Port system development dynamics in the containerization era

Since the mid-19th century and up to the diffusion of containerization as a dominant form of freight distribution in the 1980s, the development of a port system evolved from an initial pattern of scattered, poorly connected ports along a coastline to a main network consisting of corridors between gateway ports and major hinterland centers (see phases 1 to 4 on Figure 1).

Containerization revolutionized maritime shipping and port terminal operations and supported the substantial growth in international transoceanic trade over the last decades. While traditionally most ports had a fairly clear and distinctive hinterland, containerization initiated a trend towards large overlapping or contestable hinterland regions. The competitive landscape became even more complex by the setting of large container transshipment facilities in locations with a weak hinterland. From the late 1980s, the integration of such transshipment hubs led to a new paradigm in port evolution.

Enter the hinterland regionalization paradigm

In the 1990s the growth in container traffic reached a level in several large port facilities where a more efficient form of hinterland transportation needed to be organized. It involved the incorporation of inland freight distribution centers and terminals as active nodes in shaping load center development (phase 6). This port regionalization phase is characterized by the joint and coordinated development of a specific load center and multimodal logistics platforms in the hinterland, ultimately
Figure 2. Structures supporting port regionalization.

Figure 3. Foreland and hinterland-based regionalization: reconciling the pressures of massification and the demands of atomization.
leading to the formation of a regional load center network which, depending on regional characteristics, is supported by two types on inland infrastructures:

- **Inland waterway ports**
  These ports are either standard inland maritime or barge ports that are being integrated to hinterland services of coastal ports through shuttle services by barges or smaller coastal ships. This is particularly the case along the Rhine and in the Low Countries, where inland barge ports acts as feeders for large ports in the Rhine-Scheldt Delta such as Rotterdam and Antwerp.

- **Inland terminals**
  This is a rather more recent concept where a direct inland connection, particularly through rail, is established between an inland terminal and the port. It takes advantage of intermodal transportation and the improvements in the transshipment efficiency of port terminals. North America has seen the extensive development of inland terminals and their associated logistics zones.

The formation of an inland load center network therefore involves a series of inland terminals (IT) linked to the port facilities by high capacity rail or barge corridors (Figure 2). Also, a supporting land use structure needs to be established, mostly concerning the clustering of logistics activities (e.g. distribution centers) and often in co-location with the terminal facilities. For instance, port-centric logistics zones support freight distribution activities related to maritime shipping and have a dominant international trade orientation. Port authorities tend to be proactive in this type of development since it supports and provides added value to port activities. An inland port is an intermodal terminal (commonly rail) built or updated concomitantly with the development of adjacent (co-located) logistical and service activities. An intermodal industrial park is a similar structure although in proximity (not co-located) to the terminal facility.

The growing interest in port regionalization is a gradual and market-driven process, imposed on ports, that mirrors the increased focus of market players on logistics integration. The regionalization phase demands appropriate structures to be in place as to face the challenges posed by changing port-hinterland relationships. Port authorities often adopt a facilitating or catalyst role in enhancing regionalization. In some cases they even take financial participations in the development of logistics zones and inland ports, as illustrated by the financial involvement of the Antwerp Port Authority in Trilogiport (a new terminal/logistics area in the inland port of Liège) and its minority shareholding in the Beverdonk container terminal along the Albert Canal in Belgium.

### Foreland-based regionalization: Integrating transshipment hubs

Regionalization is a process that has been looked so far as taking place over the hinterland, but regionalization can also take place on the maritime foreland. The concept of *foreland-based regionalization* refers to the integration of intermediate hubs in regional shipping networks, where the maritime foreland of the intermediate hub is functionally acting as a hinterland. For reasons like deviation, small volume and niche hinterland, some ports are not that well-connected to the global long-distance shipping network and show limited opportunities to improve this connectivity. Shipping companies must consider effective network configurations that tend to focus on major gateways and intermediate hubs.

At a regional level, several small or medium-sized ports may realize that it is in their long-term interests to have a higher...
level of integration with an intermediate hub, even if it comes at the expense of shorter distance liner services calls. Foreland-based regionalization can support export-oriented strategies with a better connectivity of more marginal (or in their early stage of growth) ports to global shipping networks and thus international trade. There are also site constraints, environmental factors or low market potential that may limit the volumes generated by the hinterlands of some ports. On the intermediate hub side, the volatile long-distance transshipment traffic would be complemented with a more stable and secure regional gateway traffic. Both the foreland and the hinterland are thus mutually self-reinforcing, as hinterland stability can anchor the volatility of the transshipment function, particularly in light of footloose operators.

Massification versus atomization: a growing gap?

Freight flows on the foreland and hinterland are not taking place at the same momentum, particularly since on the foreland economies of scale have been more effectively applied than on the hinterland. This creates a capacity/scale gap between inland and maritime transportation as economies of scale in maritime shipping cannot be effectively reconciled with economies of scale in inland transportation. Inversely, there is a frequency gap as inland transport systems operate at a higher frequency to accommodate punctual (atomized) demand (Figure 3). In both cases, port terminals are facing pressures to accommodate these gaps with regionalization as a resulting strategy. Hence, port regionalization allows stretching the massification of flows beyond the port toward the hinterland through the use of high capacity barge or rail shuttles linking the port to a set of inland ports and logistics zones.

In light of an increasing massification of containerized freight loads, and while the ultimate goal remains atomization (individual containers delivered to freight owners), the insertion of an intermediate hub can in some circumstances act as a mitigation strategy that can complement the setting of an inland load center network. The largest containerships can call at intermediate hubs with high capacity and frequency services. Through feeding, ports serviced through the intermediate hub can have smaller ships (e.g. Panamax class) calling at a high frequency.

A look at European and North American hinterland-based regionalization

Regionalization strategies are strongly influenced by the geographical characteristics in which they take place. In Western Europe, the hinterland is not only intense along the coastline but also in the interior, notably along the Rhine-Scheldt delta; Bavaria in the South of Germany; the economic centers around Milan in Northern Italy, Madrid in central Spain and major markets in Paris; the Liverpool-Manchester-Leeds belt in the UK; and the belt reaching from Austria to the growing production clusters in Hungary, the Czech Republic and Southern Poland. Moreover, a large part of the European economic centers are somewhat remote from the main shipping lanes as is the case for the countries around the Baltic. European gateways are therefore not the only major markets, but often intermediary locations, even if many are important industrial centers (Figure 4).

The hinterland is accessed from coastal gateways such as Rotterdam, Antwerp, Hamburg, Bremerhaven, Le Havre, Barcelona, Marseille and Felixstowe by medium-distance...
To what extent a port’s future is decided in the hinterland?

After more than half a century of containerization many ports are facing pressures to improve their capacity and performance in light of constraints in the availability of land for expansion. Port regionalization, through the setting of an inland network of load centers, is a strategy that has been used to massify hinterland transportation and correspondingly improve port competitiveness; hinterland-based regionalization. Another form of regionalization, less common, relates to the usage of transshipment hubs as gateways to a regional port system; foreland-based regionalization. A better reconciliation between forelands and hinterlands would help to ensure that returns on investments are higher and that port terminals are able to cope with the growing capacity and frequency gaps. The ports that are the most proactive at implementing regionalization strategies are those that will be able to compete the most effectively in attracting port calls and their related traffic.

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[3] Ibid.

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