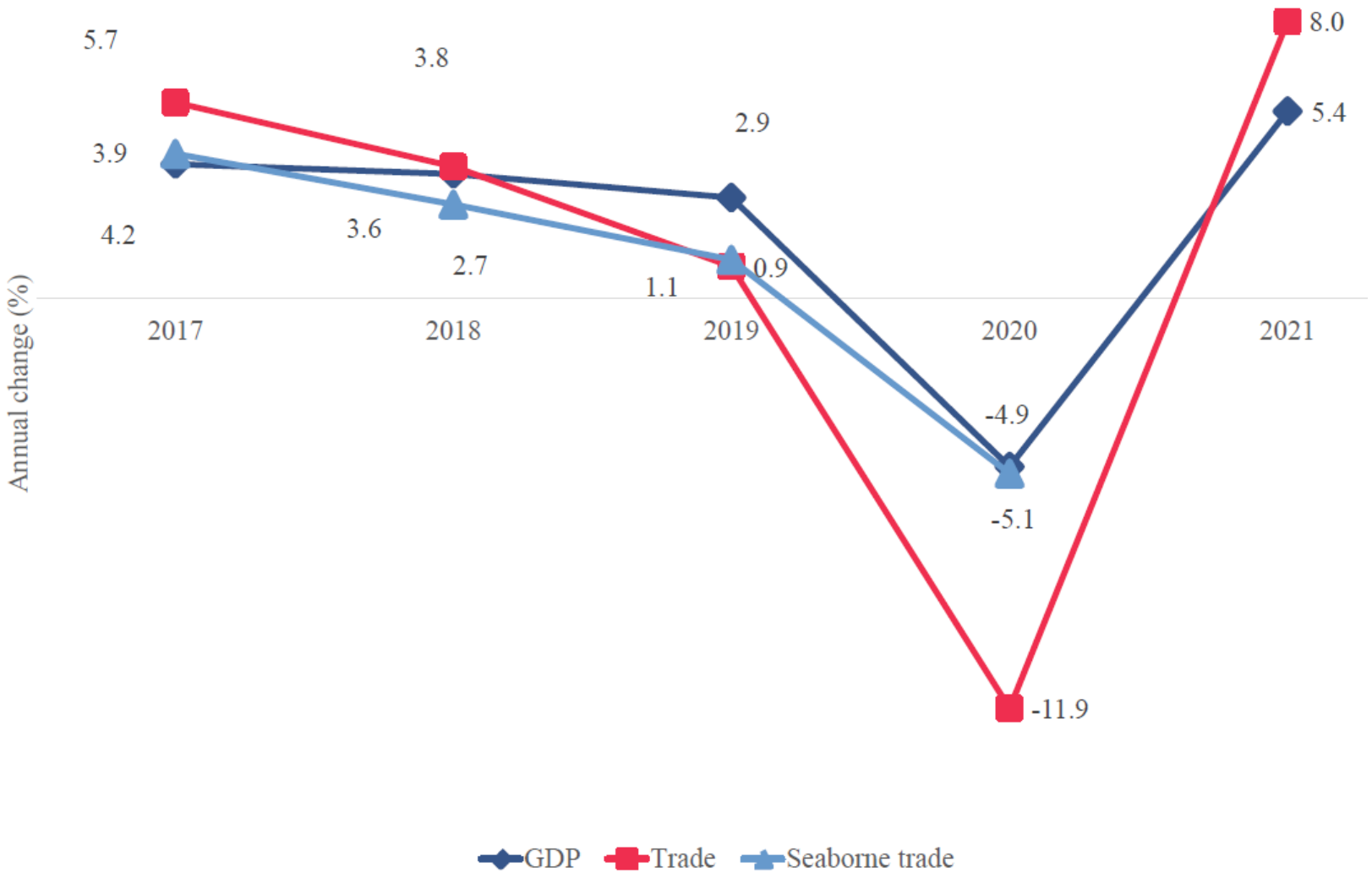


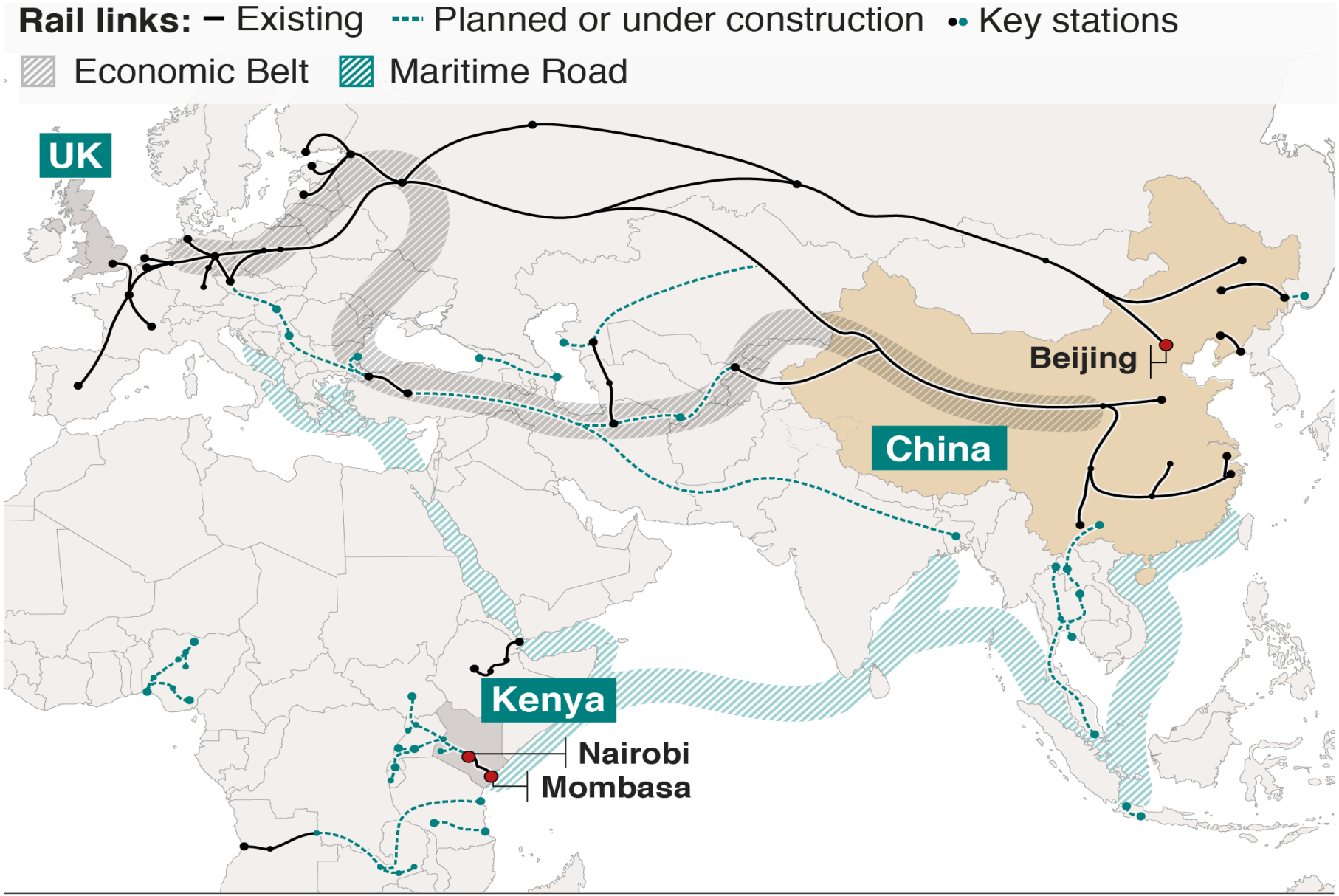
FIGURE 1 - SOURCE: SRM on IMF and Clarksons Research

Macro-political scenario

The macro-political scenario significantly contributes to shaping the trend of international trade:

- **China's Belt and Road Initiative** → growth of seaborne trade volumes
- **Trade wars (e.g. USA-China)**, the resurface of nationalism and protectionism **(e.g. Brexit), geopolitical tensions in the Middle East and Latin America** → changes and uncertainty in the three main sectors - dry cargo, tanker and container
- **IMO 2020 regulations on polluting emissions:** international law requires that, from 1 January 2020, fuels used by ships must have a sulfur content of 0.50% against the previous 3.50%.

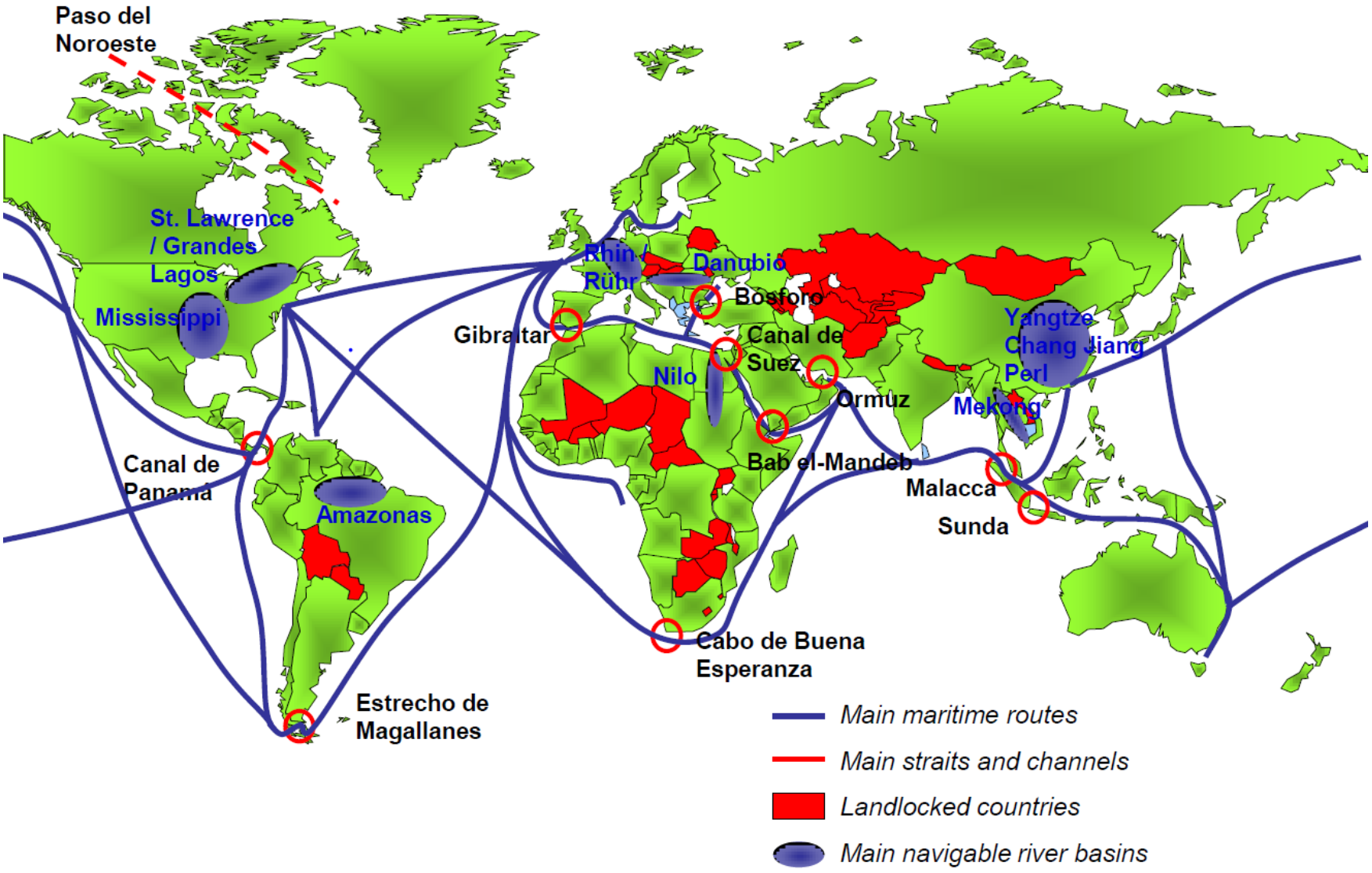
Belt and Road Initiative railway expansion plans



