COMPETITION AND COMPLEMENTARITY BETWEEN SEAPORTS AND HINTERLANDS FOR LOCATING DISTRIBUTION ACTIVITIES

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PortEconomics

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Cover photo: Left Bank port area in Antwerp, Belgium. Top: the Deurganckdock for container handling. Bottom: some of the distribution facilities located at the Vrasenedock and Verrebroekdock. Photo courtesy of Antwerp Port Authority. Photo taken in Summer 2013.

ABSTRACT

A locational duality in port-related distribution activities is emerging. In some regions, distribution activities have moved from ports to inland locations, driven in part by 'push factors' such as port congestion and scarcity of land for container handling activities, or by 'pull factors' such as the growth of intermodal corridors, the influence of inland terminals and the changing economic geography in the hinterland. In other regions, ports retain their traditional role as centres of distribution and warehousing activity. More recently, the focus on 'port-centric logistics' is indicative that some regions are refocusing on ports as potential locations for large distribution centres. The result has been a growing competition, but also complementarity, between ports and inland locations concerning the location of distribution activities, driven not only by market forces but also by institutional settings and the governance relations between the actors involved. This report provides an overview of regional differences across the world in order to develop a framework identifying for which type of distribution activities ports are suitable locations and which activities are best suited to the hinterland, taking into account geographical, economic and logistics settings. Empirical evidence is derived from a variety of regions in Europe, North America, South America, Southern Africa and Asia.

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CONTENT

INTRODUCTION

A locational dualism in port-related distribution activities is emerging. In some regions distribution activities have relocated from ports to inland locations, driven in part by 'push factors' such as port congestion, the scarcity of land for container handling and logistics activities or attempts by terminal operators to expand their influence in the hinterland. These push factors have been complemented by 'pull factors', such as the expansion of intermodal corridors, the development of inland terminals and changing economic geographies in the hinterland. In other regions, ports have retained and sometimes even expanded their traditional role as centres of distribution and warehousing activity. More recently, the focus on 'port-centric logistics' in some locations indicates a refocusing on ports as potential locations for large distribution centres (Mangan et al., 2008). The result has been a growing competition, but also complementarity, between ports and inland locations concerning the location of distribution activities, driven not only by market forces and supply chain strategies but also by institutional settings and the motivations of the actors involved. These institutional settings mainly refer to the governance of logistics zones, inland ports and inland corridors and the associated public policies aimed at creating logistics clusters. Such policy push initiatives are reinforced by the strategies of market players in view of promoting stronger port-hinterland connectivity through concepts such as extended gates.

The role of inland ports and terminals not just as transport hubs but as locations for distribution activities has been receiving increasing attention (e.g. Rodrigue & Notteboom, 2009). Likewise, it is widely accepted that ports are more than transport nodes and should be understood as elements of supply chains (Robinson, 2002). However, significant regional differences in hinterland logistics have been identified, particularly in terms of the actors involved and the roles inland ports play in supporting supply chains (e.g. Rodrigue & Notteboom, 2010; Monios & Wilmsmeier, 2013). Therefore, a systematic review of the relative merits of ports and inland locations for the setting of distribution activities can be valuable to reveal the regionalism of freight distribution. This is particularly relevant since it enables a better understanding of the role that port-centric logistics plays in light of established systems of inland ports and logistics zones. Comparing the potential of port-based versus inland-based logistics enables an assessment of the inertia of supply chains that were constructed in different contexts. This report uses a series of international case studies to analyse the key factors that favour ports or inland locations as settings for distribution activities, and seeks to explain the associated regional differences. The goal of the report is to produce a framework that can be used for structured analysis of these differences and deepening understanding of the port's role in distribution activities within increasingly complex global supply chains.

THE EVOLUTION OF DISTRIBUTION ACTIVITIES

Globalisation has enabled the spatial separation of production and consumption. Gateways for international cargo interact with national, regional and local hubs to articulate international and domestic flows. These nodes can have different features; for example, they are always points of transport interchange but they may also be large distribution centres supporting various supply chain activities. The dualism between the port and the city (Bird, 1980) was followed by a similar polarity between inland freight handling terminals and their city locations (Hesse, 2008).

