

2010

International Transport Forum 2010

*TRANSPORT AND INNOVATION*  
*Unleashing the Potential*

2

FORUM PAPERS

The logo for the International Transport Forum, featuring a stylized blue and green swoosh that forms a partial circle, with the text "International Transport Forum" in blue to its right.

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**MARITIME TRANSPORTATION:  
DRIVERS FOR THE SHIPPING  
AND PORT INDUSTRIES**

*Jean-Paul RODRIGUE*



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This document was produced as background for the 2010 International Transport Forum, on 26-28 May in Leipzig, Germany, on *Transport and Innovation: Unleashing the Potential*.

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## SUMMARY

Drivers of change in the transport system fit within six major categories, which are policy, demography & society, energy & environment, technology, economics and finance. Since all those forces are concomitantly at play, it remains complex to assess their respective contribution to innovation and change. Maritime transport is composed of the maritime shipping and the ports dimensions, which are the most globalised industry, having assets present in every market. The global market is dominated by a few maritime shipping companies in close relationship with global terminal operators, some of which are parent companies. The system is oligopolistic (10 dominant shipping companies and 4 global terminal operators), but highly competitive. A powerful economic force in maritime shipping in the last two decades has been economies of scale leading to larger container ships, placing pressures on port terminal and inland freight distribution to cope. The complexities of global freight distribution and shipping networks have favoured the emergence of intermediate hubs connecting different systems of circulation. Hinterland transportation has also expanded with the setting of gateways and their corridors, helping accommodate the surge in global trade through intermodal options (e.g. rail and barge) for regionalised ports. Supply chain integration supported by information technologies has been beneficial for global freight distribution and will continue to be so in the future with a better utilisation of existing assets. Still, many of the drivers that have propelled growth in the shipping and port industries are being questioned. Containerisation may be entering a phase of maturity where growth prospects more limited. There, however remains substantial room for growth, particularly if segments of bulk shipping are reconciled with containerisation. This, with the ongoing rationalisation of ports and shipping networks, as well as the expansion of the Panama Canal, may lead to the setting of a global system of maritime freight distribution composed of a circum-equatorial route, transoceanic pendulum services and north-south connectors interwoven by intermediate hubs. Among the drivers that are most likely to impact this industry in the future are security issues, real estate pressures around terminal facilities, economies of scale, environmental concerns, particularly at ports, the integration of information technologies, progress in terminal automation and finding capital for financing. Since the industry is predominantly private, oligopolistic with multinational assets, the realms of engagement for public policy are more limited than for other modes. However, since many stakeholders are concerned with the development of a more efficient maritime/land interface through hinterland transportation, this trend presents new realms of engagement for public policy. An emerging governance structure concerns the development of port clusters where port and maritime stakeholders can better coordinate their operational and investment strategies.



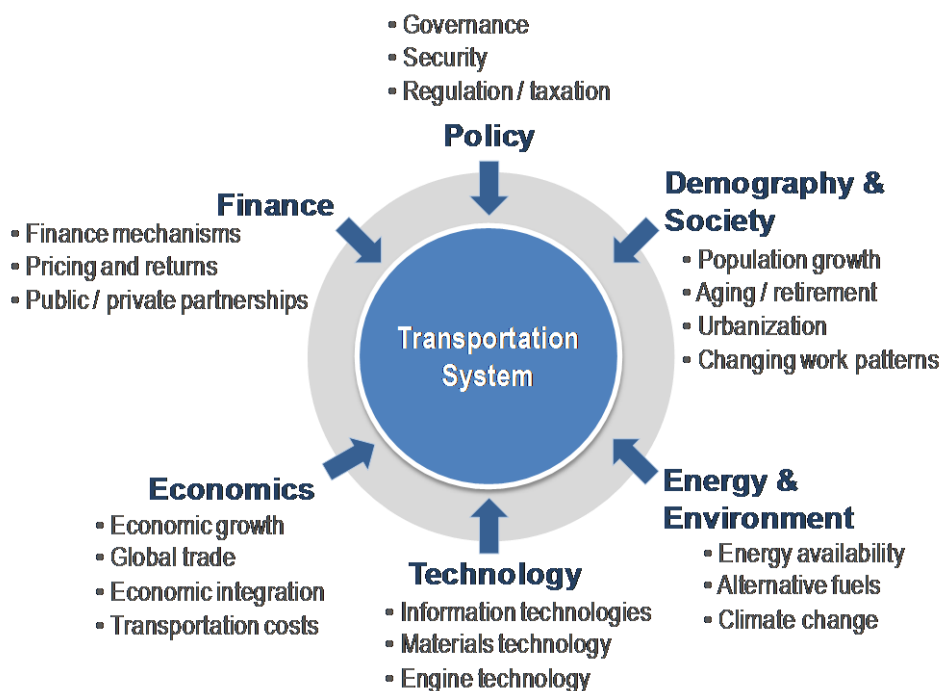
## INTRODUCTION: DRIVERS OF CHANGE IN TRANSPORTATION

*“Technology predictions are mostly bunk”, Wall Street Journal, December 27, 2009.*

*“Policy and innovation is an oxymoron”, Jean-Paul Rodrigue*

The **drivers of change** for the transportation system come in six major categories (Fig. 1): policy, demography & society, energy & environment, technology, economics, and finance. Each plays a role **individually** and in **conjunction**. It is therefore virtually impossible to establish outcomes accurately as there are too many interrelationships and uncertainties, particularly if a longer time frame is considered. It is, however, possible to identify trends that may impact each driver individually and try to assess how these trends will shape different components of the transport system.

Figure 1: Drivers of change for future transportation



Source: adapted from ICF International (2008), *Long Range Strategic Issues Facing the Transportation Industry*, Final Future-focused Research Framework, National Cooperative Highway Research Program, Project 20-80, Task 2.

- **Policy.** The inherent scale and complexity of transportation systems, particularly when they span multiple jurisdictions, will require novel approaches in governance. The role and impact of government policy is commonly subject to cycles of increasing commitments followed by different forms of retrenchment (e.g. privatisation) as regulations lead to unproductive practices and unintended consequences. In spite of deregulation, transportation is subject to many forms of regulations pertaining to safety, security and the environment. These regulations as well as the taxation of transport activities, add to the management complexity and the cost burden.

- **Demography and society.** Population growth is expected to endure in many parts of the world until the mid 21<sup>st</sup> Century, a process which will be linked with demands in mobility and increased levels of consumption. Yet, in other parts of the world, such as in Western Europe, North America and Japan, the rapid aging of the population and more people in retirement age will be associated with changes in mobility and lower levels of consumption per capita.
- **Energy and environment.** Issues related to the availability of energy and raw materials, particularly fossil fuels, are likely to endure and become more acute. This will be reflected in higher energy prices and, since each mode has a different elasticity, the comparative advantages of modal options will change towards the most energy efficient transport chains.
- **Technology.** Technological innovation is a very difficult process to anticipate and its impacts even more complex to assess. For transportation, technological innovations either concern the management, the mode (or infrastructure) or the motion (engine). It is expected that information technologies (IT) are likely to transform mobility with an improved command of flows and supply chain management practices. This is commonly linked with a better utilisation of existing assets and derived productivity gains.
- **Economics.** Economic growth and global trade have been significant vectors for the growth of mobility. Yet this process is subject to cycles of growth and recession and limits in credit based consumption. The level of activity and the structure of national economies, as well as their trade patterns, are an important influence on national and global transport systems. Economic integration is likely to endure, which will favour more comprehensive and seamless regional transport systems. The relative price of transportation is also linked with the viability of several supply chains and the comparative advantages they extract value from. As transportation costs are expected to rise on the medium term, namely due to fossil fuels, transport demand will be readjusted accordingly in volume but also in location.
- **Finance.** Transportation projects, due to their size and technological complexity, are getting increasingly capital intensive. In several cases, only the largest financial institutions, often in partnership with the public sector, can provide an adequate level of capitalisation. The value of transportation assets and the revenue they generate are likely to be important factors behind their financing.