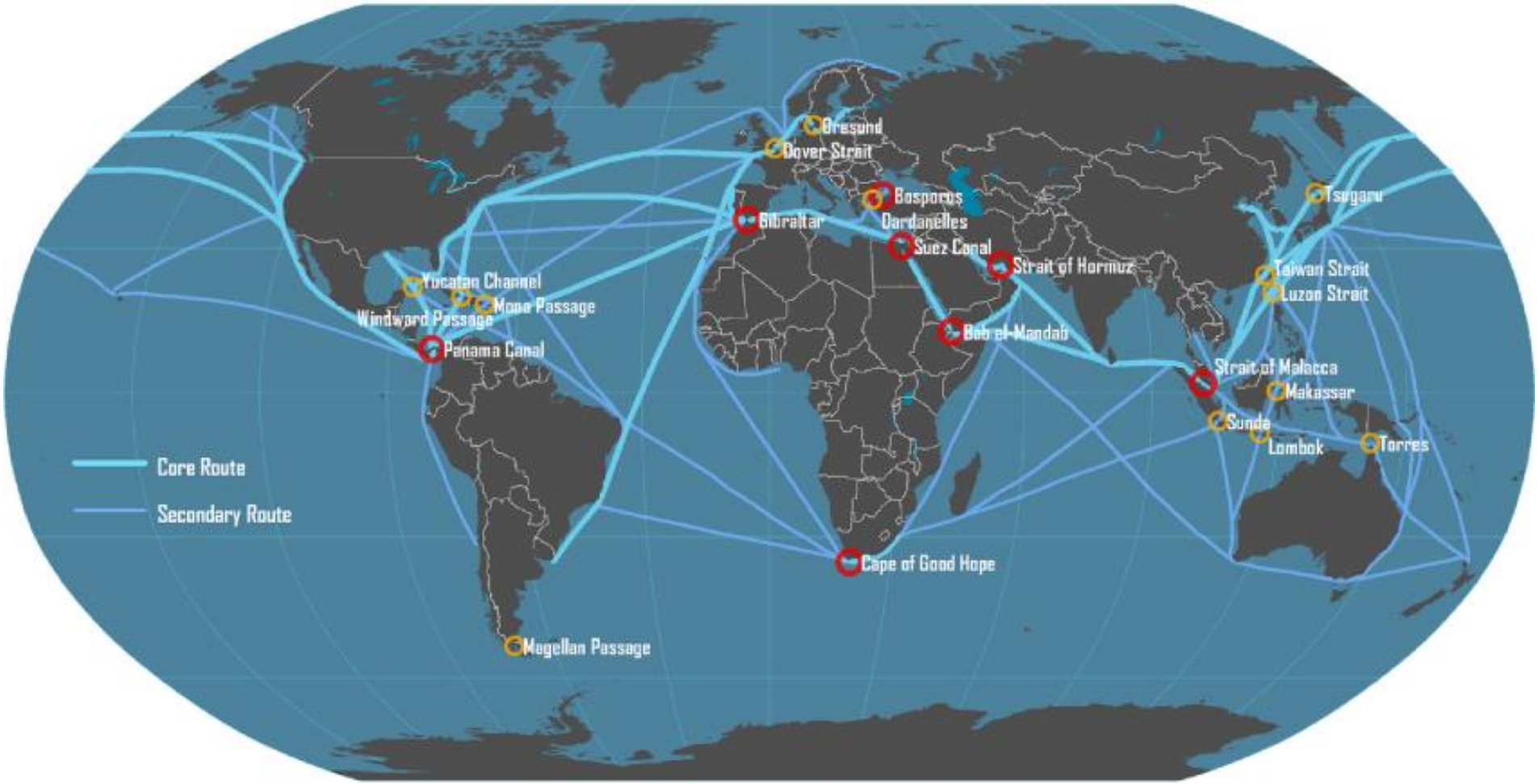
Source: Mercator Institute for China Studies (Merics)

BBC

The main maritime corridors



Main and secondary routes



AGENDA

- The shipping sector
- The role of seaports
- Port-hinterland connectivity

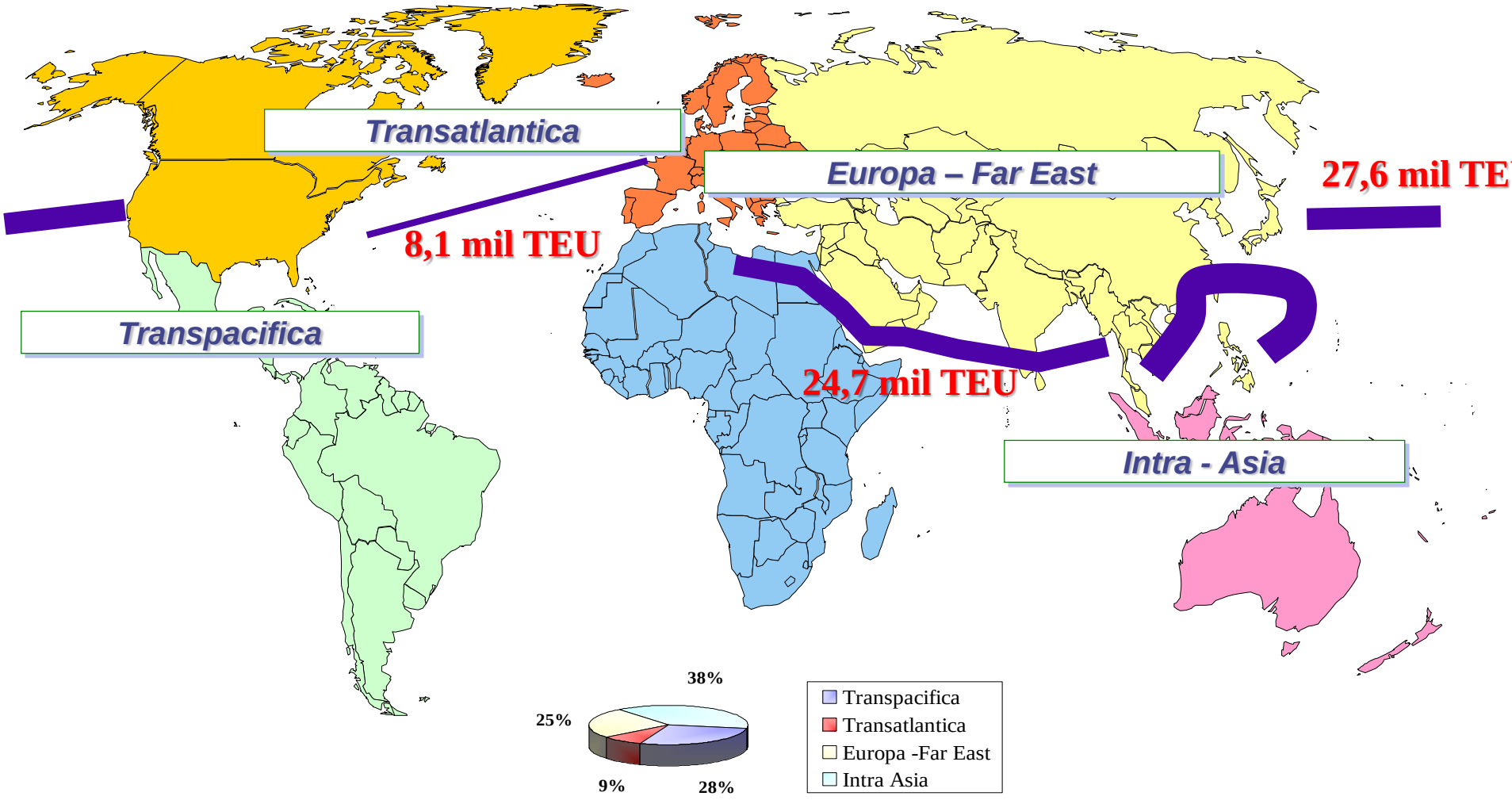
Seaports

ports competitiveness ⟺ *competitiveness of a Country*

SEAPORTS play a key role in the economic growth of States

- **critical nodes** in global supply chains, since they **support international economy and trade**
- function of modal **re-equilibrators** (sea-land)
- They "capture" value for themselves and for the logistic-productive chain in which they are embedded, generating **money and employment.**

World Routes: evolving scenarios ..



The main routing alternatives between East Asia and Northern Europe

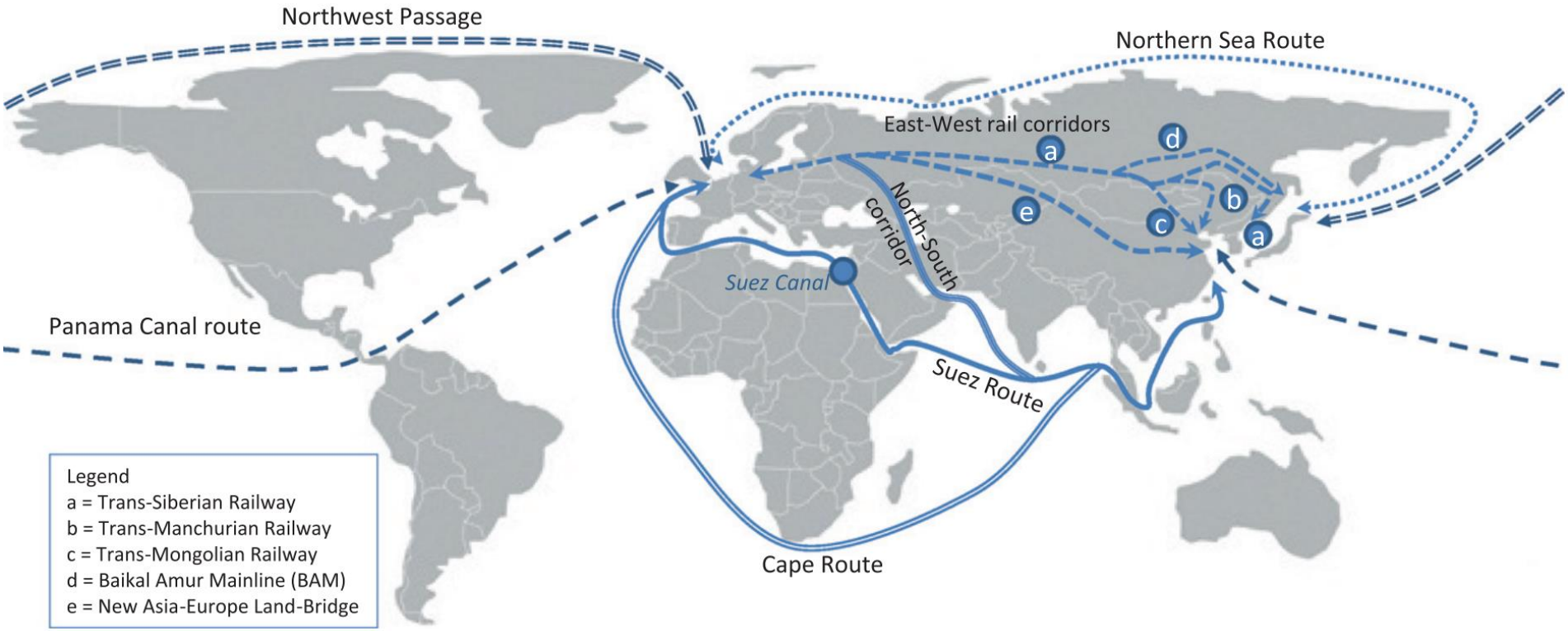


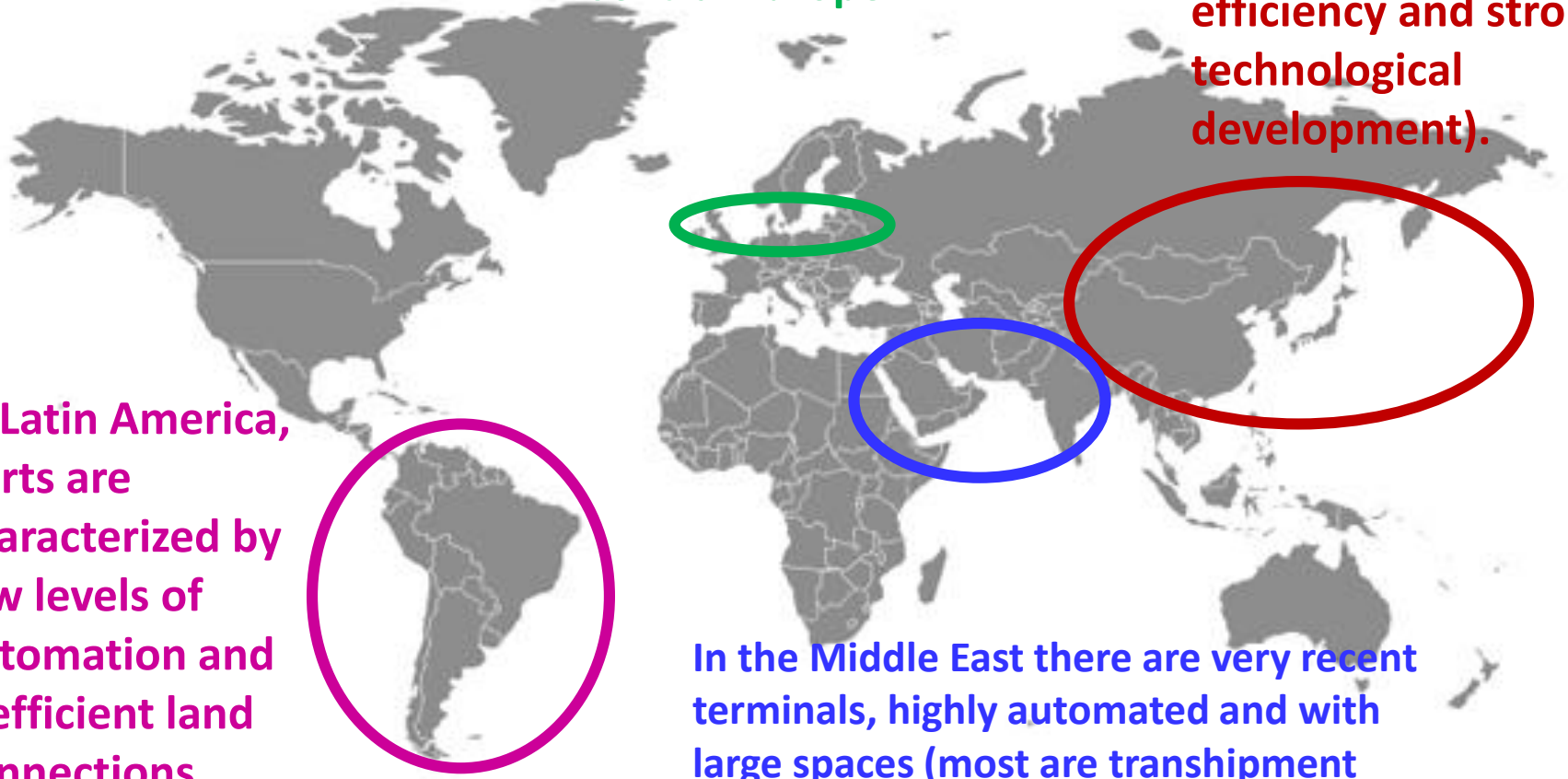
Fig. 9. The main routing alternatives between East Asia and Northern Europe.