Table 1. Centralised and decentralised distribution hubs

Landscape	Function	Location	Examples
City	Traditional place of goods exchange (regional distribution)	Historical urban centres	Market places, traditional locations for urban retail, warehouses
Port city (or inland port city)	Traditional place of goods exchange (long-distance distribution)	Shorelines, estuaries, large inland waterways, intersections of trade routes	Port land area, inland port land area, warehouses
Urban periphery	Spatial anchor of modern distribution networks	Cheap land and workforce, highway intersections	Industrial DCs and warehouses, big box retailers and shopping malls
Large scale distribution	Decoupling of distribution from urban market place	Cheap land, workforce and transport corridor access, intermediate for several urban areas	National or regional hubs for global distribution firms

Source: adapted from Hesse (2008)

Distribution has evolved from a simple transport procedure to an integrated system based on large distribution centres, which have transformed from simple storage warehouses into large buildings with storage, cross-docking, customisation, light processing and information management. They represent a spatial concentration of logistics processes that might previously have required many separate actors and locations. Rather than selecting locations close either to production or consumption, these sites tend to be located at intermediate locations, suiting a new role as centres of distribution rather than centres of production or consumption (Table 1).

The evolution of the locational strategies of distribution centres illustrates how an intermediate location, suitable for distribution to several urban centres, can become a central location, exerting through economies of agglomeration a centripetal pull on logistics facilities. The result is large concentrations of flows in certain hub regions, such as the Midlands in the UK, the Rhine-Ruhr area in Germany or the Rhine-Scheldt Delta area in Belgium and the Netherlands. This concentration of distribution activities in large sites has been enhanced by improvements in

regional transportation systems and the lowering of regional cross-border transport and trade costs facilitated by the creation of regional economic trading blocs.

The different determinants for centralized distribution centres (DC) vs. several decentralized DCs have been assessed. Kuipers and Eenhuizen (2004) revealed that the number of distribution centres serving regional markets is growing, favouring inland locations close to markets. However, the number of centres serving global markets is also growing, favouring locations close to large international seaports or airports. Notteboom (2009) indicates that the choice between the various distribution formulae depends on, among other things, the type of product and the frequency of deliveries. In the fresh food industry, for example, worldwide or continental distribution centres are not common because the type of product dictates a local distribution structure. In the pharmaceuticals industry, centralised distribution centres are common but regional or local distribution centres are not present, because the pharmaceutical products are often manufactured in one central plant and lead times are not very critical. However, several manufacturing sectors (i.e. the automotive industry) use expensive parts that need to be delivered within a tight lead time. Cost-service trade-offs also have an impact on the choice between a centralized or decentralized distribution network configuration (Nozick and Turnquist, 2000). Centralization of inventories offers opportunity to reduce costs, but storing products close to the final consumers could help increase responsiveness.

The transport mode mix is essential to any distribution system. While rail and barge often ensure a high-volume connectivity between the distribution facility and gateway port(s), the flexibility of road haulage allows less than truck loads and frequent deliveries to support increasingly complex supply chains and low inventory levels. Intermodal terminals can be used to support low inventory models, via the 'floating stock' concept, meaning that stock both in transit and awaiting transfer at terminal interchange points is monitored in an inventory system linking store, DC, intermodal terminal and gateway port (Dekker et al., 2009; Rodrigue & Notteboom, 2009). Just as new port terminals were built away from their former urban locations, so were large distribution nodes, with a focus on the optimal regional or national market accessibility, and clustering and agglomeration strategies resulted in large multi-tenant logistics platforms. Fewer, larger DCs and multi-tenant sites also provide the consolidation necessary to support the growth of intermodal corridors for secondary distribution (Monios, 2015).

While the geography of freight transport has evolved from generic concepts of nodes and links to more functional concepts of gateways, corridors and terminals, such terms rely to some degree on the activities performed and the structure of supply chains rather than intrinsic characteristics, such as the relative attraction of the gateway or inland location as a site for distribution activities (Rodrigue & Notteboom, 2009). Therefore, understanding the location of distribution activities sheds some light on the geography of freight transport. For example, a distribution strategy based on one national distribution centre (NDC) and several regional distribution centres (RDC) is different from a system with only one main distribution centre (MDC) offering direct distribution to customers or a system of many local DCs with inbound deliveries from many local suppliers (Rodrigue & Notteboom, 2009). While regional differences in distribution have been investigated before, insufficient attention has been paid from the specific perspective of port versus hinterland locations of such activities.

SPATIAL PATTERNS AND DISTRIBUTION CONCEPTS

PORT-BASED DISTRIBUTION

Many seaports have created distribution parks within the port area, which offers more advantages than providing small and separated complexes. Distribution activities can take place on the terminal itself, in a logistics park where several logistics activities are concentrated or in a private industrial facility. While there is a tendency in the container sector to move away from the terminal, for other cargoes an expansion of logistics on the terminal itself can be witnessed. As such, a mix of pure stevedoring activities and logistics activities occurs.

Port-based distribution involves a range of activities. The first category concerns activities that directly affect the unit of the cargo handled at the port. The stuffing and stripping (and often palletization) of container loads is an important activity that takes place at specialized facilities. Transloading is also commonly associated with the transfer of the loads of maritime (ISO) containers into domestic containers. The empty containers are then repositioned back to the container terminal or to an empty depot.