## CURRENT TRENDS AND DRIVERS IN MARITIME TRANSPORTATION

### Shipping companies and terminal operators

Maritime shipping is a **highly globalised industry**, both in operation and ownership. About 67% of the global fleet (in tonnage) is under a flag of convenience, which confers less regulation, lower registry costs and lower operating costs.

In a shipping industry already dominated by large vessels, mergers, acquisitions and strategic alliances, the potential **cost savings at sea are getting smaller** and the pressure to find cost savings in the field of hinterland logistics is growing.

Besides cost and revenue considerations, **demand** is the main driving force for carriers to integrate their services along commodity chains. Carriers that have traditionally been concerned only with the transportation of goods from one point to another are now seeking logistics businesses in the area of just-in-time inventory practices, supply chain integration and logistics information system management. Shipping lines are increasingly evaluating their fleet configuration in function of the ability to meet the logistics requirements of their customer base (i.e. price, transit time, schedule reliability, liner service frequency and proximity to markets).

Table 1: **Typology of global terminal operators**

Stevedores	Maritime Shipping Companies	Financial Holdings
Horizontal integration	Vertical integration	Portfolio diversification
Port operations is the core business; Investment in container terminals for expansion and diversification.	Maritime shipping is the main business; Investment in container terminals as a support function.	Financial assets management is the main business; Investment in container terminals for valuation and revenue generation.
Expansion through direct investment.	Expansion through direct investment or through parent companies.	Expansion through acquisitions, mergers and reorganization of assets.
PSA (Public), HHLA (Public), Eurogate (Private), HPH (Private), ICTSI (Private), SSA (Private).	APM (Private), COSCO (Public), MSC (Private), APL (Private), Hanjin (Private), Evergreen (Private).	DPW (Sovereign Wealth Fund), Ports America (AIG; Private Fund), RREEF (Deutsche Bank; Private Fund), Macquarie Infrastructure (Private Fund), Morgan Stanley Infrastructure (Private Fund).

Source: Notteboom, T. and J-P Rodrigue (2010), "The Corporate Geography of Global Container Terminal Operators".

**Global port operators** have played a substantial role in the dynamics of container port terminals as they provide for the operation of terminal facilities as well as for the strategic planning of infrastructure investment. Both short term and long term time horizons are part of their concern as short term issues are linked with the capacity and quality of their services while long term issues concern market expansion. They come in three major categories; stevedores, maritime shipping companies and financial holdings (Table 1):

- **Stevedores.** Port terminal operators that expanded into new markets to replicate their expertise and to diversify their revenue. Port of Singapore Authority (PSA) is the largest global terminal operator coming from a stevedore background.
- **Maritime shipping companies** that have Invested in port terminal facilities to help support their core maritime shipping business. AP Moller (APM), a parent company of Maersk, is the largest global terminal operators coming from a maritime shipping background.
- **Financial holdings.** Various financial interests ranging from investment banks, retirement funds to sovereign wealth funds have been attracted by the port terminal sector as an asset class and for revenue generation potential. The majority has an indirect management approach, acquiring an asset stake and leaving the existing operator to take care of the operations. Others will directly manage the terminal assets through a parent company. Dubai Ports World (DPW), a sovereign wealth fund owned by the Dubai government, is the largest global terminal operator coming from a financial holding background.

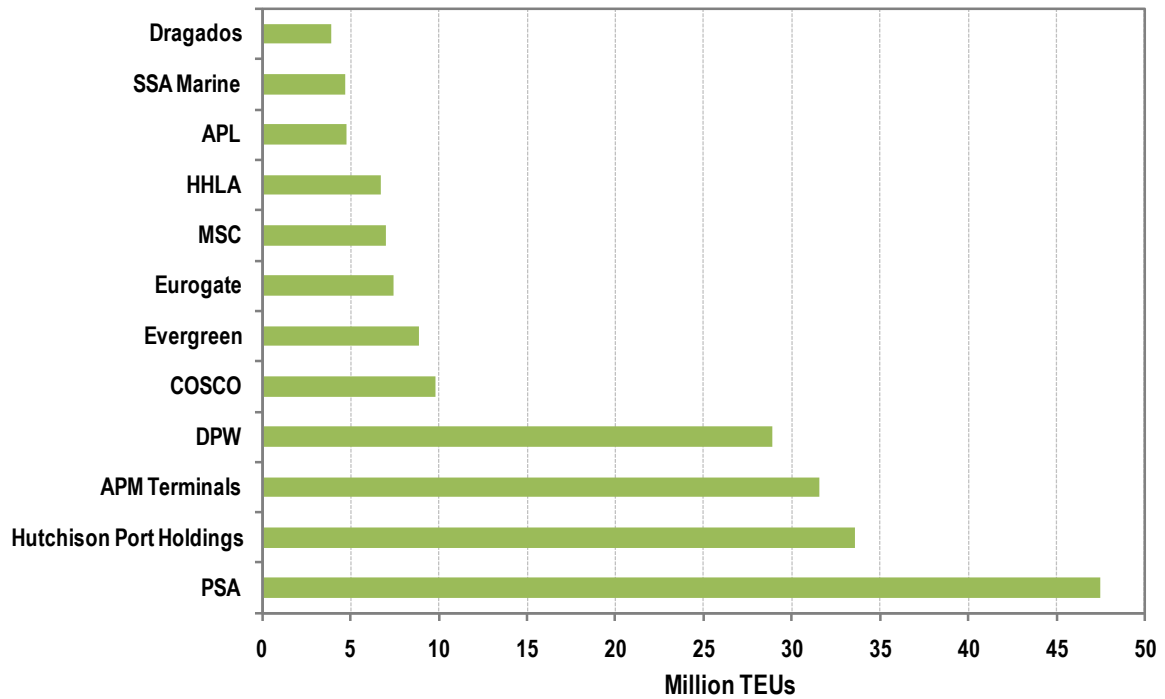
In the past decades the container terminal industry witnessed **horizontal and vertical integration processes**. This involves mergers and acquisitions of existing terminals or the construction of new terminal facilities (organic growth). The conventional actors that considered port operations as their core business, stevedores companies, have expanded into new locations. This process was concomitant with vertical integration strategies pursued by several maritime shipping companies that have invested in terminal operations directly or through parent companies. The financial sector follows a more hybrid approach as vertical or horizontal integration strategies depend on the asset class of the holding.

Since terminal operators have various stakes depending on the concerned terminal, **equity-based throughput** is commonly used to measure the respective amount of containerised traffic they handle (Fig 2). For instance, two terminal operators may have respective stakes in a terminal of 75% and 25%. If that terminal handles 100 000 TEU per year, then 75 000 TEU will be attributed to one terminal operator and 25 000 TEU to the other. By using such a measure, PSA is the world's largest terminal operator, even if HPH, DPW and APM have more terminals in their portfolio. Actually, PSA owns a 20% stake in HPH, which from an equity-based throughput perspective conveys traffic handled by another terminal operator.

An inventory of more than 400 container terminals throughout the world's main ports reveal **substantial real estate assets** along coastal areas controlled by terminal operators, accounting for more than 20 500 hectares (205 square kilometers) (Fig. 3). The last two decades have seen growing constraints over these assets to accommodate the setting of global production networks and the related logistical activities. These assets are difficult and capital intensive to expand (additional demand) or replace (new site). It is thus not surprising that the financial sector has played a growing role in the industry.