Source: T. Notteboom, Journal of Transport Geography 22 (2012) 164–178

World seaports

Northern Range: modern infrastructure, high automation and efficient land connections with Central Europe

More than 50% of global traffic is managed by Asian ports (high space, organizational efficiency and strong technological development).



In Latin America, ports are characterized by low levels of automation and inefficient land connections.

In the Middle East there are very recent terminals, highly automated and with large spaces (most are transhipment ports)

The main seaports in Russia

Type of flows passing through a seaport

SEA

Transhipment

EXPORT (outbound)

IMPORT (inbound)

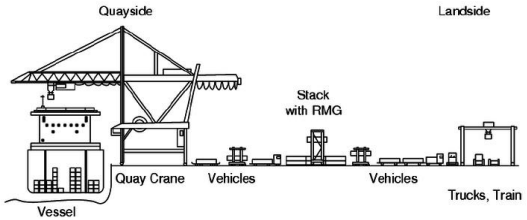
PORT

LAND

Hinterland transport (**road, rail, inland waterways**)

EXPORT (outbound)

IMPORT (inbound)



Type of seaports

Classification of **ports** based on the flow of goods:

- ***gateway import***, if the prevailing flow is from ship to truck / train.
- ***gateway export***, if the prevailing flow is from truck / train to ship.
- di ***transhipment***, if the prevailing flow is from bigger ships (*deep-sea vessel*) to smaller ones (*feeder vessel*).

Top 20 seaports for container traffic (TEU)

Rank	Port	Country	2014	2015	2016	2017	2018	Var.% 18/17	Var.% 17/16	Var.% 16/15	Var.% 15/14
1	Shanghai	China	35,285,000	36,537,000	37,133,000	40,230,000	42,010,000	4.4%	8.3%	1.6%	3.5%
2	Singapore	Singapore	33,869,000	30,922,400	30,903,644	33,666,556	36,600,000	8.7%	8.9%	-0.1%	-8.7%
3	Ningbo-Zhoushan	China	19,450,000	20,627,000	21,561,000	24.610.000	26,520,000	7.8%	14.1%	4.5%	6.1%
4	Shenzhen	China	24,030,000	24,205,000	23,979,000	25,210,000	25,736,000	2.1%	5.1%	-0.9%	0.7%
5	Guangzhou	China	16,363,000	17,624,900	18,857,700	20,370,000	21,890,000	7.5%	8.0%	7.0%	7.7%
6	Busan	South Korea	18,683,283	19,468,725	19,456,291	20,493,475	21,670,000	5.7%	5.3%	-0.1%	4.2%
7	Hong Kong	China	22,226,000	20,073,000	19,813,000	20,760,000	19,640,000	-5.4%	4.8%	-1.3%	-9.7%
8	Qingdao	China	16,624,000	17,436,000	18,050,000	18,300,000	19,320,000	5.6%	1.4%	3.5%	4.9%
9	Tianjin	China	14,057,000	14,111,000	14,519,000	15,070,000	15,972,000	6.0%	3.8%	2.9%	0.4%
10	Jebel Ali	UAE	15,250,000	15,592,000	14,772,000	15,370,000	14,940,000	-2.8%	4.0%	-5.3%	2.2%
11	Rotterdam	Netherlands	12,300,000	12,234,535	12,385,168	13,734,334	14,480,000	5.4%	10,9%	1.2%	-0.5%
12	Port Klang	Malaysia	10,945,804	11,886,685	13,169,577	11,980,000	12,030,000	0.4%	-9,0%	10.8%	8.6%
13	Antwerp	Belgium	8,977,738	9,653,511	10,037,318	10,450,897	11,020,000	5.4%	4.1%	4.0%	7.5%
14	Xiamen	China	8,600,000	9,182,815	9,613,700	10,380,000	10,702,300	3.1%	8.0%	4.7%	6.8%
15	Kaohsiung	Taiwan	10,590.000	10,264,420	10,464,860	10,270,000	10,445,726	1.7%	-1.9%	2.0%	-3.1%
16	Dalian	China	10,130,000	9,450,000	9,614,000	9,700,000	9,770,000	0.7%	0.9%	1.7%	-6.7%
17	Los Angeles	USA	8,340,066	8,160,458	8,856,783	9,343,193	9,458,748	1.2%	5.5%	8.5%	-2.2%
18	Port Tanjung Pelepas	Malaysia	8,523,935	9,117,025	8,280,710	8,380,000	8,900,000	6.2%	1.2%	-9.2%	7.0%
19	Hamburg	Germany	9,728,666	8,821,481	8,906,817	8,815,469	8,730,000	-1.0%	-1.0%	1,0%	-9.3%
20	Laem Chabang	Thailandia	6,583,165	6,821,335	7,227,430	7,784,498	8,110,000	4.2%	7.7%	6.0%	3.6%
	Top 20		**310,556,657**	**312,189,290**	**317,600,998**	**334,918,422**	**347,944,774**	**3.9%**	**5.5%**	**1.7%**	**0.5%**

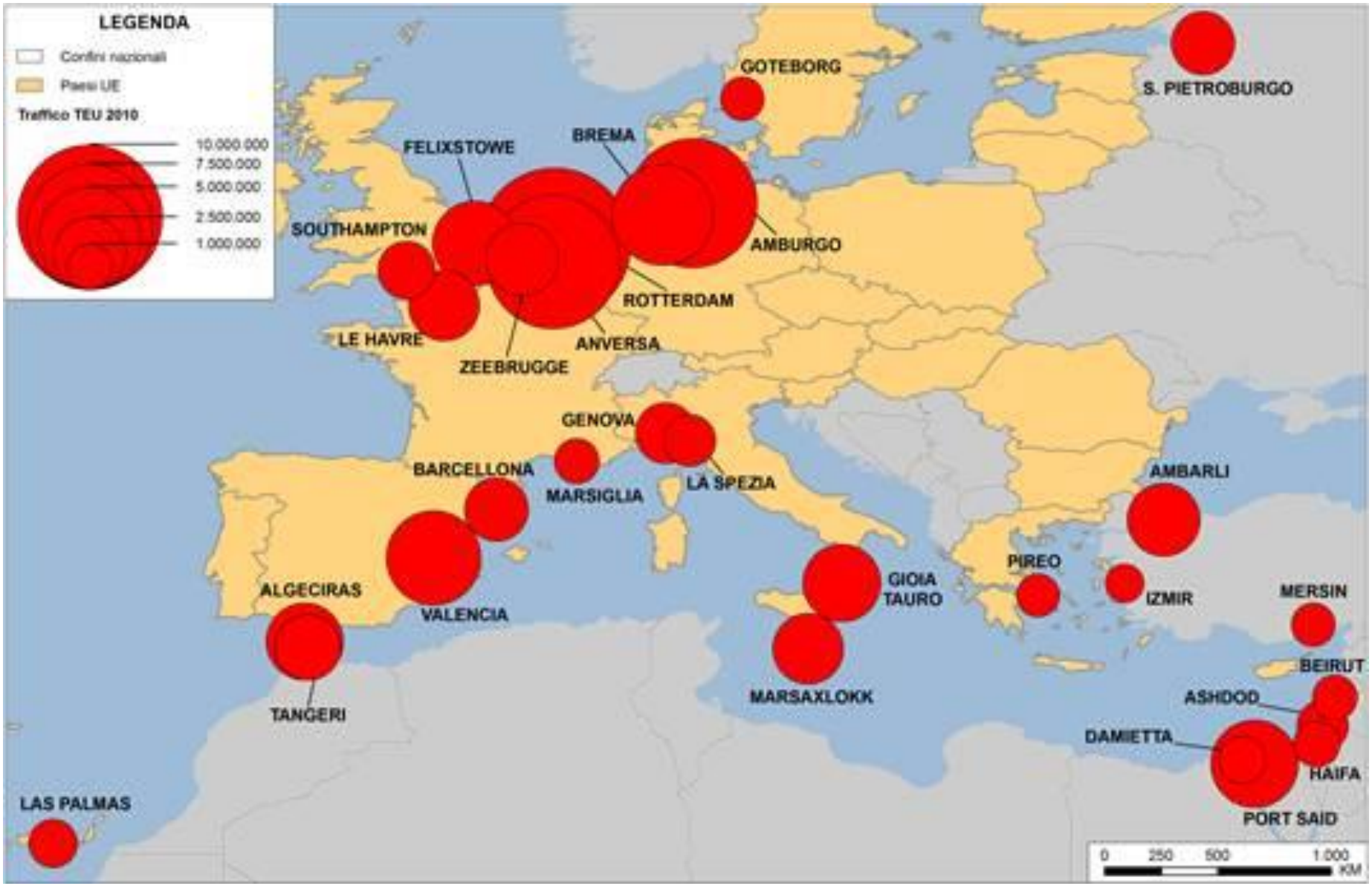
Top 30 ports in EU and Med (TEU)

Rank	Port	2015	2019	
1	Rotterdam	12.234.535	14.810.804	—
2	Antwerp	9.653.511	11.870.000	—
3	Hamburg	8.821.481	9.257.683	—
4	Piraeus	3.339.293	5.648.030	▲
5	Valencia	4.615.196	5.439.827	—
6	Algeciras	4.511.322	5.125.385	—
7	Bremen	5.546.657	4.856.873	▼
8	Tanger Med	2.961.837	4.801.713	▲
9	Felixstowe	4.043.000	3.781.000	▼
10	Port Said	3.462.400	3.658.159	▼
11	Barcelona	1.953.282	3.324.196	▲
12	Ambarli	3.091.026	3.110.000	▼
13	Le Havre	2.559.000	2.786.000	▲
14	Marsaxlokk	3.064.005	2.720.000	▼
15	**Genoa**	**2.242.902**	**2.615.375**	—
16	**Gioia Tauro**	**2.550.000**	**2.522.874**	▼
17	St. Petersburg	1.715.139	2.221.724	▲
18	Gdansk	1.091.202	2.073.215	▲
19	Southampton	1.954.000	*1.970.000*	▼
20	Mersin	1.466.199	1.939.029	▲
21	Alexandria	1.661.917	1.814.950	▼
22	Zeebrugge	1.568.938	1.710.000	▼
23	London	1.185.041	*1.680.000*	▲
24	Izmir	656.000	*1.600.000*	▲
25	Ashdod	1.307.000	1.538.000	▼
26	Marseille	1.223.173	1.454.621	▼
27	Sines PSA	1.332.200	1.423.213	▼
28	**La Spezia**	**1.300.442**	**1.409.381**	▼
29	Haifa	1.220.000	1.379.000	▼
30	Beirut	1.130.284	1.229.081	▼

In corsivo i dati stimati al 2019.