The second category concerns port-related production and distribution, which is the set of activities that perform a level of transformation to the cargo that transits through a port, also sometimes referred to as value-added logistics services (VALS). Inbound cargo, particularly finished goods, require to be consolidated and sorted in distribution centres for hinterland customers. Outbound cargo is usually warehoused waiting to be loaded (break-bulk cargo) or stuffed (containerized cargo). Manufacturing activities that are closely dependent on global markets, either for inputs (suppliers) or for outputs (customers), will tend to be located in the vicinity of port areas. Seaport-based distribution parks are often container-oriented and may be found in close proximity to large container terminals. However, also specialised seaport-based distribution parks exist focusing on the storage of liquid bulk (chemicals), on trade in which a combination of warehousing and office space is offered to a number of import-export companies or on high-value office-related employment in which Fourth Party Logistics Service Providers, logistics software firms, financial service providers to the maritime industry and consultants are located in the park.

Port-centric logistics is usually defined as the provision of distribution facilities and value-added logistics services at a port (Mangan et al., 2008; 36). While this definition could take various forms, from de-stuffing to sorting or customisation (e.g. labelling for different countries), these activities are already commonplace whereas locating a full DC within the port perimeter, from which the distributor serves customers, is less common. Port-centric logistics minimizes the primary distribution leg from the port to an inland-based DC. From a port's point of view, port-based distribution allows them not only to secure cargo but to earn additional revenue from these activities on their own land (Pettit & Beresford, 2009). Whether this presents an attractive option to a port depends on factors such as how much land is available and the quality of hinterland connections.

An additional characteristic of a port is whether it acts as a free trade zone (FTZ), whereby imports do not clear customs and therefore pay duties until such time as they leave the port, and if they are re-exported then duties are not required.

NEAR-PORT DISTRIBUTION

The term “distripark” has been used to denote a logistics platform or freight village based within or on the outskirts of a port (Notteboom & Rodrigue, 2009; Pettit & Beresford, 2009). Such a near-port location offers several similar advantages to being based within a port (e.g. lower transport cost because of short drayage, availability of equipment and cluster advantages), without the restriction of being within the port perimeter. Many of the large container ports of the world are surrounded by large areas of distribution activities, whether considered specifically as unified distriparks or not, and this concept may also fall within the category of a port cluster. This model may include transloading, sorting and storage or a full DC operation.

INLAND-BASED DISTRIBUTION

Inland-based distribution refers to the location of DCs inland. While these distribution facilities and parks are located sometimes at a distance of hundreds of kilometres, they have a clear flow orientation on one or more seaports. The goods travel directly via intermodal transport services from the port to an inland terminal and then by truck to the DC or warehouse. Alternatively, the warehouse or distribution centre itself may be co-located at the inland terminal, in a logistics platform, freight village or inland port. Additionally, a form of “terminalisation” may be practiced, in which the terminal is used as a storage buffer to reduce inventory holdings at the DC (Rodrigue & Notteboom, 2009).