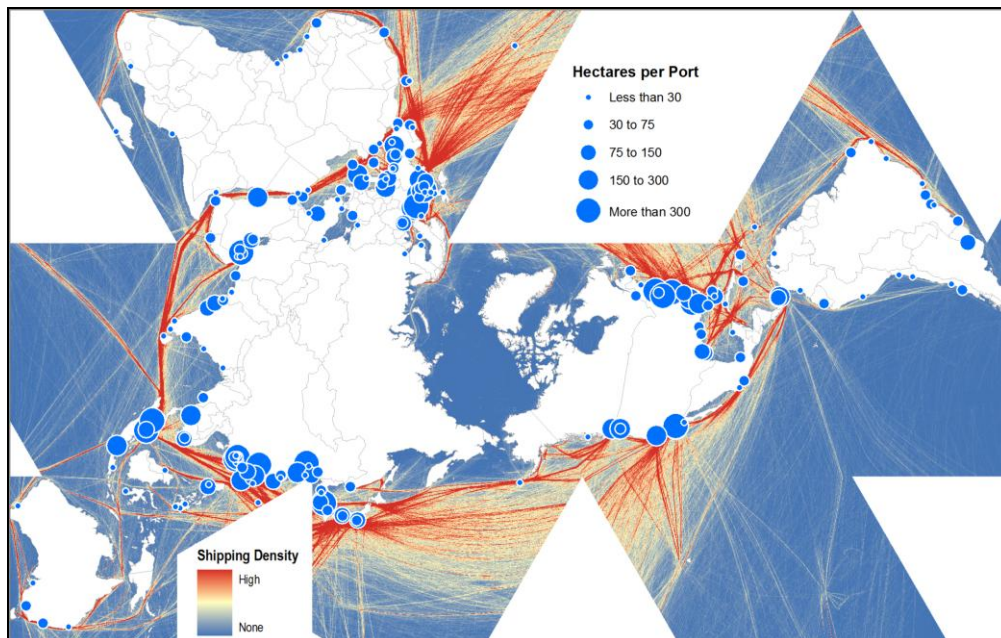


Figure 2: Top 12 global port operators in equity-based throughput, 2007



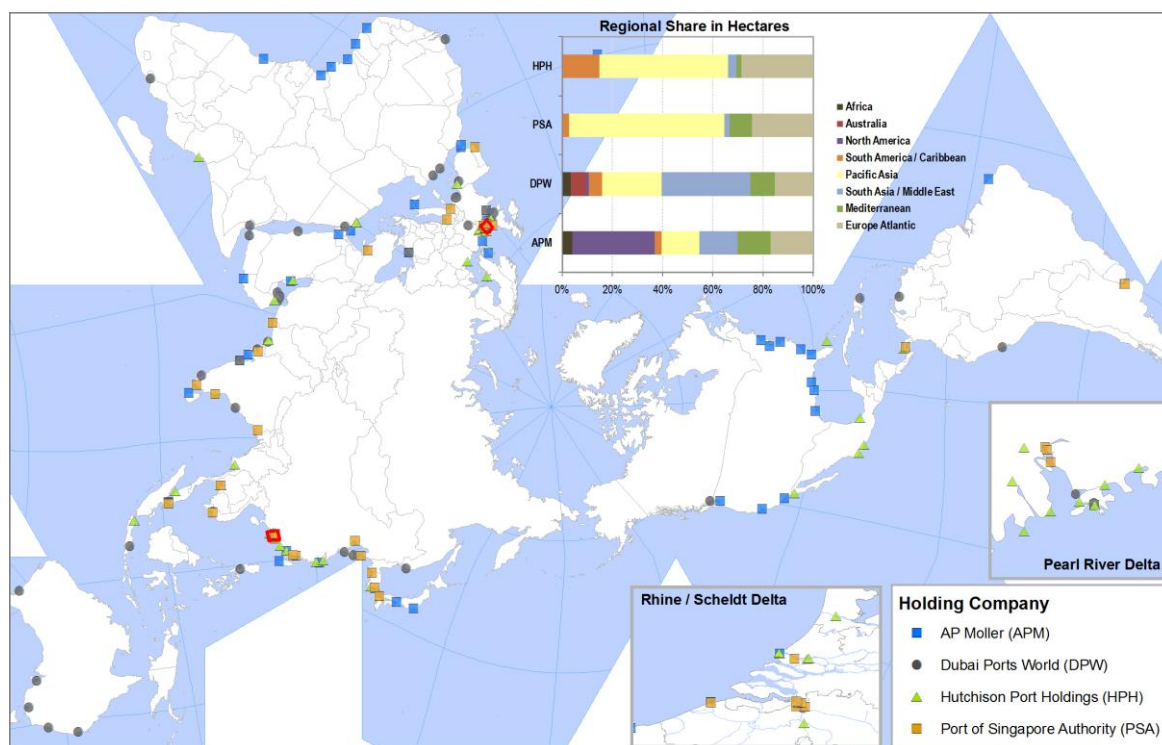
Source: Drewry (2008), *Annual Review of Global Container Terminal Operators – 2008*.

Figure 3: Container terminal surface of the world's major port holdings and shipping density, 2009



Source: Survey of web sites of global terminal operators. Shipping density data adapted from National Center for Ecological Analysis and Synthesis, *A Global Map of Human Impacts to Marine Ecosystems*.

Figure 4: **Container terminals of the world's four major port holdings, 2009**



Source: Survey of web sites of global terminal operators.

- **Four major port holdings** have substantial global assets of about 45 dedicated port terminals each (Fig. 4); APM Terminals (controlled by the Danish maritime shipper Maersk), Dubai Ports World (DPW), Hutchison Port Holdings (Hong Kong), and the Port of Singapore Authority (PSA). Jointly, they controlled through various equity stakes 179 dedicated maritime container terminals in 2009. They are particularly focused along the world's main commercial gateways, such as the Pearl River Delta (Hong Kong) and the Rhine/Scheldt Delta (Rotterdam and Antwerp). Their assets are geographically diversified, with Pacific Asia being the main focus of HPH and PSA, South Asia and the Middle East having DPW well represented and APM having a portfolio with a strong North American emphasis.
- Several other port holdings exist, owned by specialized private companies (such as SSA for North America or Eurogate for Europe), by ocean carriers (Hanjin and Evergreen have notable assets) or by financial holdings (Ports America owned by AIG), but their focus is mostly **regional**, but many have grown an extensive international portfolio.
- A **concentration of ownership** among four major port holdings is taking place. In 2006 when DPW acquired the terminal assets of P&O (Peninsular & Oriental Ports) further consolidating its global holdings. However, DPW was constrained to rescind the American assets of this transaction (terminals in Baltimore, Miami, New Orleans, New York and Philadelphia) to the holding AIG (Ports America) due to a political controversy; a Middle Eastern holding operating major American port terminals was perceived negatively in the post 9-11 setting.

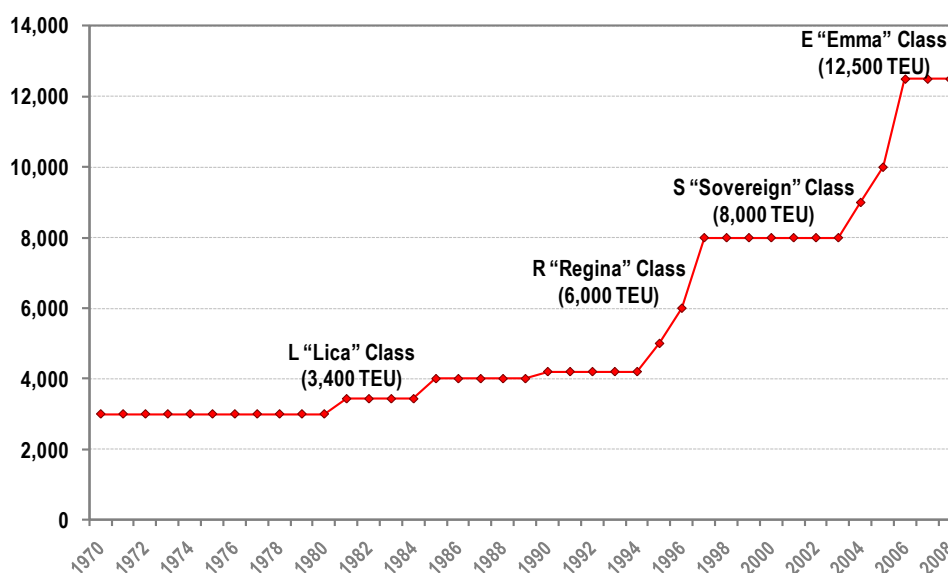
## Economies of scale in maritime shipping

The evolution of containerisation, as indicated by the size of the largest available containership, is a **stepwise process** (Fig. 5). Changes are rather sudden and often correspond to the introduction of a new class of containership by a shipping company (Maersk Line tended to be the main early mover), quickly followed by others.