TABELLA 12 - FONTE: SRM su Autorità Portuali

Container traffic in the main European ports



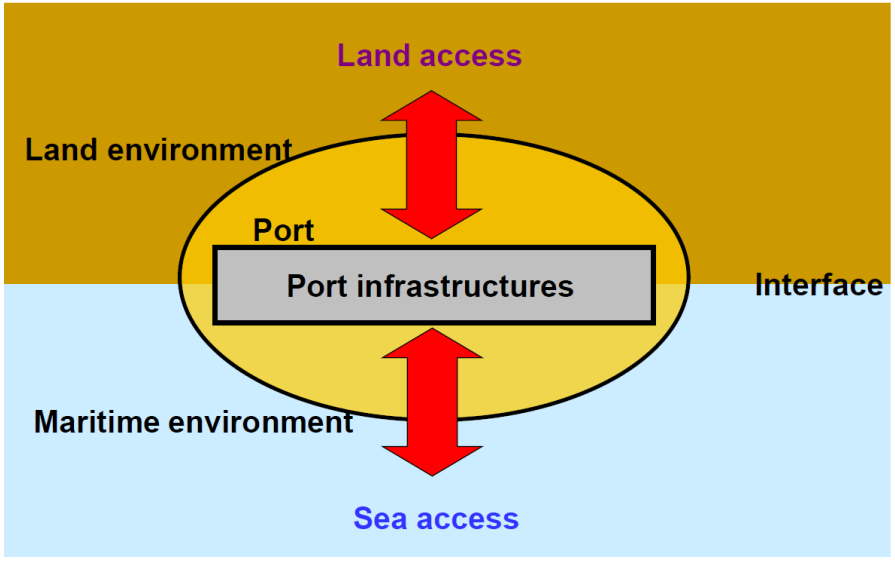
Competition among seaports

WOOCLAP 3

The **competitiveness factors** of a seaport (gateway) are related to:

1. **Geographical position** of the port (respect to the sea and the hinterland)
2. **Infrastructures and superstructures**

- **internal** factors at the port: dredging, lengths of the docks, number and type of equipment, etc.
- **external** factors to the port: maritime network capacity, railway and road network, connections with dry ports, etc.



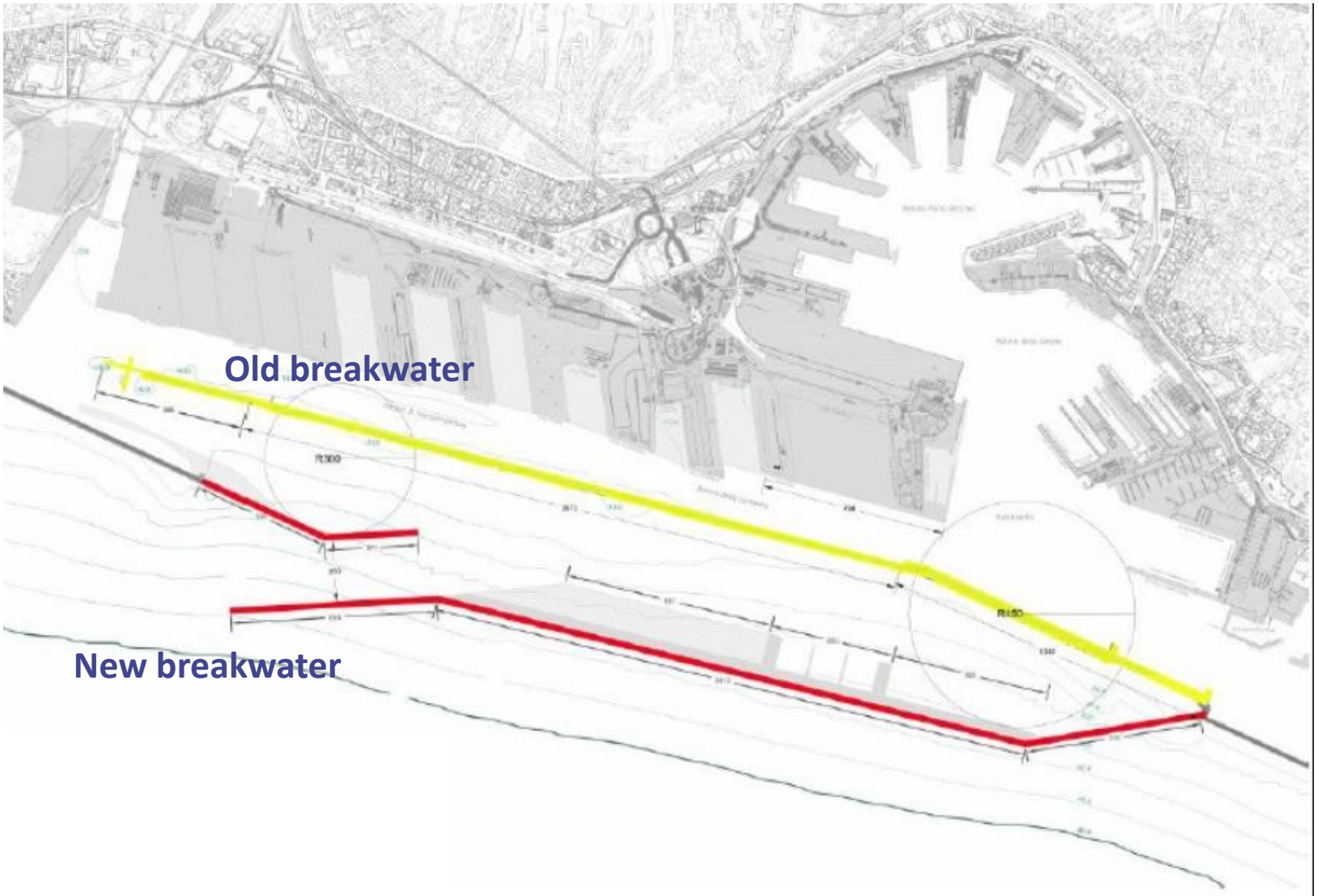
Competition among seaports

3. **Quality of service: times** of public, private and nautical services, etc.
4. **Costs**:
   - **internal costs:** handling and parking, maritime services, port taxes and charges, etc.
   - **External costs:** connections with hinterland and sea routes.

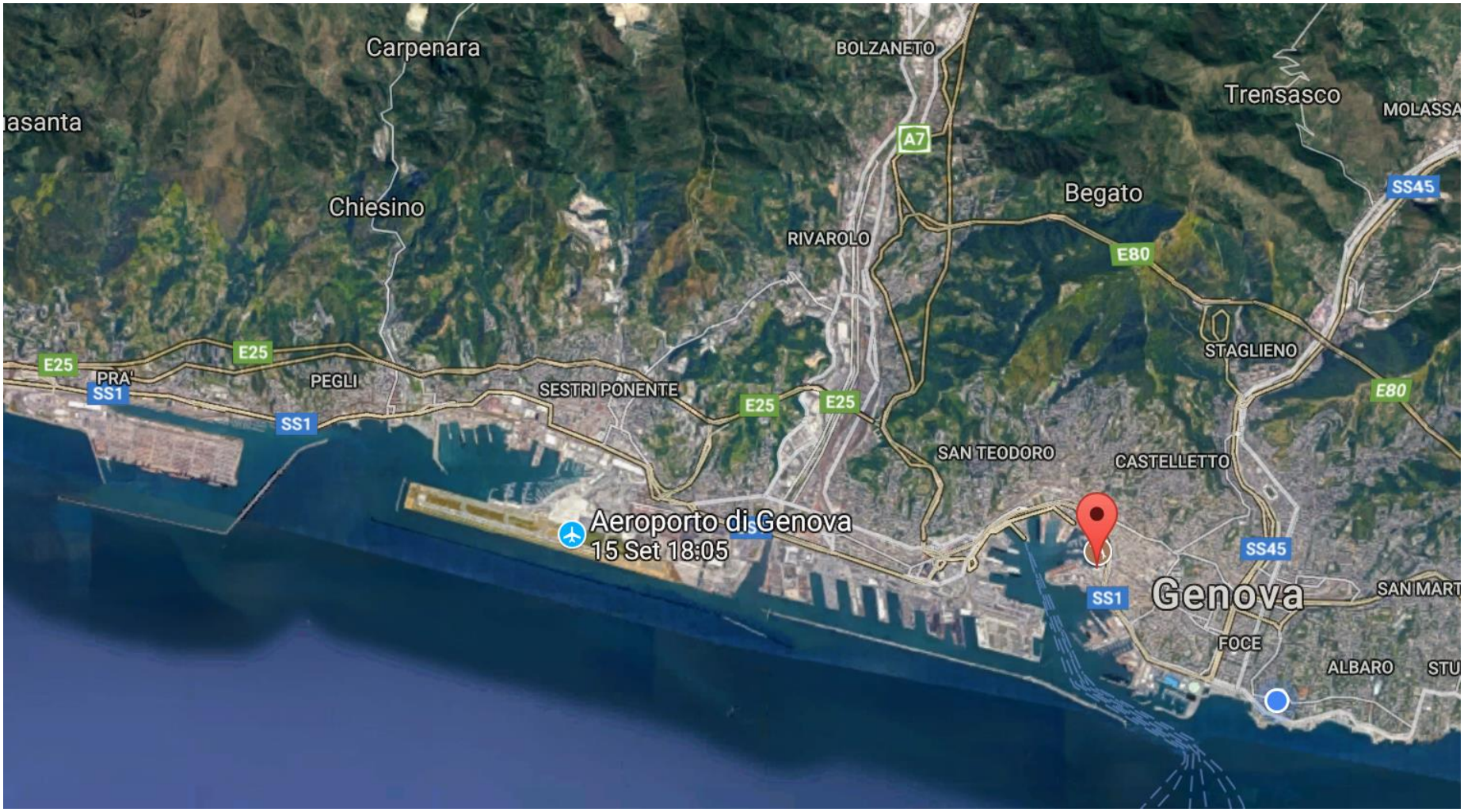
Maritime network capacity

Infrastructural impact of gigantism

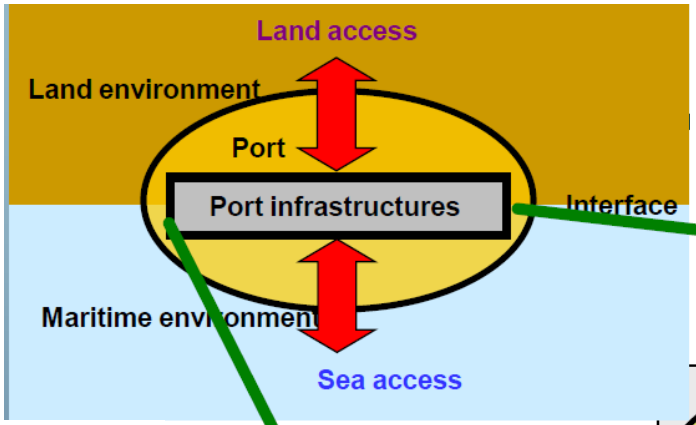
GENOA port



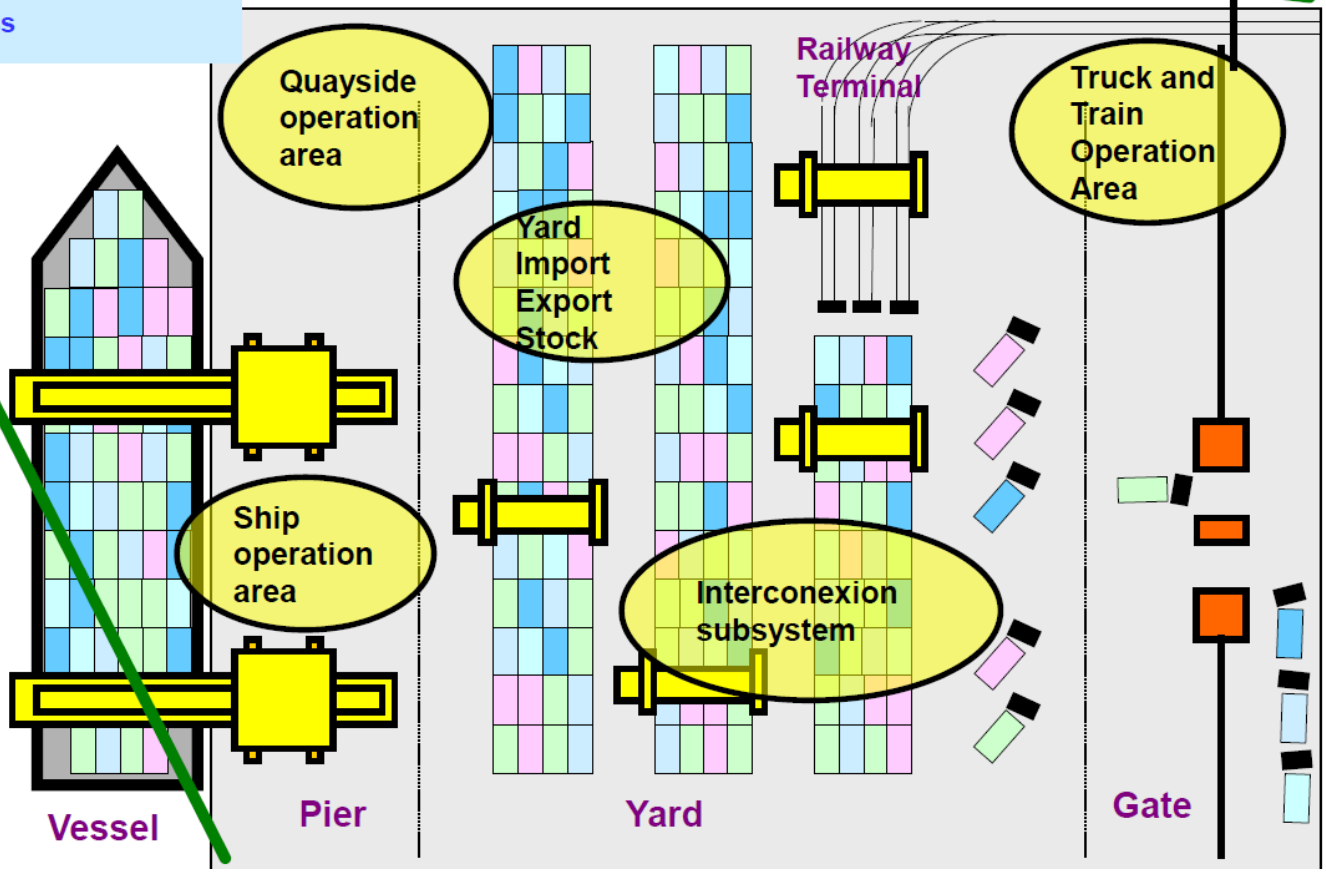
The port of Genoa



Competition among seaports



Ports superstructures and infrastructures:



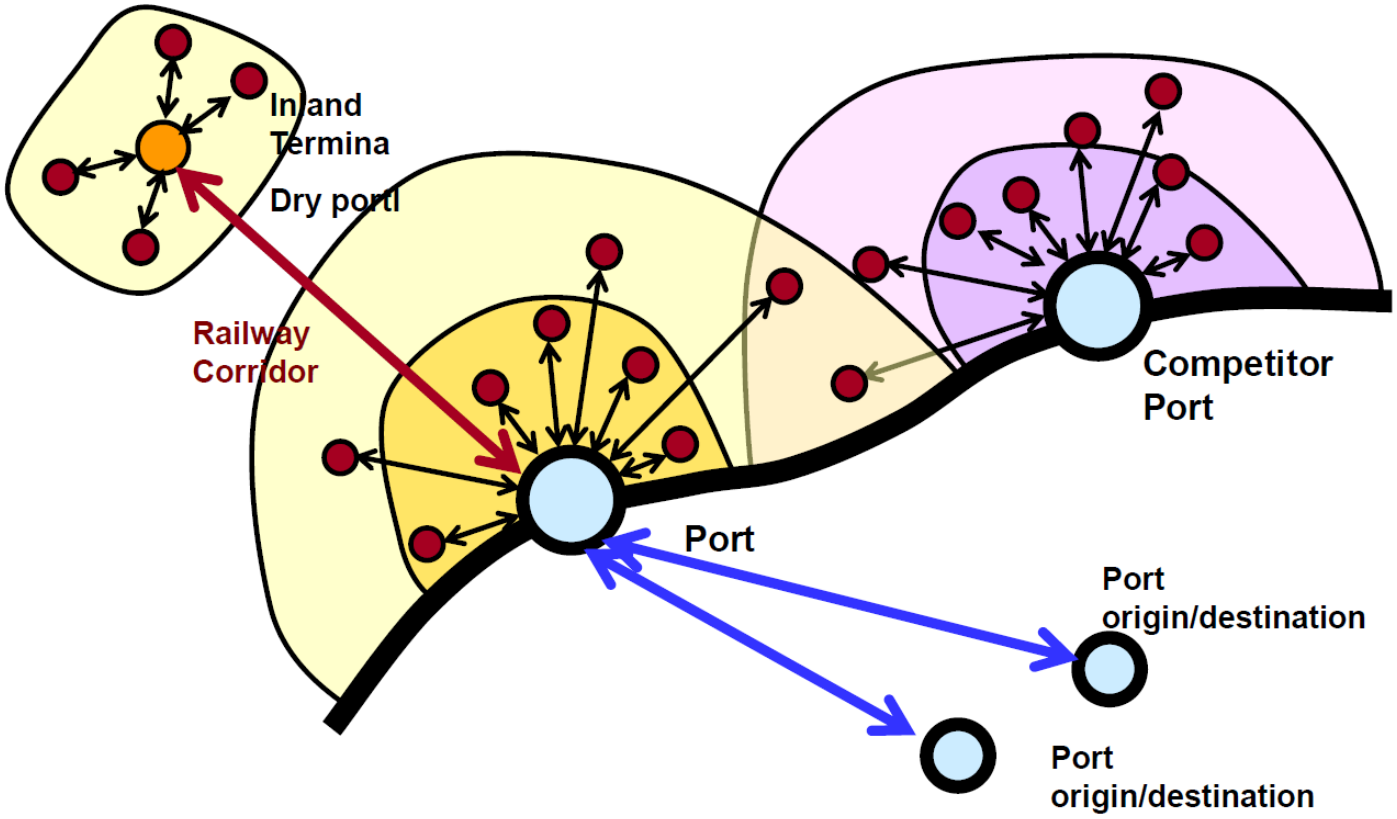
AGENDA

- The shipping sector
- The role of seaports
- Port-hinterland connectivity

Competition among ports

Hinterland

- The port **hinterland** is a land area over which a port sells its services and interacts with its users.
- Port hinterlands are strategic market areas to interact and compete *(Notteboom and Rodrigue)*



Competition among seaports: hinterland

- **CONNECTIVITY** is the **ability of a seaport to easily connect with inland ports, airports, production and consumption areas through logistics and transport networks**.

- Therefore, both the **efficiency of the Country** (diffusion and functionality of infrastructures such as transport and communications, regulations, procedures and bureaucracy) and the **degree of integration of a country with its reference markets play a crucial role.**

- "*The port becomes an intermodal node par excellence where the movement of goods is no longer sufficient in itself to guarantee the success of the port, but transport to the hinterland is one of the main determinants*" (SOURCE: Acciaro M. in SRM (2015), Italian Maritime Economy Risks and opportunities in the center of the Mediterranean 2nd Annual Report, Giannini Editore, Naples

Source: Italian Maritime Economy 3°Rapporto Annuale, SRM, 2016

How to connect the port with its hinterland?