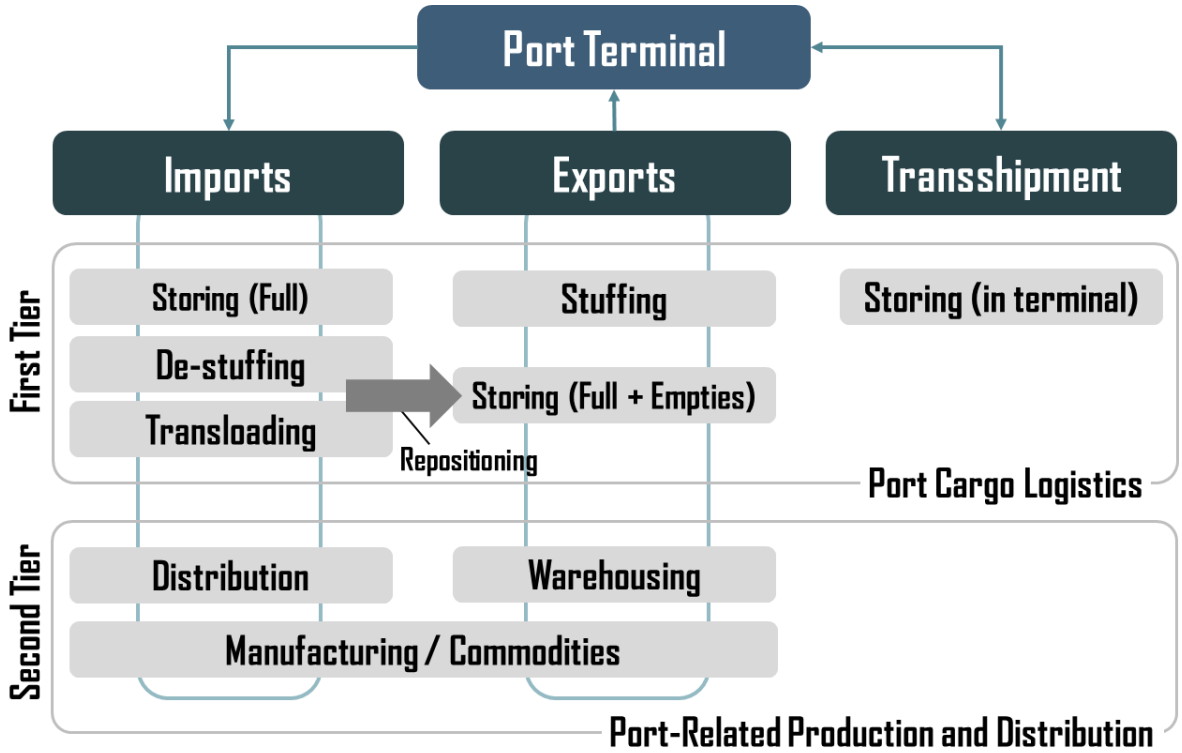
When using an inland intermodal terminal, containers are transloaded from barge or rail to truck then taken to DCs for stripping, then trucked empty back to the depot at the inland terminal (or maybe another depot). Or if the customer is located in a logistics platform adjacent to the terminal, the container can be stripped and the empty returned immediately to the onsite depot. How quickly the container must be returned to the port will depend to a large degree on whether the shipper has selected carrier or merchant haulage. The choice of an inland location might be affected by the ability to perform customs clearance, which was one of the key drivers for early inland freight facilities in the UK. While customs reform in the European Union and North America has to a large degree mitigated this issue, developing countries are finding customs reform to facilitate inland processing a key driver for strategies of inland port development (Monios & Wang, 2013).

TYPES OF ACTIVITIES IN PORT-BASED, NEAR-PORT AND INLAND-BASED DISTRIBUTION

Port-based distribution, near-port distribution and inland-based distribution can involve simple stuffing/de-stuffing at the port, some sorting, light processing or customisation at the port, a port-based first tier DC (i.e. product moves from here to a second-tier DC), a port-based single tier DC (i.e. direct to final customer or store from here), a near-port location for DC and/or related activities and inland-based DC and/or related activities. Figure 1 provides an overview of first-tier and second-tier port-related activities. All possible models at the level of port-based, near-port and inland-based distribution may also be combined.

For example, the containers can be transloaded in the port with further transport of the repacked load to a near-port or inland DC. Similarly, transloading may be done at a near-port location and the container may be sent by rail to an intermodal terminal in the hinterland and then by truck to the DC. As such, the models within the proposed typology are not mutually exclusive and can serve as building blocks for more complex distribution strategies. These building blocks have specific influences on locating activities inside, near or further away from a port.

Figure 1. First-tier and second-tier distribution activities



CHARACTERISTICS OF SEAPORT AND INLAND LOCATIONS

Several potential influences on the location of distribution activities can be identified from the literature (Revelle and Eiselt, 2005). The optimal distribution location decisions are based on inherent trade-offs among facility costs, inventory costs, transportation costs and customer responsiveness (Nozick and Turnquist, 2000), and are also influenced by the inventory stocking policy of the company (Nozick and Turnquist, 2001). The variables which affect site selection are thus numerous and quite diverse, cf. centrality, accessibility, size of the market, reputation/experience, land and its attributes, labour (costs, quality, productivity), capital (investment climate, bank environment), government policy and planning (subsidies, taxes) and personal factors and amenities. Traditional location selection criteria have emphasized cost-related variables such as economies of scale and transportation costs. Nowadays, however, non-cost-based variables have taken a more prominent role, such as infrastructure support, local labour market characteristics, environmental considerations, and institutional factors.

Many of the factors likely to influence the location of distribution activities are operational or market-based, while some relate more to policy and regulatory influence, others are derived from a region's historic trade role and the resulting path dependence. Some are likely to favour port-based distribution or near-port or inland locations. Locational decisions of distribution facilities are affected by the large-scale development of inland logistics zones and inland ports, such as the case in Europe, North-America and parts of China (cf. Yangtze basin). The functions of inland logistics centres range from simple cargo consolidation to advanced logistics services. Many inland locations with multimodal access have become broader logistics zones. They not only have assumed a significant number of traditional cargo handling functions and services, but also have attracted many related services such as distribution centres, shipping agents, trucking companies, forwarders, container repair facilities and packing firms. Quite a few of these logistics zones are competing with seaports for the location of distribution facilities.