Since the 1990s, two substantial steps took place. The first involved a **jump from 4 000 to 8 000 TEUs**, effectively moving beyond the "panamax" threshold of around 5 000 TEU. This threshold is particularly important as it indicates the physical capacity of the Panama Canal and thus has for long been an important operational limitation in maritime shipping. The second step took place in the 2000s to reach the **12 500 TEU level**. This is essentially a "suezmax" level, or a "new panamax" class when the extended Panama Canal is expected to come online in 2014. From a maritime shipper's perspective, using larger container ships is a straightforward process as it conveys economies of scale and thus lowers costs per TEU carried. From a port terminal perspective, this places intense pressures in terms of infrastructure investments, namely portainers.

When it comes to the dimensioning of the latest generation of ultra-large container carriers, it is becoming increasingly clear that large followers (e.g. MSC, COSCO and CMA-CGM) are not blindly following the path of early adopter Maersk Line. Their 'wait and see' approach has resulted in slightly shorter vessels compared to the Maersk giants (350-370m instead of the 396m of the Emma Maersk) while achieving nearly the same unit capacities. Their more compact size will make these vessels fit perfectly in the new Panama Canal locks (the Emma Maersk is oversized) and results in a better maneuverability on bendy rivers to major 'must' ports of call such as the river Scheldt to Antwerp and the river Elbe to Hamburg. Therefore, the size and the configuration of the largest container ships are being "fine tuned" to **optimize the existing and projected nautical profile** of the world's shipping lanes and ports.

Figure 5: The largest available container ship, 1970-2008 (in TEUs)



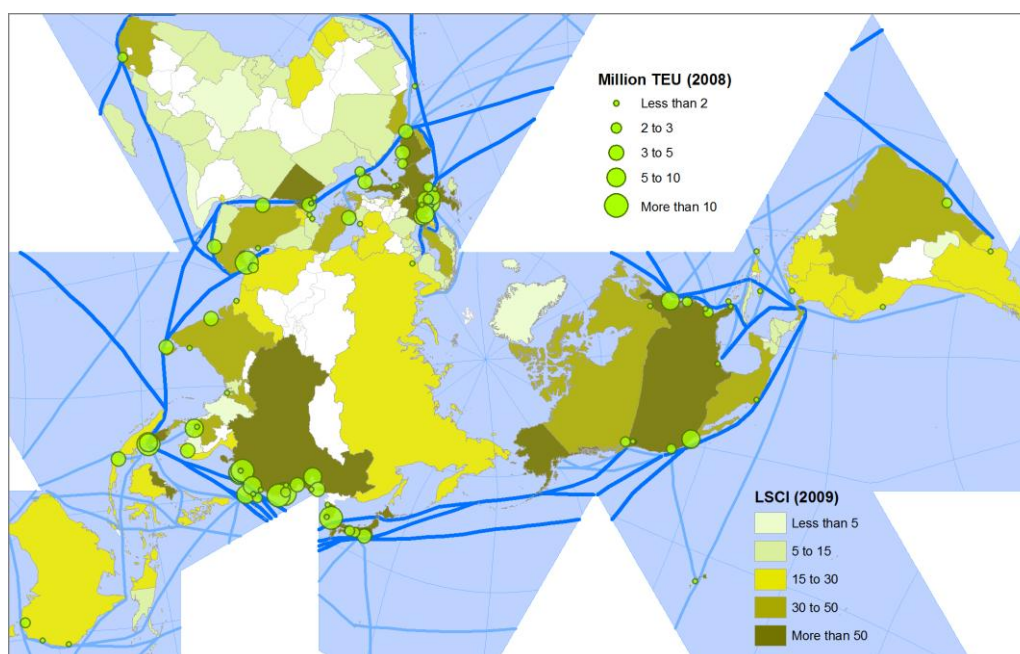
Source: Notteboom, T. and J-P Rodrigue (2009), "The Future of Containerization: Perspectives from Maritime and Inland Freight Distribution", *Geojournal*, Vol. 74, No. 1, pp. 7-22.

## Shipping networks and transshipment hubs

The Liner Shipping Connectivity Index (LSCI) aims at capturing a **country's level of integration into the existing liner shipping network** by measuring liner shipping connectivity (Fig. 6). LSCI can be considered a proxy of the accessibility to global trade. The higher the index, the easier it is to access a high capacity and frequency global maritime freight transport system and thus effectively participate to international trade. Therefore, LSCI can be jointly considered as a measure of **connectivity to maritime shipping and as a measure of trade facilitation**. It reflects the strategies of container shipping lines seeking to maximise revenue through market coverage.

The countries that have the highest LSCI values are **actively involved in trade**. Namely, the export-oriented economies of China and Hong Kong rank first, with the transshipment hub of Singapore ranking third. Large traders such as the United Kingdom (6), Germany (8) the United States (9) and Japan (15) also rank among the top 15. Countries such as Malaysia (10), Spain (11), the United Arab Emirates (16), Egypt (17) and Oman (19) also rank high because of the major transshipment function their ports perform.

Figure 6: **Liner shipping connectivity index and container port throughput, 2008-2009**



Source: LSCI data from UNCTAD.

An important emerging function for several container port terminals involves **transshipments** (ship-to-ship). It is technically and economically impossible to establish direct shipping connections between every country. There may not be enough volume or the ports may be far too distant from one another. Unlike bulk shipping, container shipping networks are established as sequences of port calls along a route often structured as a pendulum between maritime facades. Therefore, a set of direct or transshipments connections are required to link all country pairs by maritime shipping. Only 17% of all country pairs are directly connected, while 62% of all country pairs require at least one transshipment and 18.6% of all pairs require two transshipments.

With the growth of long-distance containerised trade, intermediate hubs grew in importance in helping **connect different systems of maritime circulation**. They tend to be located along the main circum-equatorial maritime route that goes through Panama, the Strait of Malacca, Suez and Gibraltar and that links the world's major markets (Fig. 7). Many also provide a **relay function** between the north-south and the east-west shipping lanes. The world's most important intermediate hub is Singapore, where 92% of its traffic is transshipment, which accounted for more than 25.7 million TEUs in 2007.

The emergence of major intermediate hubs favoured a **concentration of large vessels along long-distance, high capacity routes** while lesser ports can be serviced with lower capacity ships. Consequently, the emergence of intermediate hubs has permitted liner services that would otherwise be economically unfeasible. However, there is a limit to the hub-and-spoke network configuration and consequently also to the size of the vessels being deployed on the trunk routes.

Figure 7: **World's main intermediate hubs, 2007**



Source: Notteboom, T. and J-P Rodrigue (2010), "Foreland-Based Regionalization: Integrating Intermediate Hubs with Port Hinterlands", in press, *Research in Transportation Economics*.