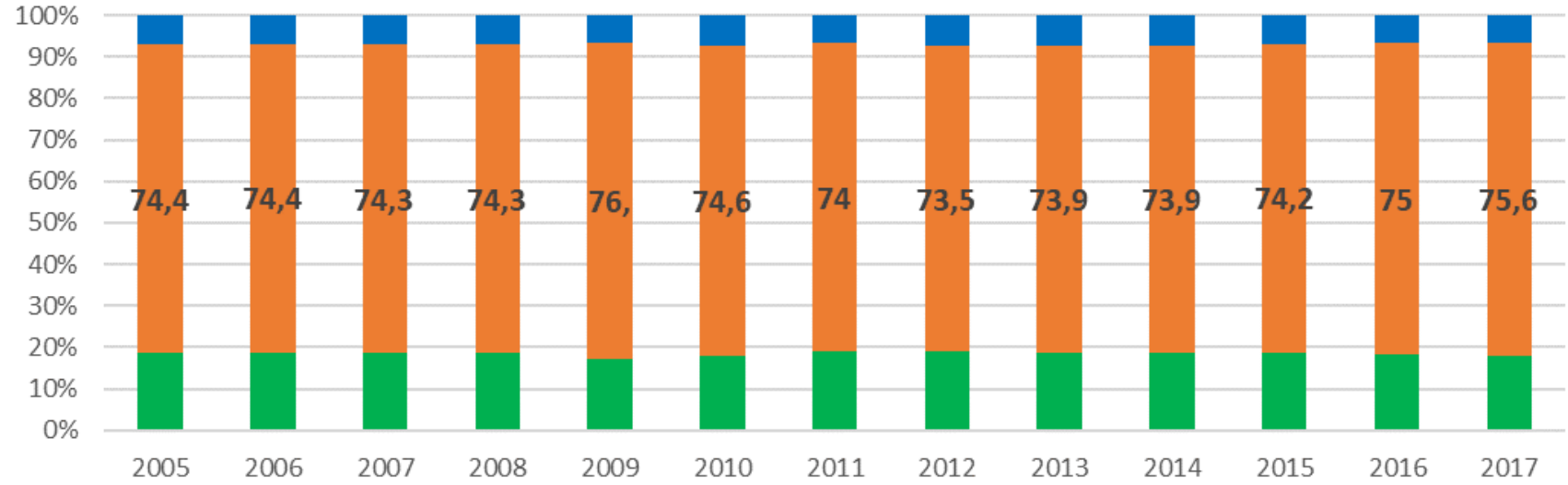
ROAD transport

RAIL transport

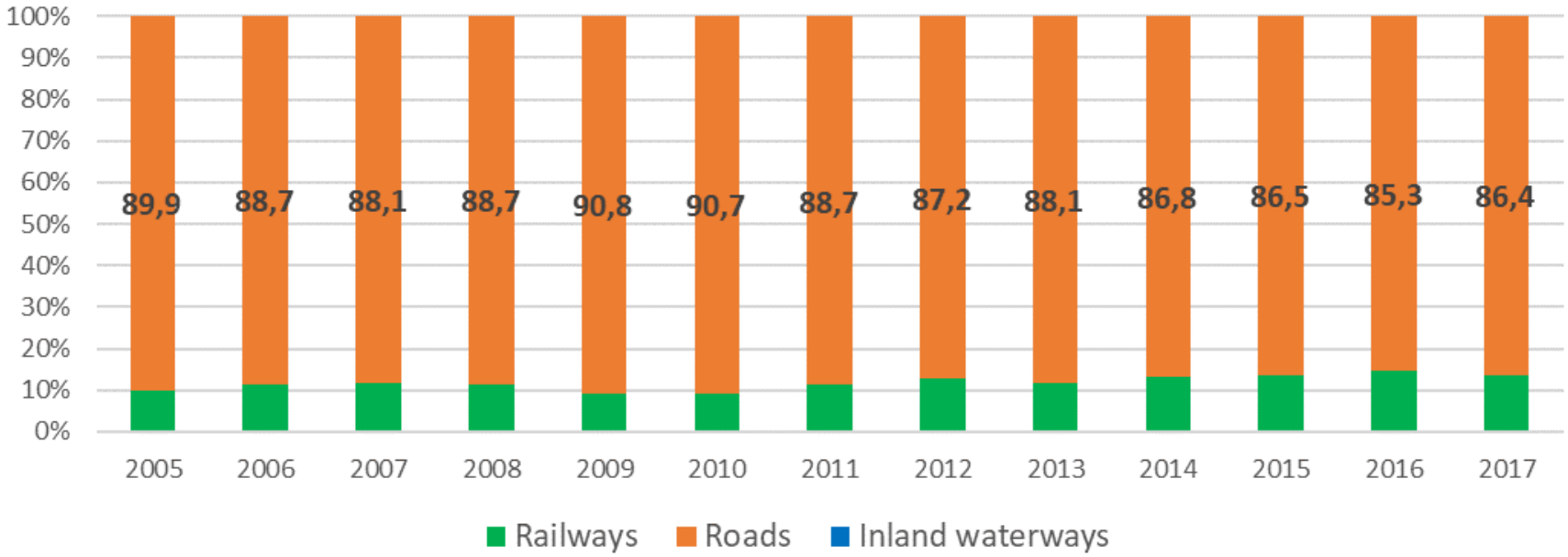
INLAND WATERWAYS transport

Inland modal share

EU 27



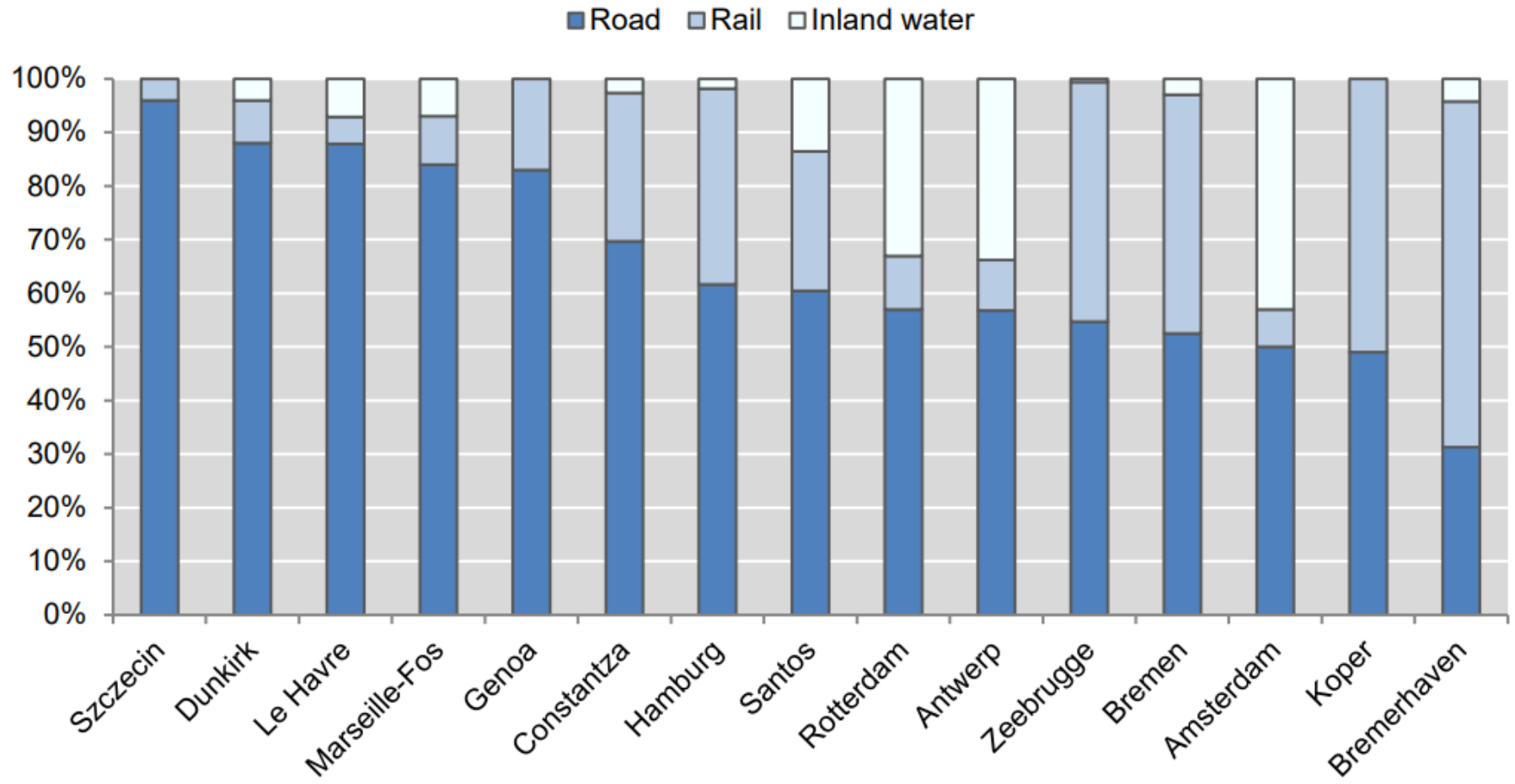
Italy



Source: EUROSTAT

Inland modal share

Some selected ports



Source: OECD (2014).

The Hinterland

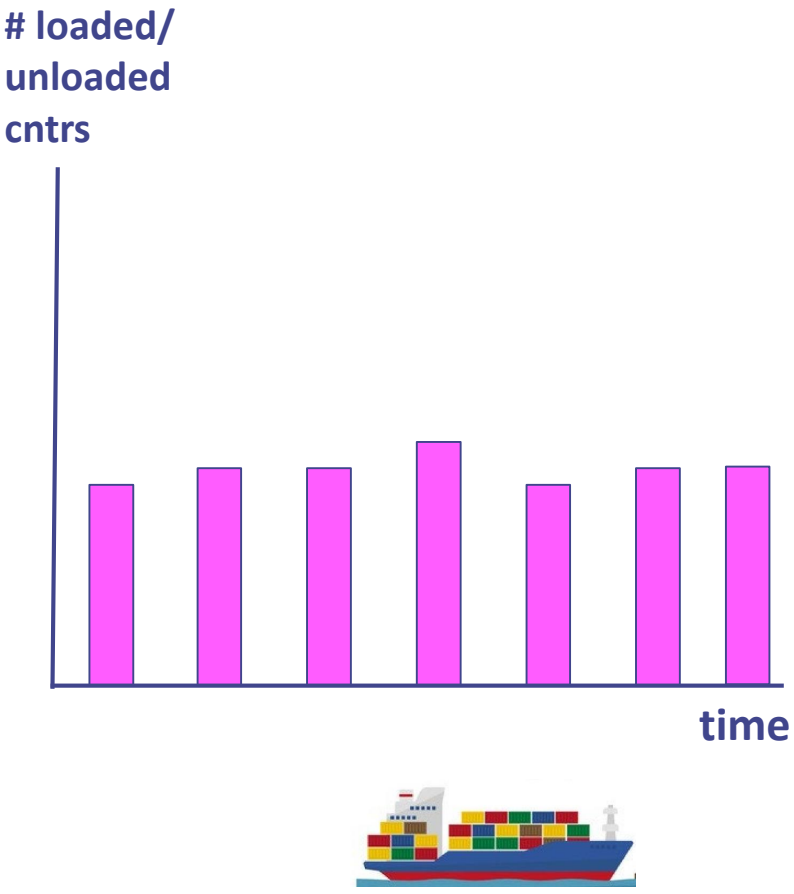
- The competitiveness of a seaport strongly depends on the **extent the cargo handled in the port can reach its hinterland destination.**
- The **importance of hinterland connections** has been recognised as **one of the most critical issues in port competitiveness** and development in most ports around the world.

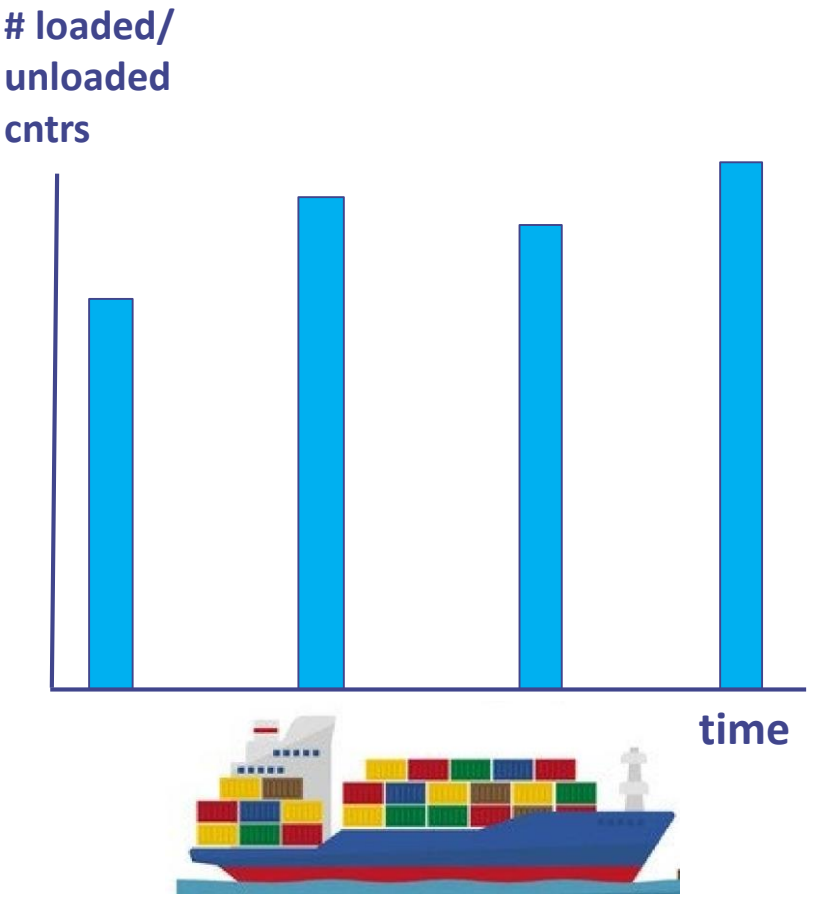
Need of smooth and seamless port-hinterland connections

Note that **increasing ship vessel** size exacerbates the bottlenecks related to port hinterland connectivity!!!

A signigicant impact of gigantism

- Quay crane productivity decreases
- Need to size on peaks
- IT costs





How to improve hinterland connections

Ports around the world have developed multiple strategies to improve their hinterland connections, in response to the challenges imposed by:

- **increasing traffic**
- **Impact of gigantism**
- **shrinking public budgets**
- **competition for road and rail use from passenger and personal vehicle**
- **proximity of many ports to densely urbanised areas**

How to improve the PORT-HINTERLAND connectivity?

WOOCLAP 4

a) Infrastructures (extension, maintenance, …)

b) Planning and management of operations

c) Coordination and synchronization

d) Digitalization/IT/paperless and interoperability

e) Favour rail and inland waterways modes

f) Develop connections with inland terminals

g) Develop CORRIDORS

How to improve the PORT-HINTERLAND connectivity?

a) Infrastructures (extension, maintenance, …)

How to improve the PORT-HINTERLAND connectivity?

b) Planning and management of operations

- Better **planning** to reduce transit times and costs
- More **flexible** organization
- Manage and control road traffic flows (*Truck Appointment Systems*)

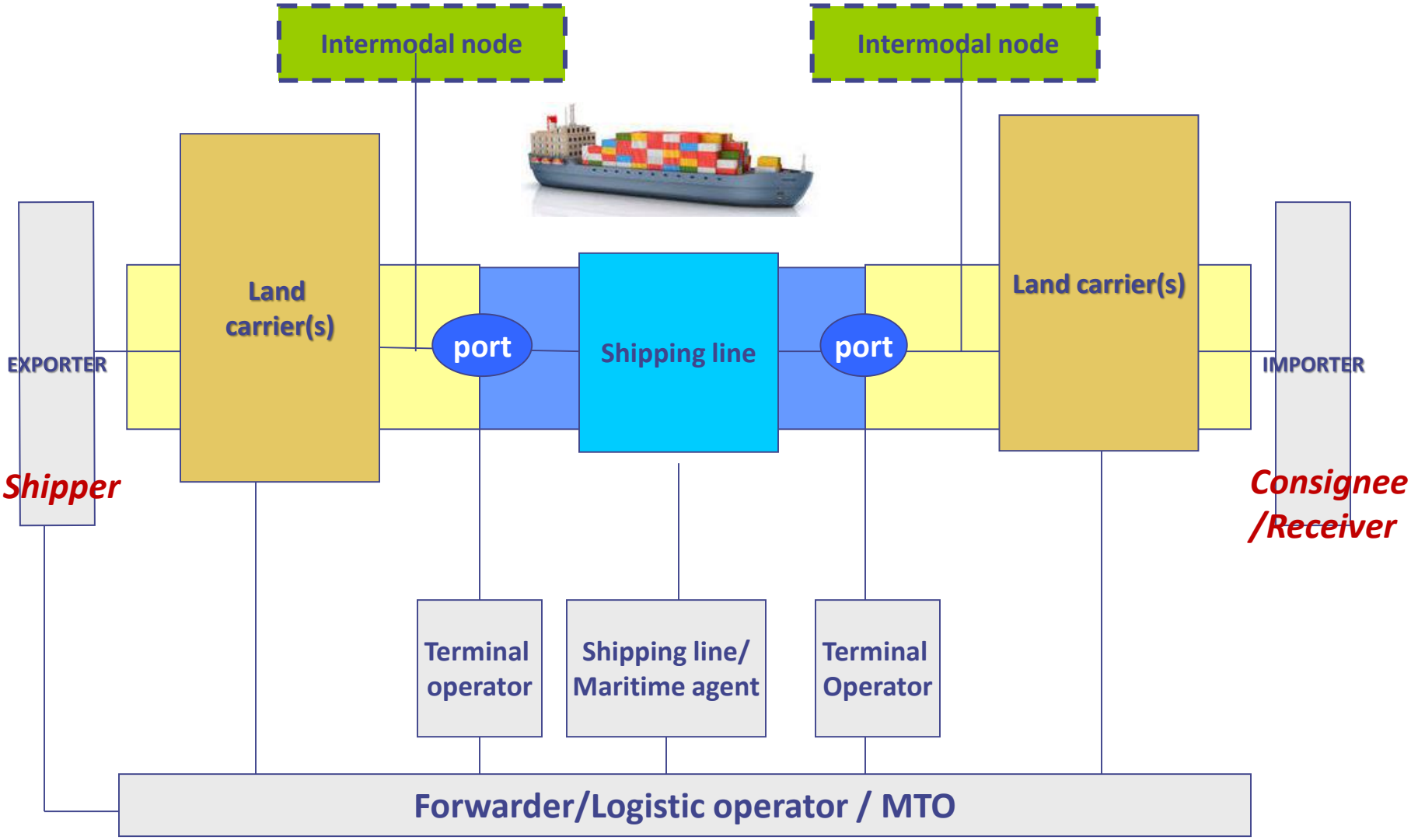
Giganstim → concentration of flows in **narrow time windows** (**peaks**)!!!