As competition over a port's hinterland is growing, the question remains as to which logistics activities are truly port-related. The most salient logistics activities are those (Derveaux, 2004):

- resulting in a considerable reduction in the transported volume;
- involving large volumes of bulk cargoes, suitable for inland navigation and rail;
- directly related to companies which have a site in the port area;
- related to cargo that needs flexible storage to create a buffer (products subject to seasonal fluctuations, speculation by commodity traders or irregular supply);
- with a high dependency on short-sea shipping.

Moreover, port areas typically possess a strong competitiveness for the location of distribution centres for import cargo and as a consolidation centre for export cargo.

The decision to locate a distribution centre inside the port implies advantages and disadvantages. According to Ferrari et al. (2006), the most cited advantages can be summarized as follows:

- Good integration and cooperation between terminal operations and distribution centre activities;
- Possibility to re-export from the port to other markets;
- Reduce traffic congestion and pollution for local inhabitants when operating distribution activities inside the port area.

There are also disadvantages of a location in a seaport.

First, port land tends to be more expensive than land in immediately surrounding areas. The market price of port land is often higher as port authorities or the government want to avoid facing opportunity costs linked to the sub-optimal use of prime locations in the port area. Still, port authorities cannot price the port land too high as they have to take into account the competitive setting in attracting logistics operations.

Second, port land tends to be priced in a different way. Very often the logistics service provider cannot buy the land as most ports are of the landlord type whereby the port authority gives the port land in concession to the private port or warehouse operator for a specific term (Notteboom, 2006). Some asset-based logistics companies might not prefer port locations as landlord ports typically do not sell the land, but give it in long-term concessions.

Third, manufacturers have less flexibility because of the constraint to call the port where the distribution centre is located.

Fourth, the work regime in distribution centres in ports is often managed in accordance with the same (sometimes very restrictive) rules for dock workers. Logistics service providers might decide not to locate a distribution centre in a port partly because of the complexity of the labour system and the position of local labour unions.

Finally, in some cases, the port is located far from the final destination of goods and is not well integrated with inland distribution structures. Monios and Wilmsmeier (2012) highlighted the difficulties in balancing not just inbound and outbound cargo but different equipment such as container types, trailers and rail wagons when distributing from a port.

What is lacking is a systematic review of which influences are dominant in different regions across the world, and an analysis of to what extent the results are as expected or whether a diversity of institutional settings is producing unexpected spatial outcomes. Using a framework of key influences to structure the cases will allow a systematic review of these differences, before proposing potential explanatory factors for these differences. The main factors identified are listed in Table 2.

The following section will present narratives of regional case studies from different parts of the world, giving necessarily brief overviews of the key influences and outcomes, as well as identifying to what extent port vs inland distribution is favoured. The results will be compared and discussed in section 6.

Table 2: Main influences on the location of distribution activities

Factor category	Individual factors
Production and transport economics	1. Relative availability and cost of land and labour at port or inland location 2. Diminishing returns such as congestion, energy and empty movements.
Capacity and congestion	3. Congestion in the port and access infrastructure. 4. Quality and capacity of hinterland connections. 5. Availability of inland distribution centres, custom clearance, container depots and logistics facilities.
Market structure and trade strategy	6. Trade structure of the region: physical geography, resource endowment, centrality/ intermediacy, mix of foreign and locally sourced inputs, regional specialisations, history of the region. 7. Degree of vertical cooperation and integration between port and inland transport operators 8. Strong port competition driving new initiatives, either by securing hinterlands or by anchoring tenants at the port.
Supply chain management	9. Supply chain strategy of local shippers and distributors (e.g. push vs pull, high or low inventory, primary/secondary distribution needs). 10. Dominance of merchant vs carrier haulage in the region.
Policy and regulation	11. Economic development strategies of public sector agencies leading to favourable land use policy, zoning, financial incentives. 12. Policies related to foreign trade zones and customs procedures. 13. Cargo safety and security procedures. 14. Regulatory labour framework (e.g. unionization)

CASE STUDIES

EUROPEAN MAINLAND

Western Europe shows a specific distribution of economic activity in the hinterland. Major economic centres are not only found along the coastline but also in the interior, notably along the Rhine river system and its tributary rivers (Main and Neckar), Bavaria in the South of Germany, the economics centres around Milan in Northern Italy and 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. Large parts of the European economy is somewhat remote from the main shipping lanes as is the case for the countries around the Baltic. European gateways therefore act as intermediary locations to reach inland markets