## Regionalisation

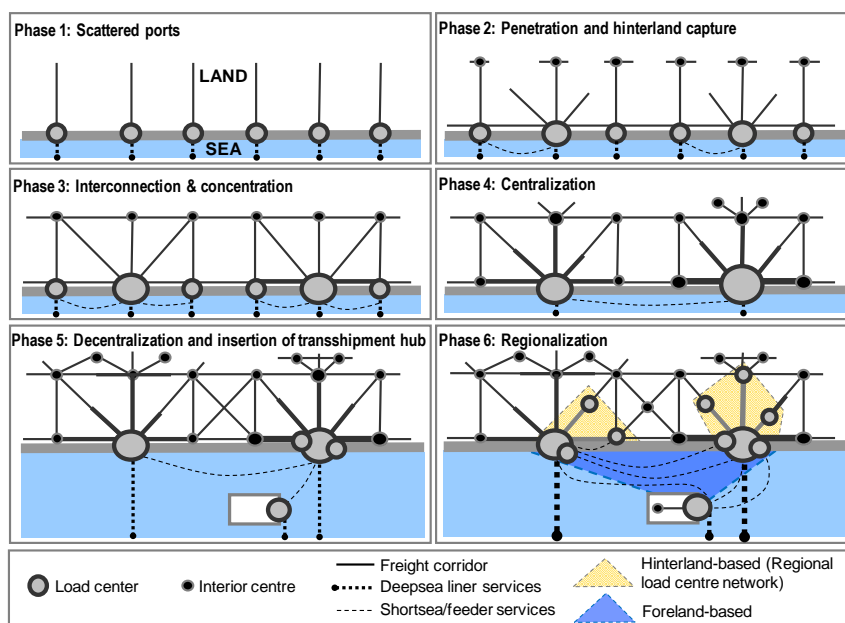
Ports are going beyond their own facilities to help accommodate additional traffic and the complexity of freight distribution, namely by improving hinterland transportation. **Port regionalisation** is such an outcome and indicates a higher level of integration between maritime and inland transport systems, particularly by using rail and barge transportation, which are less prone to congestion than road transportation. The development of global supply chains increased the pressure on maritime transport, port operations, and on inland freight distribution. Inland accessibility as such has become a cornerstone in port competitiveness. Port regionalisation is characterised by strong functional interdependency and even joint development of a specific load centre and logistics platforms in the hinterland. This leads ultimately to the formation of a regional load centre network (Fig. 8).

Ports, especially large gateways, are facing a wide array of **local constraints** that impair their growth and efficiency. The lack of available land for expansion is among one of the most acute problems. This issue is exacerbated by the deepwater requirements for handling larger ships. Increased port traffic may also lead to diseconomies as local road and rail systems are heavily burdened. Environmental constraints and local opposition to port development are also of significance. Port regionalisation thus enables partial circumscription of local constraints by externalising them.

**Global production and consumption** have substantially changed distribution with the emergence of regional production systems as well as large consumption markets. No single locality can efficiently service the distribution requirements of such a complex web of activities. For instance, globally integrated Free Trade Zones have emerged near many load centers, but seeing a FTZ as a functionally integrated entity may be misleading as each activity has its own supply chain. Port regionalisation thus permits the development of a distribution network that corresponds more closely to fragmented production and consumption systems.

**Transloading operations** have become important, particularly in the North American setting. A maritime container can be picked up at the port terminal and trucked to a distribution center in the vicinity of the inland rail terminal. At the distribution center, the contents of three maritime containers (40 footers) can be transloaded into two domestic containers (53 footers) and then loaded on a freight train. This has the notable advantage of reducing domestic transportation costs since rail companies charge about the same rate for 40 and 53 footers. This also prevents long-distance movements of empty maritime containers as they remain in the vicinity of the port and available to maritime shippers who own 55% of the global containerised assets. The “synergy” between the port and the inland terminal of such a concept creates a new type of maritime/land interface which essentially results in a regionalized port.

Figure 8: The spatial development of a port system



Source: Notteboom, T. and J-P Rodrigue (2005), “Port Regionalization: Towards a New Phase in Port Development”, *Maritime Policy and Management*, Vol. 32, No. 3, pp. 297-313.

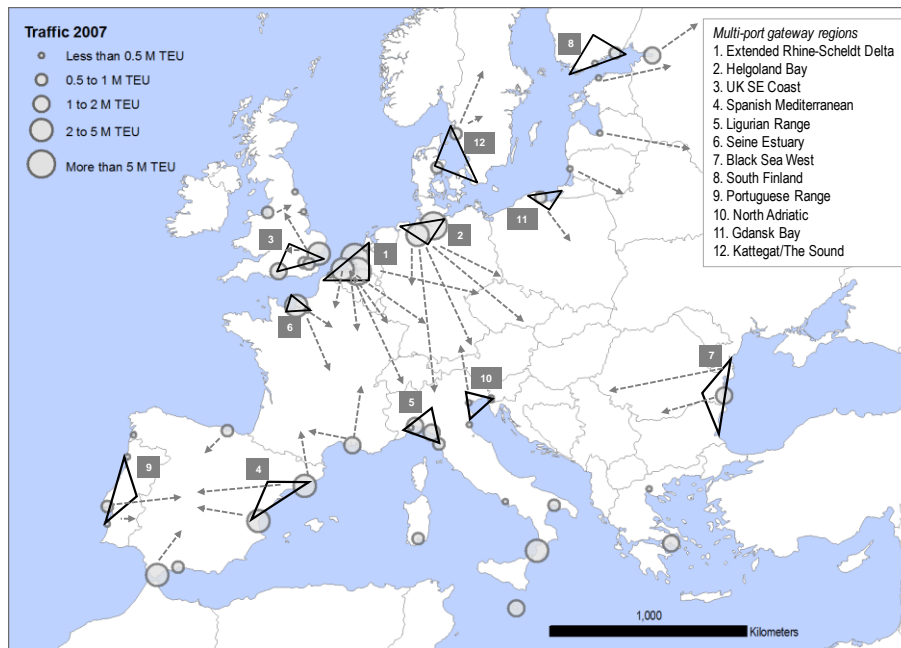
## Gateways, corridors and inland ports

The relationships between ports and their hinterlands have become fundamental in port competitiveness. Global trade leans on gateways and their maritime and inland connectiveness. As much as port infrastructure investments are important to keep up with traffic growth expectations as well as current performance requirements, the **hinterland shapes growth potential** by anchoring traffic and offering cargo rotation for inbound and outbound container flows. This has led to the development of corridors leaning on rail or barge services connecting to **inland terminal facilities**, which act either as satellite terminals, load centers or, less commonly, transmodal facilities. Many port authorities, terminal operators, commercial real estate developers and local/regional governments have been actively involved in the setting of such facilities.

- **Satellite terminals.** These tend to be close to a port facility, but mainly at the periphery of its metropolitan area (often less than 100 km), since they mainly assume a service function to the seaport facilities. They accommodate additional traffic and serve functions that have become too expensive at the port, such as warehousing (e.g. empty containers) and distribution. Satellite terminals can also serve as load centers for local or regional markets, particularly if economic density is high, in which case they form a multi-terminal cluster with the main port they are connected to through regular rail or barge shuttle services. For gateways having a strong import component, a satellite terminal can also serve a significant transloading function where the contents of maritime containers are transloaded into domestic containers or truckloads.
- **Load centers.** This refers to a major intermodal facility - load center - granting access to well defined regional markets that include production and consumption functions. It commonly corresponds to a metropolitan area where a variety of terminals serve concomitantly intermodal, warehousing, distribution and logistics functions. These tend to take place in logistics parks and free trade zones (or foreign trade zones). The inland terminal is thus the point of collection or distribution of a regional market. The more extensive and diversified the market, the more important is the load center. If the load center has a good intermediary location, such as being along a major rail corridor, then freight distribution activities servicing an extended market will be present.
- **Intermodal/transmodal facilities.** These link large systems of freight circulation either through the same mode (e.g. rail-to-rail) or through intermodalism (e.g. rail-to-truck). In the latter case, the inland terminal assumes the role of a load center. The origin or the destination of the freight traffic tends to be elsewhere, particularly for transmodal freight.