How to improve the PORT-HINTERLAND connectivity?

c) Coordination and synchronization

- One of the main issues related to the development of adequate hinterland connections in ports is the **need to coordinate multiple** actors often with **conflicting mandates:**
  - ❑ Many stakeholders involved
  - ❑ Different (sometimes conflicting) objectives
  - ❑ Different IT systems and working modes
  - ❑ Public and private entities

A generic international shipment: stakeholders involved



Source: re-elaborated version on E. Musso slide

A generic international shipment: stakeholders involved

EXPORTER

Road carrier

port

Shipping line

port

Road carrier

IMPORTER

Shipper

Consignee /Receiver

Terminal operator

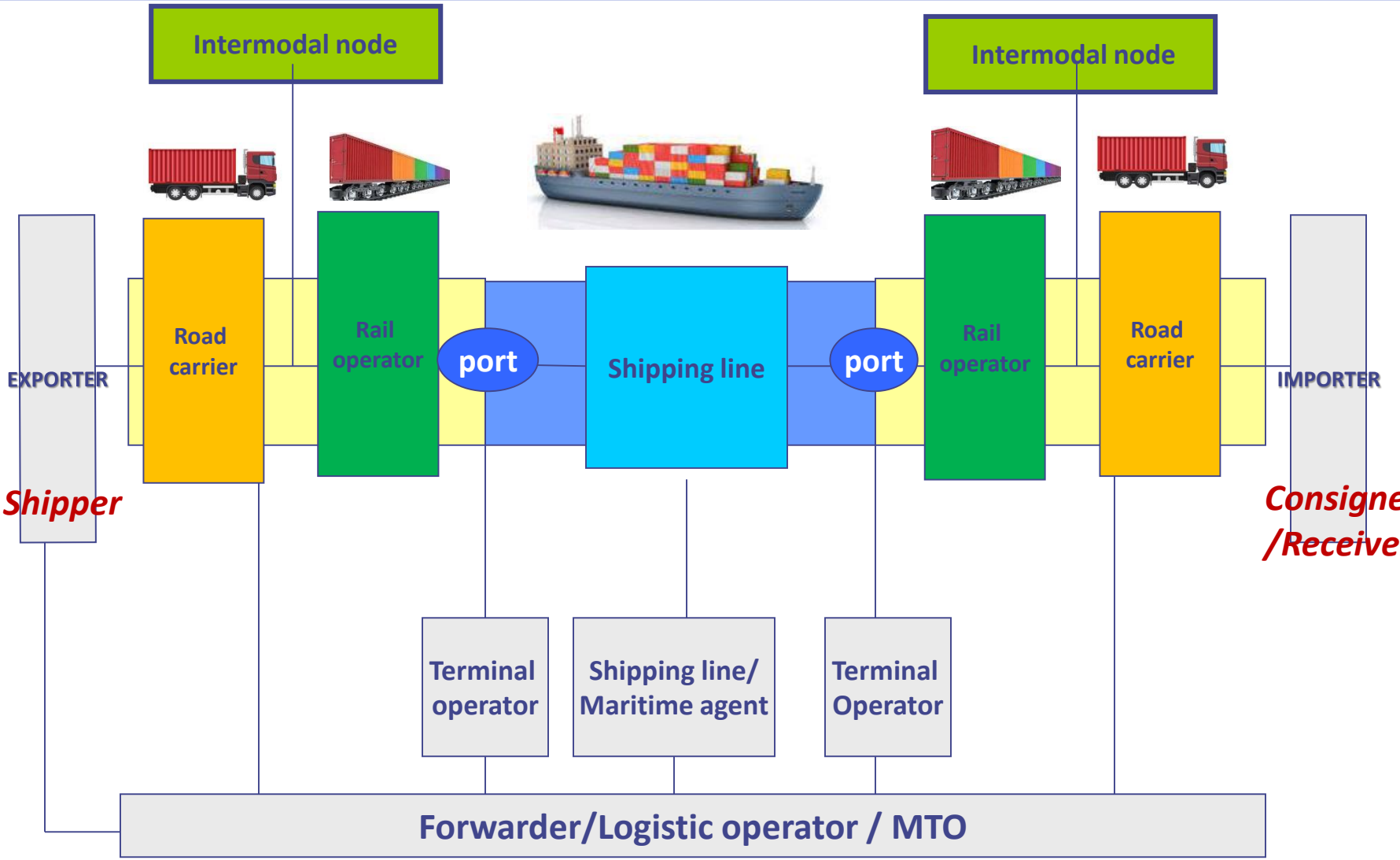
Shipping line/ Maritime agent

Terminal Operator

Forwarder/Logistic operator / MTO

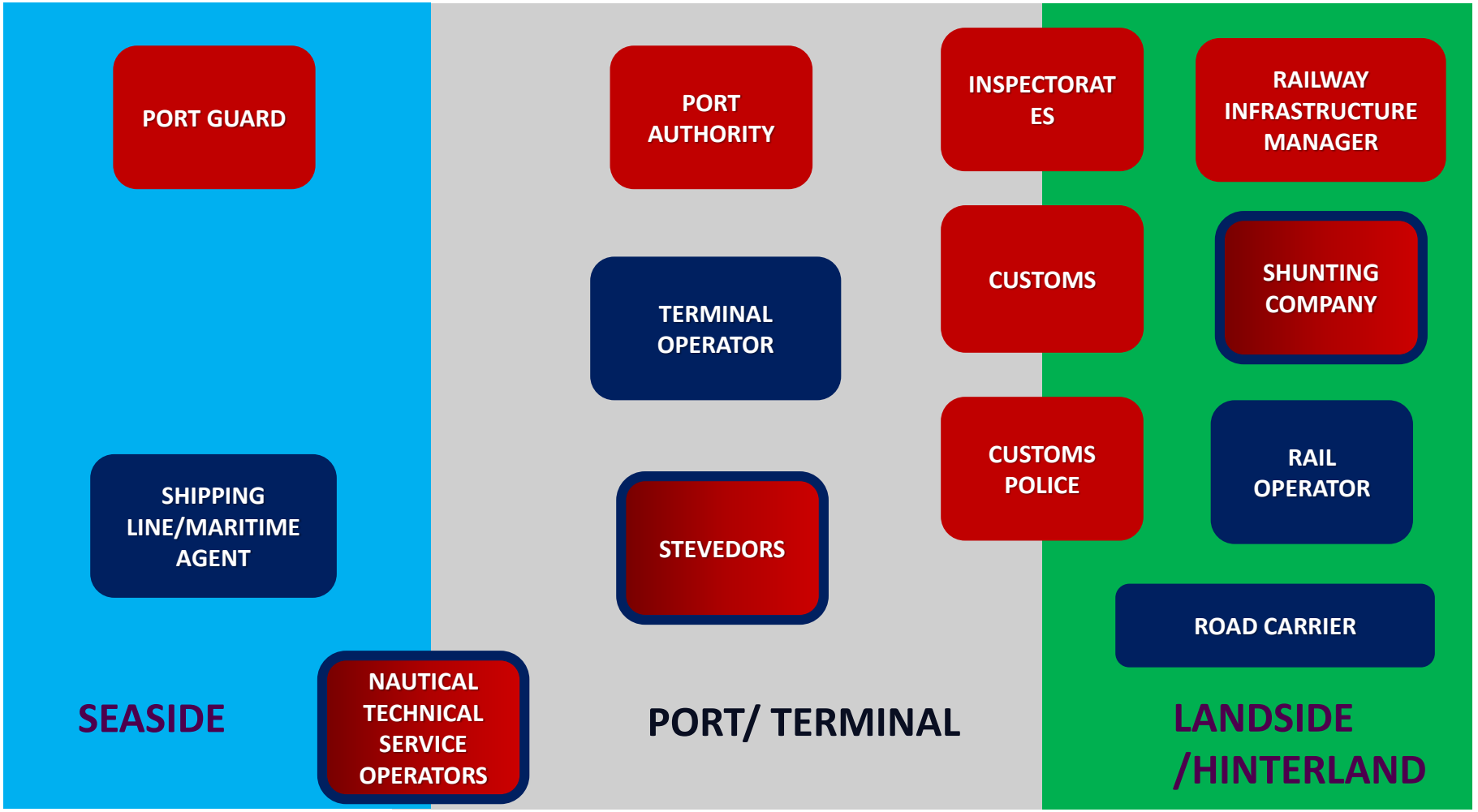
Source: re-elaborated version on E. Musso slide

A generic international shipment: stakeholders involved



Source: re-elaborated version on E. Musso slide

The stakeholders involved in maritime – port logistic



NVOCC

FORWARDER

MTO – MULTIMODAL TRANSPORT OPERATOR

3PL-4PL

Public body

Private subject

How to improve the PORT-HINTERLAND connectivity?

d) Digitalization/IT/paperless and interoperability

To speed up times
and reduce costs!

How to improve the PORT-HINTERLAND connectivity?

e) Favour rail and inland waterways modes

- Increasing traffic flows
- Gigantism: peaks of traffic
- Sustainability issues (environment and society)

Need to increase the **railway transport and inland waterways!**

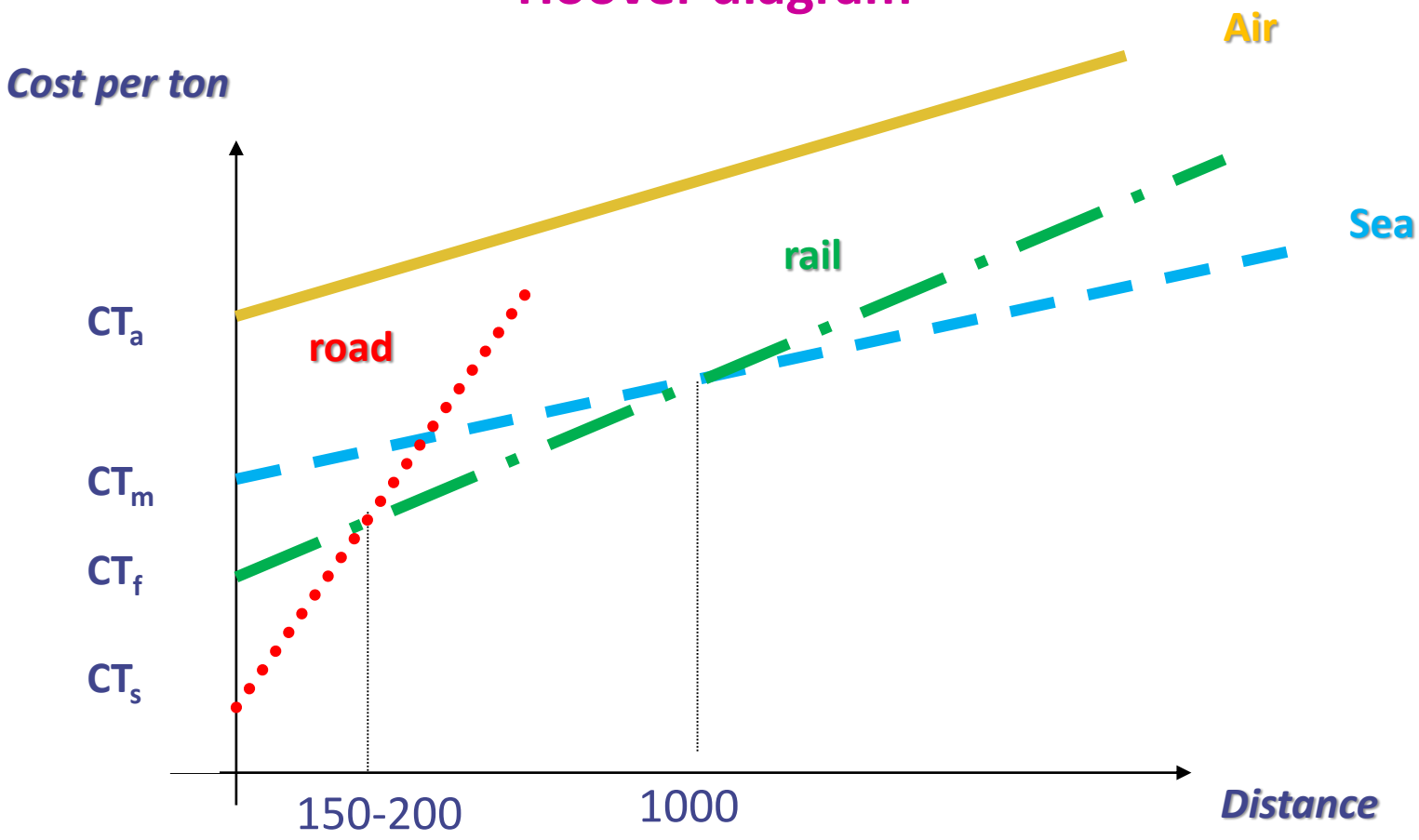
Transport modes

	Advantages	Disadvantages
	■ Speed, flexibility and versatility ■ Accessibility ■ Single access allows door-to-door ■ Many hauliers ■ Extensive road network	■ High cost ■ Limited capacity ■ Saturation of the road network ■ Environmental issues
	■ Low cost ■ High capacity ■ Low-pollution Low congestion, accidents, noise	■ Possibility of damage ■ Inconsistency of the service ■ Limited network ■ Few companies ■ Door-to-door as the exception
	■ Speed ■ Safety	■ High cost ■ Limited capacity ■ Contribution to climate change ■ Impossibility of door-to-door
	■ High capacity ■ Low cost ■ International use ■ Low-pollution ■ All sorts of cargo	■ Slow ■ Impossibility of door-to-door as such ■ Limited to navigable areas