Rodrigue and Notteboom (2010) illustrated how distribution network configurations in Europe were transformed. The creation of the European internal market in 1993 combined with the development of a trans-European transport network (TEN-T) gave companies a chance to consolidate their distribution operations into one central European Distribution Centre covering all European Union countries instead of having national distribution centres in the countries they present. The rise of EDCs meant longer distances to the final consumers and in some market segments local market demand has led companies to opt for regional distribution centres. More recently, a certain degree of decentralization of European distribution structures has taken place. At present, the tiered structure consisting of one EDC in combination with some smaller local warehouses, 'merge in transit' concepts or 'cross docking' offer a good mix to guarantee frequency of delivery and distribution cost control. Companies today often opt for a hybrid distribution structure of centralized and local distribution facilities. For instance, they use an EDC for medium- and slow-moving products and RDCs for fast-moving products. These RDCs typically function as rapid fulfilment centres rather than holding inventories. The increasing focus of logistics service providers and shippers on the objective to deliver goods across Europe in only 24h to 48h supports the shift from EDC based distribution networks to more tiered structures. Companies might even opt for the upgrading of one or more RDCs in their network to EDC status, leading to a double or triple EDC configuration. At the other extreme of the spectrum goods might be directly delivered to the logistics platforms of wholesalers or supermarket chains, a practice also known as DC bypass.

Some locations are more "EDC preferable" than others. At present, the centre of gravity for EDCs is located in a region comprising Belgium, the south and eastern parts of the Netherlands, northern France (Lille/Valenciennes) and parts of western Germany (mainly the Ruhr area). According to the statistics of the Holland International Distribution Council (HIDC), 57% of all EDCs serving American companies and 56% of those serving Asian companies are located in the Netherlands, concentration levels far higher than in the other EU countries in the ranking, namely Belgium and Germany (Ferrari et al., 2006). Cushman & Wakefield (C&W) publishes the European Distribution Report every two years to compare European top-regions for logistics, based on macro-economic factors with an impact on distribution and logistics. The reports traditionally give a ranking of countries in and around the so called "Blue Banana" area, and now had expanded to most of the "Key European Hubs" including 61 regions. In 2009, Liège in Belgium ranked as the top location for EDCs, closely followed by the provinces of Limburg and Hainaut in Belgium and Nord-Pas-de-Calais in France. The main reasons for this top ranking are excellent access to main European markets, a central geographic location to cover a wide range of European markets, top transport infrastructure and volume, close to main ports or with good

multimodal links to these ports, low costs for land, warehousing and labour, and a labour force that is available, highly productive, skilled for supply chain jobs, and with a good language knowledge (Cushman & Wakefield, 2009).

However, there are indications that the centre of gravity for European distribution is slowly moving to the southeast due to the rise of Central and Eastern Europe. This would make Wallonia in Belgium, Luxembourg and many German logistics hubs more interesting as future ideal location for EDC activity. This geographical shift is facilitated by strongly developed rail and barge corridors emanating from the west ports Rotterdam, Antwerp and Zeebrugge and the north German gateways of Hamburg, Bremerhaven and Wilhelmshaven. Port competition has become fiercer as all these ports, and even ports in the south such as the Adriatic ports, vie to serve these new logistics regions.

However, not all EDC activities are drawn inland. Major seaports, such as Antwerp, remain the prime location for large-scale distribution facilities for commodities such as oil products, cacao, coffee and tobacco (cf. impact of traders), for forest products and steel, for new and second-hand cars and for bulky goods linked to the local (chemical) industry. The port offers more than 6 million sqm of covered warehousing space, more than the ports of Rotterdam, Hamburg, Bremerhaven and Le Havre combined. The vast majority of the distribution activities in the port are operated by Antwerp-based companies such as Katoen Natie, Tabaknatie, Zuidnatie, Wijngaardnatie, Molenbergnatie, Noord Natie, Luiknatie, etc., many of which have also invested in other ports around Europe. The notion of ‘natie’ or guild goes back many centuries and is unique to the cargo handling and warehousing business in the port of Antwerp. A ship was discharged in the harbor by captain and crew, assisted by locally recruited stevedores. Once the crane brought the goods on quay, they were received and stored by the guild. The guild worked on commission for the buyer of the goods. Only few of the companies with ‘natie’ in their name are still organised as true guilds. Also, over the years they have integrated stevedoring in their portfolio of activities.

Dry port development has entered a new phase with port authorities such as Rotterdam, Barcelona, Le Havre, Marseille, Antwerp and Lisbon getting actively involved in inland port development and related logistical port-hinterland solutions. Some terminal operators and shipping lines in Europe are incorporating inland terminals as ‘extended gates’ to seaport terminals (Rodrigue and Notteboom, 2009). A good example is container terminal operator ECT in Rotterdam (part of Hutchison Port Holdings) which follows an active strategy of acquiring key inland terminals acting as extended gates to its deep sea terminals (Veenstra et al., 2012). ECT offers highly frequent inland barge and rail connections to various logistics hotspots in the European hinterland. Terminal dwell time considerations can enhance the use of inland locations as extended gates to seaport terminals: inland terminals often offer a long free time for containers while seaport terminals typically impose a short free time and high dwell time charges for containers. These extended gates are typically located in large logistics parks so that base volume for the rail and barge services is guaranteed.