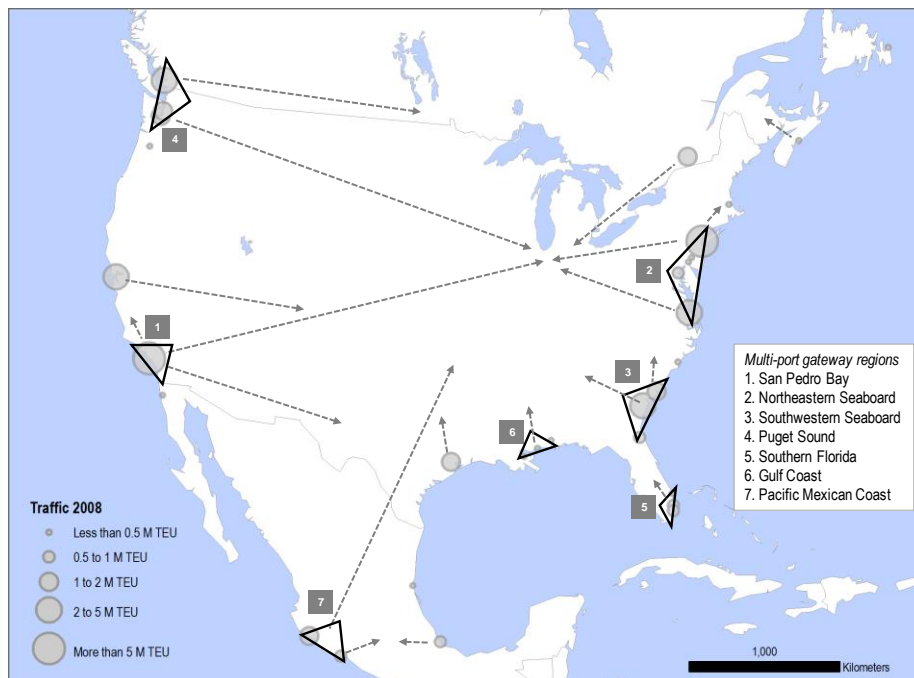
Western Europe and North America have been particularly prone in the setting of **multi-gateway port regions** accessing their respective hinterlands with corridors along which are located inland ports (Fig. 9 and 10). This is linked with new forms of collaboration between actors within the intermodal chain as each saw multiplying effects in terms of value capture (e.g. transshipment, transloading, warehousing, consolidation, deconsolidation). In North America, the private ownership of both the infrastructure and operation of railways, the possibility of double stacking and the limited convenience of inland waterways have favoured long-distance rail corridors. The bulk of the North American market is thus accessed by a relatively limited number of gateways.

Figure 9: The European container port system and its multi-port gateway regions



Source: Rodrigue, J-P and T. Notteboom (2010), "Comparative North American and European Gateway Logistics: The Regionalism of Freight Distribution", in press, *Journal of Transport Geography*.

Figure 10: The North American container port system and its multi-port gateway regions



Source: Ibid.



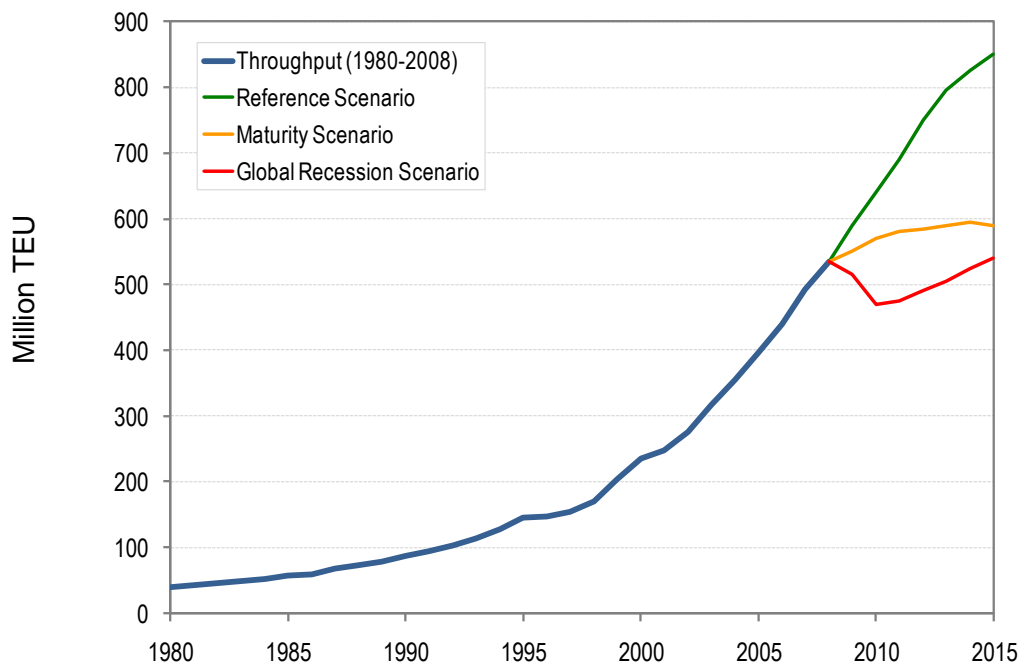
## SOME EMERGING PATTERNS

### Maturity of the containerisation cycle

The growth of container transportation since its inception 50 years ago has been impressive and far reaching in consequences; globalisation would not have been possible without containerisation. Since containerisation is concomitantly a technology and a management practice it has a **business cycle**. This involves phases of introduction, diffusion and the last 10 years have seen an acceleration of its adoption as the dominant mode supporting global supply chains. Fast growth is usually followed by a phase of maturity where a paradigm reaches its optimal market potential and consequently its growth rate slows down significantly. There is mounting evidence that containerisation is entering a phase of **maturity**, implying that its future growth potential is more limited and likely linked to niche market opportunities.

Figure 11 underlines potential container port throughput scenarios for the near future (2015). The shape for the growth curve incites to assume that future throughput would follow the reference scenario, which expects traffic to double between 2005 and 2015. Such a perspective prevailed within the industry up to late 2008. If the maturity scenario is considered, throughput would be leveling off by 2015. It assumes that the process of globalisation slows down and that most comparative advantages in manufacturing have been exploited. However, the financial crisis that began to unfold in 2008 is indicative of a global recession impacting international trade and consequently container flows. Under such circumstances container throughput in 2015 could be at a level similar to 2008 throughput figures.

Figure 11: **Global container port throughput, 1980-2008, and projection scenarios for 2015**



Source: 1980-2008 container throughput data from Drewry Shipping Consultants. Projection scenarios based on T. Notteboom and J-P Rodrigue (2009), "Economic Cycles and the Organizational and Geographical Attributes of Global Value Chains: Is the Pendulum Changing Direction?", Integrating Maritime Transport in Value Chains Workshop, Montreal (Canada).

Several converging factors underline that further economies of scale in maritime shipping are **unlikely to unfold** within the foreseeable future, which is linked with the maturity of containerisation. The more economies of scale are applied to maritime shipping, the lower the number of ports able to handle such ships, which limits commercial options and accessibility. Economies of scale involve higher costs for inland operations as a large quantity of containers arrive at once and must be handled effectively to maintain a level of service. In all the dimensions it involves, economies of scale require capital intensiveness in infrastructure and equipment (ships, portainers, terminal facilities) that is prone to risk.

The maturity of containerisation is likely to trigger a **reallocation of ship assets** along shipping routes to more closely reflect optimality in terms of capacity and level of service. Although this took place as containerisation developed, it was often a safe bet to introduce larger container ships across the board since demand was consistently growing. There was a “trickle down” effect as larger container ships were introduced first on main long-distance shipping routes since it was on those routes that the new economies of scale they offered could be the best utilised. The “outclassed” ships were redeployed on secondary routes, such as feeder services. With the introduction of the 12 500 TEU class in 2006, such services could only call at very large port terminals having enough volume to use the capacity of those ships. The market potential of such ships has thus some limitations. If issues linked with the number of port call options, capacity, frequency and transshipment speed are jointly considered, ships of 8 000 TEU appear to be a suitable load size for most pendulum routes.

### The containerisation of commodities

Commodities, from grain, to chemicals, to wood, are among a large array of goods being traded in the global economy and represent a **niche for the growth of containerisation**. Both transport systems – bulk and containerised – have a role to play, implying that the containerisation of commodity chains is more likely to be a process based on a complementarity rather than on competition since each transport chain has its own advantages.