Modal choices based on costs and distance

The competitiveness of the different modes varies depending on the distance due to the incidence of **terminal costs.**

Hoover diagram

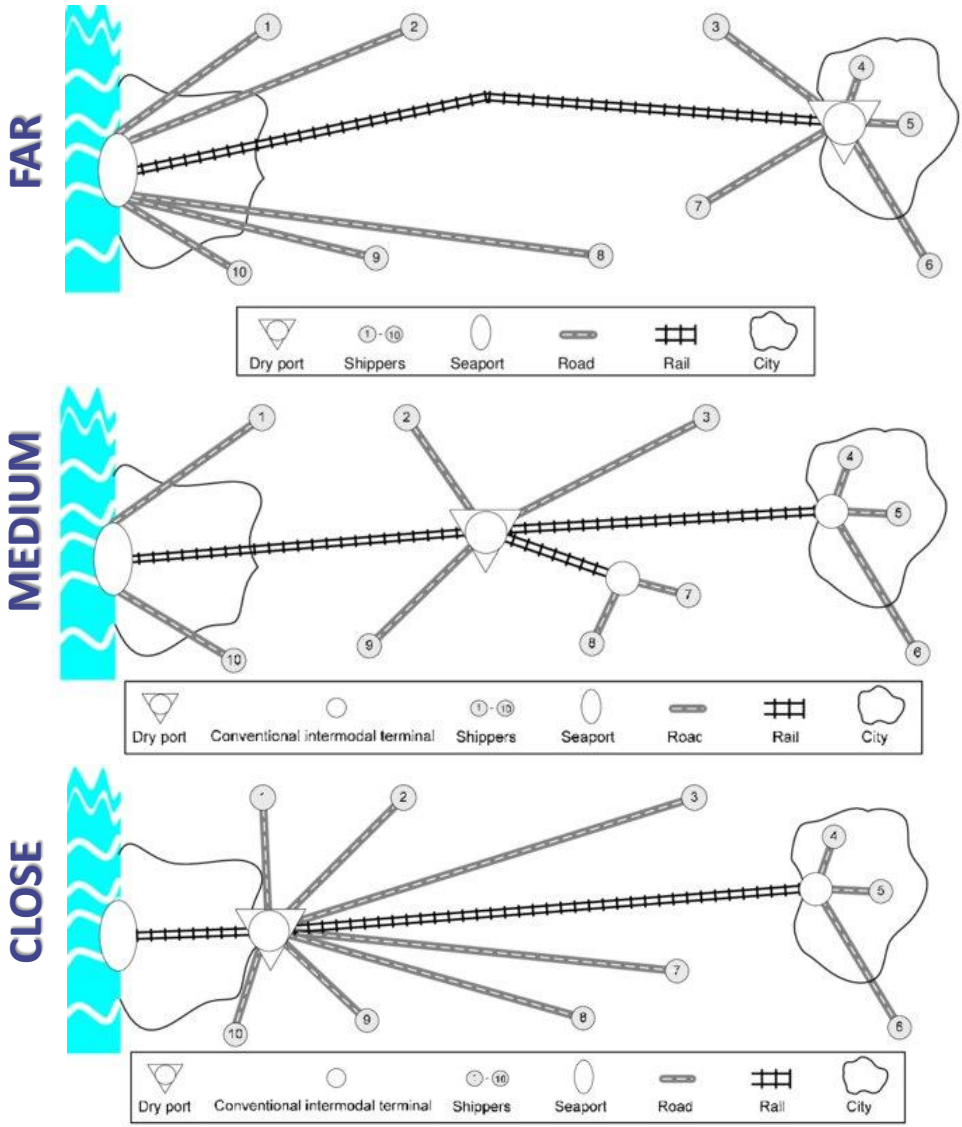


How to improve the PORT-HINTERLAND connectivity?

f) Develop and improve connections with inland terminals

(Dry ports, freight villages)

- to increase port throughtput
- To relieve ports from congestion (negative externalities)
- to decrease costs to handle goods



How to improve the PORT-HINTERLAND connectivity?

f) Develop and improve connections with inland terminals

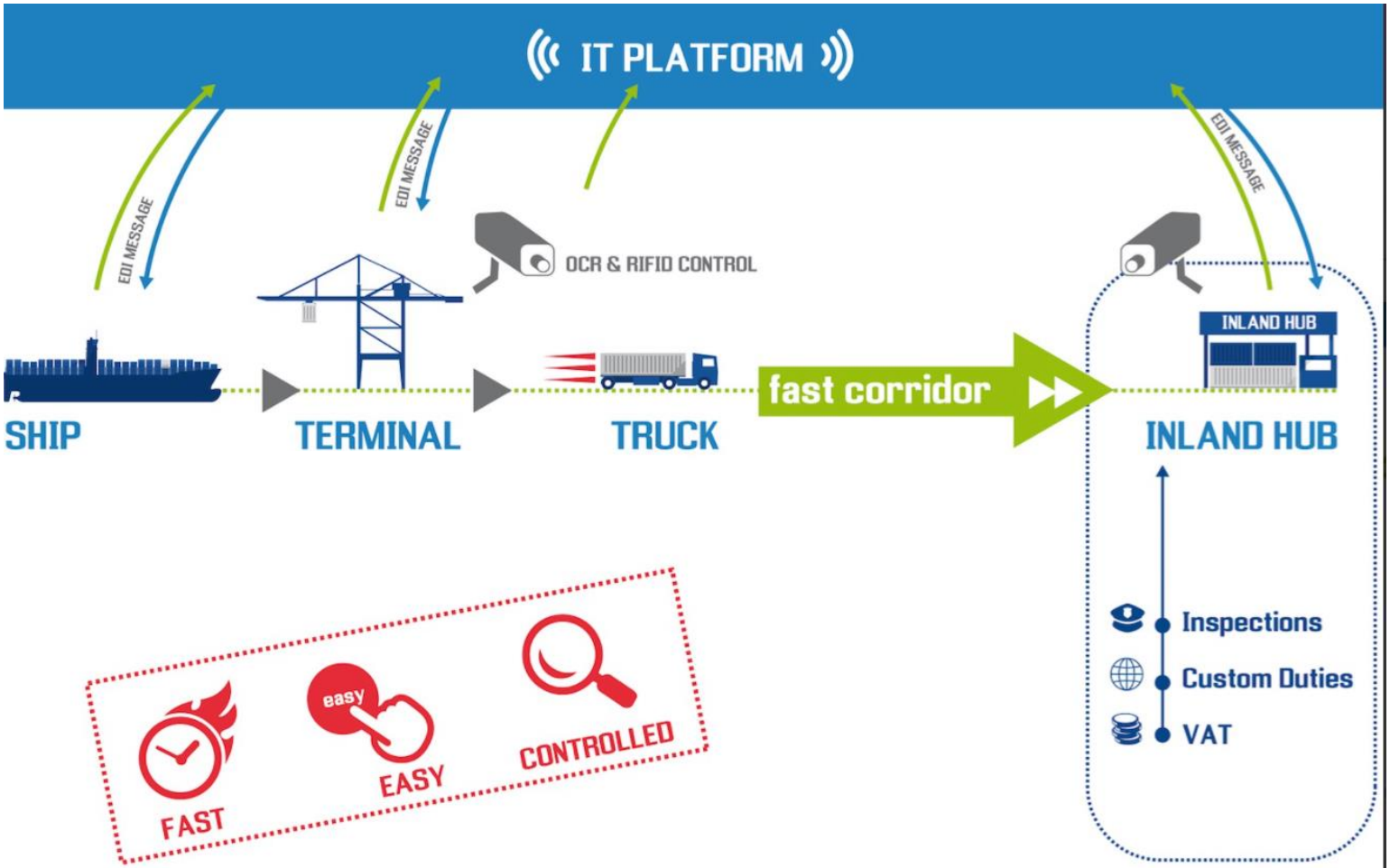
(Dry ports, freight villages)

DRY PORTS →The tendency to move some **port functions** to the hinterland is related to the **difficulties** to **increase the in-port capacity** due to the infrastructural and economic constraints of the ports.

How to improve the PORT-HINTERLAND connectivity?

G) Develop CORRIDORS

Italian Customs Fast Corridors

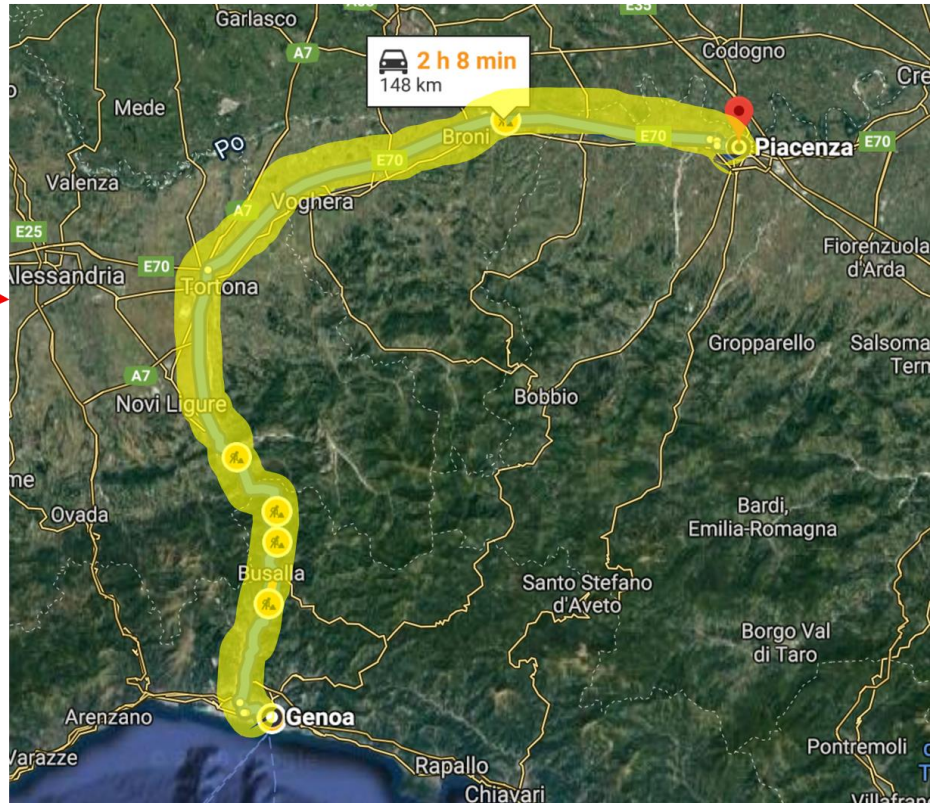


How to improve the PORT-HINTERLAND connectivity?

G) Develop CORRIDORS

IKEA Fast Corridor

Geofencing technology



Questions?

Bibliography

- Haralambides, Hercules E., ***Gigantism in container shipping, ports and global logistics: a time-lapse into the future***", Maritime Economics & Logistics, Vol. 21, pp. 1-60, 2019
- Ortega Hortelano, A., Van Balen, M. «***Research and innovation in low emission alternative energy for transport***", European Commission, JRC Science for Policy Report, 2019
- International Transport Forum «***The Impact of Mega-Ships***», OECD, 2015
- Böse, Jürgen W., ***Handbook of terminal planning,*** Vol. 49. Springer Science & Business Media, 2011
- ***Review of Maritime Transport 2020***, UNCTAD
- Panayides, Photis M., and Robert Wiedmer. "***Strategic alliances in container liner shipping.***" Research in transportation Economics Vol. 32 (1), pp.25-38, 2011
- International transport Forum, ***Port Hinterland Connectivity***, OECD, 2015

POLITECNICO
DI TORINO

claudia.caballini@polito.it