Fragmentation of inland ports and logistics parks remains a major concern in many European regions. National and regional governments have made attempts to develop master plans and blueprints for logistics park development covering a wider region. For example, the Extended Gateway policy was initiated by the Flanders Institute for Logistics (VIL) in 2006 and consisted of several plans for the development of logistics sites and inland cargo centres in the Flemish hinterland (Belgium). The implementation of the idea of the Extended Gateway received top priority status in Flanders. Following the introduction of the Extended Gateway concept for Flanders in 2006, several regional studies were carried out to analyse the logistics potential of

each province in Flanders. While these plans entered an implementation phase, the government did not succeed in 'steering' logistics development in the Provinces. Also in other regions around Europe, ambitious local public authorities combined with strong market-driven forces have resulted in a fair amount of fragmentation in inland terminal development and distribution activities. As a result, many smaller logistics zones exist with an insufficient terminal scale, low utilization levels and major challenges at the level of intermodal cargo bundling.

EUROPE – UK

UK distribution is largely centralised in the "golden triangle" of distribution centres in the Midlands, which not only allows distribution to all parts of the country, but encourages competition between ports at similar distances, due to the island geography of the country. Customs was reformed in the 1960s to allow inland clearance of containers which also encouraged inland-based distribution facilities as a result of the container revolution in shipping. Shippers and forwarders operate their own DCs, individually and in clusters or logistics platforms (e.g. Magna Park, Lutterworth: at 550 acres it is one of the largest logistics platforms in Europe).

Road and rail infrastructure has been developed to serve this model, with the UK's busiest intermodal terminal DIRFT Daventry handling around 200,000 containers per year. The site was developed in two phases by ProLogis, the first opening in 1997. The current site contains an open-user rail terminal, a private rail terminal for retailer Tesco and large distribution centres housing many of the largest retailers and distributors, some with their own rail connections. The third phase expansion, approved in 2014, will add an additional 8m sq. ft. of distribution space and achieve total rail capacity of 500,000 containers p.a. Container rail shuttles between the large southern ports to the Midlands have grown significantly in recent years; secondary distribution takes place largely by road around the UK, while in recent years a substantial Anglo-Scottish rail corridor has developed based on secondary distribution of picked retail loads from Midlands NDCs to Scottish RDCs and then to Scottish stores.

Now that the majority of products are imported through ports, it may not always be desirable to haul containers to an inland DC then offer secondary distribution from there. Currently the overall import focus of UK trade leads to empty container repositioning costs, from the inland location to the port, and then back to exporting countries in Asia. Some impetus therefore exists for relocating distribution to locations nearer the major ports; UK ports are fairly close to inland O/Ds therefore secondary distribution from ports is feasible. Another possibility is to utilise continental ports where some UK cargo is transhipped and consolidated.

Medium-sized ports in the UK are pursuing port-centric logistics as a way of competing with larger ports, as the latter generally have less land available for distribution activities, but some larger ports are also developing similar strategies. From a political perspective, there has been some use of incentives at national and regional level for businesses to locate in the UK through tax relief through the creation of "enterprise zones" which are more about economic development and jobs. The UK has five Free Zones, in which goods are considered outside the country for the purpose of taxation and customs duties, allowing the shipper to delay payment while storing and reprocessing goods.

The port of Teesport in the northeast of the UK, owned and operated by PD Ports, has been the market leader in terms of port-centric strategy. While it still handles a large amount of non-unitised trade (such as steel and chemicals), it has used ex-brownfield land vacated by the decline

of traditional industries to attract consumer goods to the port. Major retailers Asda (500,000 sq. ft., opened 2006, 30 year lease) and Tesco (900,000 sq. ft., opened 2009, 125 year lease) opened import-focused DCs inside the port for product lines such as clothing and electronics, even though their grocery lines remained based in their Midlands NDCs. Other firms have located DCs inside and in the vicinity of the port, in the latter case; big box retailer Argos located near the port of Teesport, and their carrier changed their port choice from the large southeaster ports in order to reduce land transport costs.

The port's container traffic increased significantly from 178,000 TEU in 2009 to 252,000 TEU in 2010, a figure it has maintained in the years since, and 2014 figures are expected to show an increase. The port can handle vessels up to 3,500 TEU and has hopes of eventually attracting direct deepsea calls; accordingly, the port's handling capacity has already been expanded to 650,000 TEU, with an eventual goal of 1.5m TEU. Plans for the creation of a further 1.6m sq. ft. of distribution space are now in place. Some challenges have arisen, however; Tesco no longer ships containers through this port, instead bringing containers from the ports of Felixstowe and Southampton, which indicates that even with port-centric strategies, centralisation tendencies are difficult to overcome. This is partly because Tesco has fewer stores in the northeast than Asda so the port-centric strategy was not suitable to their store coverage.