There are several converging factors that support the containerisation of commodities. A general **rise in commodity prices** and growing demand in new markets have made many commodities more prone to be containerised from a value proposition standpoint. **Fluctuations and rises in bulk shipping rates**, as evidenced by the Baltic Dry Index, have incited the search of options to bulk shipping. Volatility also makes long term planning for bulk shipping complex and subject to risks. Relatively stable and even **declining container shipping costs**, particularly in light of rising commodity prices, rendered the container even more attractive (Fig. 12). Global trade imbalances are transcribed in imbalanced container shipping rates, which represent a notable **export subsidy for return cargo**. For markets having notable imbalances, such as China (exports) and the United States (imports), incentives are acute. Empty container repositioning has created opportunities by making available **pools of empty containers** that can be filled for backhauls.

### Rationalisation of the shipping and port industries

**Massive investments** in shipping and port infrastructure has taken place in recent years, particularly after 1995. The main rationale of these investments was derived from **higher future expectations about trade volumes** compounded by the increased involvement of the financial sector<sup>1</sup>. The maritime industry became an attractive prospect for various funds chasing return.

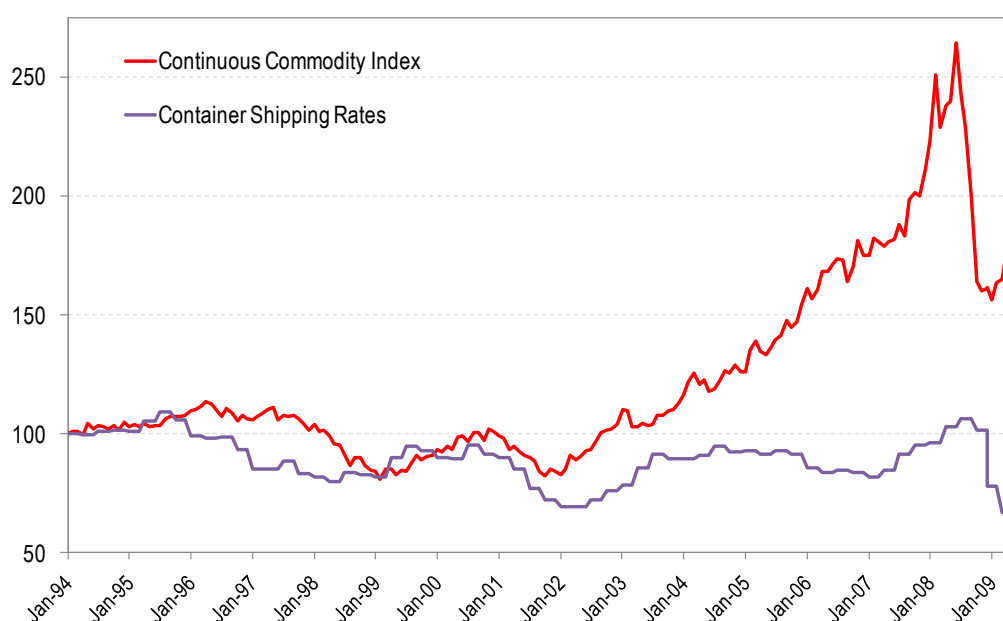
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1. Notteboom, T., J-P Rodrigue and G. De Monie (2010), "The Organizational and Geographical Ramifications of the 2008-09 Financial Crisis on the Maritime Shipping and Port Industries", in P.V.

Forecasts about future traffic prospects were made to **justify capacity investment**. While prior to 2000 most forecasts underestimated future traffic, mainly because containerisation entered the acceleration phase of its growth cycle, in recent years forecasts tended to exaggerate future traffic. A common methodology was to use compound annual growth rate (CAGR), which **significantly exaggerated traffic figures**, particularly for longer term projections. Such a perspective incited investments and additional capacity came online at the same time that the global economy was entering a major recession, compounding financial difficulties of the maritime industry.

For the first time in decades, the maritime shipping and port industries are facing the prospects of a **rationalisation** of their assets and services. This involves a paradigm shift linked with the first crisis of globalisation, as the boom of the last decade was mainly credit-driven.

Figure 12: **Continuous commodity index<sup>2</sup> and average container shipping rates<sup>3</sup>, 1994-2009 (1994=100)**



Maritime shipping companies and terminal operators will **reassess their capacity deployment** and their **pricing**, some leaving market segments altogether. At this point, it remains uncertain about the ports and the network configuration this will take, but it will have profound ramifications on the industry as well as global supply chains. It can be expected that port (market) size and productivity will be an important factor in this expected rationalisation. Because of their pricing power and better hinterland access, large ports could be less impacted than smaller ports. Rent seeking behavior imposed by prior infrastructure investments could advantage players that are **less financially leveraged**.

Hall, B. McCalla, C. Comtois and B. Slack (eds), *Integrating Seaports and Trade Corridors*. Surrey: Ashgate.

2. Also known as the CCI/CRB index published by the Commodities Research Bureau.
3. The container shipping rate is an un-weighted average of shipping rates per TEU along four major long-distance shipping routes (Asia - United States and Asia - Europe).

There will be pressures to **renegotiate concession agreements** for port terminals, particularly those established with high traffic expectations. As the maritime sector becomes less profitable, capital will be more difficult to secure and investment needs for new or expanded projects will be assessed more closely.

### **Information technologies and terminal efficiency**

Information technologies had **multiplying effects** on maritime transportation, particularly over the management of intermodal assets. The range of applications is impressive, from the loading and unloading sequence of container ships, stacking in container yards, navigation (GPS), scheduling (pick up and delivery), gate access and tracking the whereabouts of a container.

**Supply chain integration** also favoured (and was favoured by) by the application of information technologies. As a higher level of control over freight flows was established, particularly through vertical integration, the need for electronic data interchange became apparent. Recent years have also seen IT become fundamental for security issues (E-manifest) and have incited the industry to move forward as a matter of compliance to advance notice schemes for the cargo being carried<sup>4</sup>.

More stringent supply chain management practices, productivity pressures on terminal real estate, economies of scale in maritime shipping and better integration with inland freight distribution have incited various **terminal automation strategies**, which are capital intensive. Automation can be applied to three intermodal stages within the terminal. The first concerns transshipment with the loading and unloading sequence. The second relates to container tracking and yard management, such as stacking. The third involves the interface between the terminal and inland transport systems.

### **An emerging global maritime freight transport system**

A **global maritime freight transport system** has been established since the late 19th century and expanded with containerisation. Figure 13 illustrates the structure this system is likely to take in the coming years.

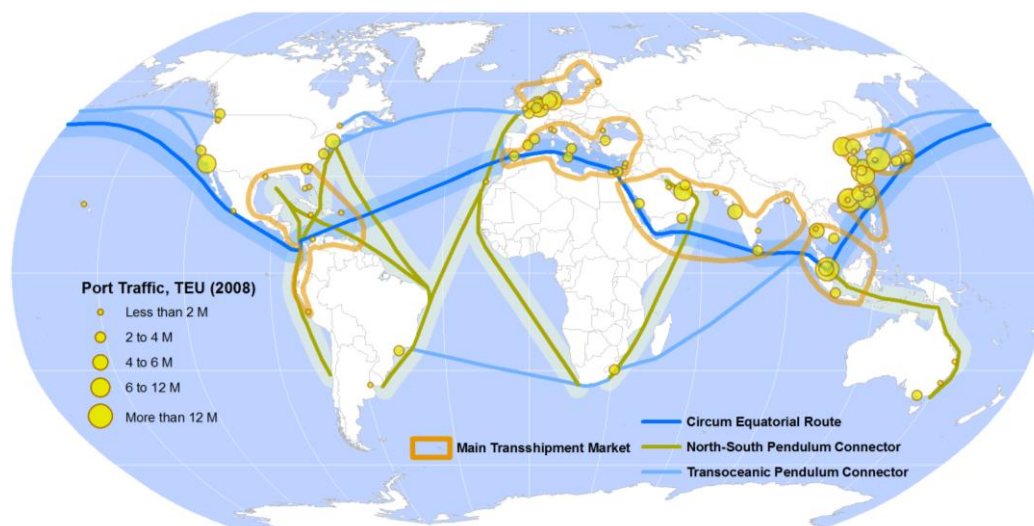
- **Circum Equatorial Route.** With the expansion of the Panama Canal expected to come online in 2014, a relative parity will exist for the first time between the Panama and Suez canals. In such a setting, maritime shipping companies may elect to establish circum equatorial routes in both directions with the usage of high capacity (8 000 to 12 000 TEU) container ships. This high frequency "conveyor belt" could support a significant share of global east-west freight movements in a cost effective way. This does not imply a homogeneous service as several different configurations of ports of call are possible along this route, particularly if a 300 nautical miles deviation is considered. This enables different circum equatorial network configurations.
- **North-South Pendulum Connectors.** These connectors reflect existing commercial relations, namely for raw materials (oil, minerals, agricultural goods), such as South America/North America, Africa/Europe or Australia/Asia. For container shipping, they are mostly based on the rationale that there is not enough volume to support transoceanic services, so cargo is collected/delivered along a latitudinal sequence of ports. This conventional network will be expanded with transshipment opportunities with the circum equatorial route.

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4. Such as the Maritime Transportation Security Act (2002).

- Transoceanic Pendulum Connectors.** These will connect through pendulum services selected ports of the facades of large oceanic masses. The three main transoceanic connectors are trans-Pacific, Asia-Europe (through the Indian Ocean) and trans-Atlantic. The industrialisation of Asia (China in particular) has made the Asia - Europe and the trans-Pacific connectors particularly important. Growth within the “BRIC” countries (Brazil, India and China) favors the emergence of a new connector in the Southern Hemisphere between the east coast of South America, the Cape of Good Hope and Southeast Asia.

Figure 13: **Emerging global maritime freight transport system**



Source: Containerization International, Jean-Paul Rodrigue.

- Transshipment Markets.** These connect regional port systems to transoceanic and circum equatorial routes, mainly through hub-and-spoke services. The relay function between long-distance shipping services performed by those markets is also significant. The most important are Southeast Asia, the Mediterranean and the Caribbean. They are referred to as markets because the transshipment function can be substituted to another port. Therefore, a group of ports in a transshipment market are "bidding" for port calls as this type of traffic is difficult to anchor. The development of circum equatorial routes is thus likely to expand the opportunities of transshipment, including interlining between these routes.

### Drivers in the maritime transportation: A summary

For ports and maritime shipping, the most complex policies have been related to **security considerations**, namely advance notice of cargo content and scanning cargo at ports. These have been absorbed in practices and costs as efficient security procedures became a competitive factor along supply chains. An emerging driver concerns the **governance** of increasingly regionalised ports (issue discussed more in detail in the next section).

Since containerised maritime transportation is strongly derived from the level of consumption of final goods, aging is likely to place pressures on future growth potential. As a greater share of the global population lives in urban areas, additional **pressures are felt on port terminal facilities** that find themselves with limited room for expansion. New sites are therefore located further away from existing activity centers, which leads to new opportunities for more efficient connections with inland transport systems since the new facilities can be planned in conjunction.

Paradoxically, maritime transportation is the most energy efficient mode, but bunker fuel accounts for about 50% of operating costs. Any change in energy prices has a **direct impact on operations** as there are limited options to absorb higher costs. The outcome is a greater reliance on **economies of scale** to mitigate those costs but also where possible **slow steaming**. The latter requires a larger number of ships to maintain service frequency along pendulum routes.

Due to local pressures, several ports are embarking in various **environmental regulations** such as restricting ship engine idling and drayage, which focus on noise and pollutant emissions because they have **clear local impacts**. For instance, it is common that a truck will end its life cycle in drayage operations. Climate change is also an issue that may add to the sustainability of transport systems, particularly in terms of a more stringent regulatory framework. Yet, since maritime transportation only accounts for 2.3% of greenhouse gas emissions attributed to fossil fuel consumption<sup>5</sup>, the industry is a low priority target.

Table 2: **Existing and emerging drivers for future maritime transportation**

	Maritime Shipping	Ports
<b>Policy</b>	Shipping security (advance notice) Cabotage	Port security Cluster governance Demurrage
<b>Demography</b>	Derived demand	Real estate pressures on terminal facilities
<b>Energy &amp; Environment</b>	Higher operating costs Emission regulations	Modal shift for inland distribution Emission regulations (e.g. drayage)
<b>Technology</b>	Economies of scale (?) Ship design	Integrating information technologies Terminal automation
<b>Economics</b>	Network rationalisation Slowdown in global trade Maturity of containerisation Development of niche markets	Hinterland access regimes Transshipment (competition)
<b>Finance</b>	ROI	ROI

IT also has a high potential to contribute to trade facilitation through more efficient custom procedures as **cargo information becomes more standardised and exchangeable**. Improvements in materials and engines are also highly possible with the expected benefits on shipping and terminals, namely in terms of performance. A particular realm concerns **terminal automation**, which is especially suitable for ports that have a good volume and acute real estate pressures.

Both for ports and maritime shipping, the short and medium terms underline a process of **rationalisation**. The exploitation of comparative advantages, which have been a driving force of globalisation, is yielding **lower productivity gains** and many suppliers are reconsidering their **outsourcing strategies**. It can be expected that containerisation will reach a phase of **maturity**, at least in advanced economies, and that future growth potential will be more limited to **niche markets**, such as commodities. Hinterland access regimes<sup>6</sup> are developing as important port competition factors, particularly in light of the footloose transshipment function.

5. McCollum, D., G. Gould and D. Greene (2009), *Greenhouse Gas Emissions from Aviation and Marine Transportation: Mitigation Potential and Policies*, Pew Center on Global Climate Change.

6. P.W. de Langen (2008), *Insuring Hinterland Access: The Role of Port Authorities*, International Transport Forum, Discussion Paper N. 2008-11.

Since the maritime sector is highly capital intensive, for ships and ports, **finance** will be a particularly acute issue in the coming years. While in the last decade finance was relatively easy to secure because of high traffic growth expectations, an **overcapacity exists**, which will take years to absorb. **Returns on investments** (ROI) are likely to be less significant than expected, implying that maritime transportation will be a less attractive venue for financial firms. The bankruptcy of some maritime shipping companies and terminal operators is possible.

## REALMS OF ENGAGEMENT FOR PUBLIC POLICY

Both maritime shipping and terminal operations are characterised by a **small number of large private players**, some being publicly owned (e.g. sovereign wealth funds) but competing in the same manner than their private counterparts. The industry can be considered an oligopoly with high entry costs but also very competitive in regard of cargo. This industry is **strongly globalised**, having multinational assets and for maritime shipping those assets can quickly be reassigned. It thus represents one of the transportation realms where public policy is the least effective, unless concerted efforts are made and in line with the objectives of the industry.

Like any private industry, it is concerned by **costs**, **efficiency** and **reliability** and is actively seeking improvements in any of these dimensions. Among the numerous strategies being pursued is a higher level of integration with elements of the intermodal chain. Particularly, maritime shipping companies, such as Maersk, have been involved in the development of a portfolio of terminals, and even trucking companies, rail operators and distribution centers. As this takes place, new realms of engagement with public policy become possible.

The **maritime/land interface** represents, however, a unique opportunity of engagement as it facilitates trade, reduces inefficiencies and offers new distribution alternatives. Flexibility in the movement of container assets is important as it enables better taking advantage of commercial opportunities. Many countries have restrictions about ports of entry, demurrage and cabotage. In this context freight forwarders tend to prefer transloading the contents of maritime containers into domestic containers or truck loads. This is linked with inefficiencies and delays.

The governance of hinterland access regimes is linked with **port cluster formation**<sup>7</sup>. It refers to the agglomeration effects and the degree of internal cohesion and competition within a port hinterland. **Cluster governance** relates to the mix of, and relations between, organisations and institutions that foster co-ordination and pursue projects that improve the cluster as a whole through regional strategies. The main advantages of cluster governance are a better access to competencies and innovative ideas, a better access to suppliers and customers, a better access to capital and an overall reduction of transactional costs.

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7. Global Institute of Logistics (2009), Seaport Cluster Research Programme, Global Maritime Logistics Council, [www.globeinst.org/portcluster](http://www.globeinst.org/portcluster).