Unusual for the UK, London Gateway is an entirely new container port with a first phase capacity of 1.6m TEU (with a final goal of 3.5m TEU), developed by global operator DP World and commencing operations in 2014. It is located on the site of an ex-Shell oil refinery on the Thames to the east of London. Its marketing position is that is best-placed to serve the UK's largest consumption zone (London and the southeast UK) as well as competing with the UK's primary container port Felixstowe for deepsea cargo destined for traditional distribution locations in the centre of the country. As part of serving the former, the development includes plans for a 9.25 million sq ft. distribution area. The key clients for this were Marks & Spencer and Uniserve who had each agreed to build a 900,000 sq. ft. DC in the port, but withdrew. The port is, however, in talks with other clients and some DCs in the range of 100,000-400,000 sq. ft. are expected to begin construction in 2015. While concerns had already existed regarding whether the UK required such a level of additional container handling capacity, there also appears to be some reluctance for the logistics sector to anchor their distribution activities at this location. In summary, port-based and near-port distribution are being developed in the UK by private sector port owners, but they are challenged by existing centralised inland-based distribution strategies.

NORTH AMERICA

There have been large inland terminals in North America since the development of the continental railway system in the late 19th century. Their setting was a natural process where inland terminals corresponded to large inland market areas, commonly around metropolitan areas commanding a regional manufacturing base and distribution system. Although exports were significant, particularly for agricultural goods, this system of inland terminals was mostly for domestic freight distribution. With globalization and intermodalism two main categories of inland terminals have emerged in North America. The first is related to ocean trade where inland terminals are an extension of a maritime terminal located in one of the three major ranges (Atlantic, Gulf and Pacific) either as satellite terminals and more commonly as inland load centres (e.g. Chicago or Mexico). The second category concerns inland terminals mainly connected to NAFTA trade that can act as custom pre-clearance centres. Kansas City can be considered the most advanced inland port initiative in North America as it combines intermodal rail facilities

from four different rail operators, foreign trade zones and logistics parks at various locations through the metropolitan area.

Although every large port has a concentration of logistics activities, these are rarely the outcome of port-centric logistics strategies. Los Angeles accounts for the largest concentration of port-centric logistics activities in North America, but little of these activities are the outcome of a concerted effort. In addition to distribution to the large West Coast markets, a substantial amount of cargo is transloaded for domestic distribution and bound for inland distribution facilities such as inland ports. The port of Savannah represents an unique case of planned port-centric logistics. The port is under the jurisdiction of the Georgia Ports Authority (GPA) and has become a major commercial gateway along the American East Coast and represent a relevant example of a deliberate planning and development process for the setting of port centric logistics zones. Up to the 1990s, the port used to be dominantly focusing on exports such as paper and chemicals. Savannah was a relatively small container port with a traffic level well under Charleston, a nearby competing port with deeper drafts. Since it is within the general mandate of GPA to promote port and regional development, strategies were devised to increase container imports and promote Savannah as a commercial gateway of the American Southeast.

The Savannah logistics cluster was developed to capture hinterland commercial opportunities that were ill-serviced, particularly in the context of the changing commercial environment of freight distribution from the late 1980s. This includes access to the American Southeast with the port hinterland covering about 44% of the American population. The immediate hinterland includes the Piedmont Atlantic region (Atlanta, Charlotte, etc.) which accounts for a population of 15 million. These developments have been related to the setting of a number of logistics zones within a radius of about 40 km from the port, forming a port-centric logistics cluster that accounts for the one of largest in the United States for import retail distribution centres. These zones are built upon a set of advantages mostly related to the availability of land, short drayage distances, effective use of container assets and supply chain considerations, particularly the proximity of producers and consumers. The status of a Foreign Trade Zone (FTZ) offers several operational advantages in terms of postponement and added value strategy for American logistics zones. Importers are using this advantage to delay payments on their imports until they are leaving the FTZ to their stores or regional distribution centres. The logistic cluster of Savannah was granted FTZ status in 1984. The case of Savannah underlines a set of strategies spearheaded by the port authority to cope with the import oriented functions generated by the freight distribution activities of North America's largest "big box" retailers. Several recent logistic zones projects in North America are capitalizing on the planning and setting of a new intermodal rail terminal done concomitantly with a logistics zone project. This co-location partnership fundamentally acts as a filter for the commercial potential of the project as both actors must make the decision to go ahead with their respective capital investment in terminal facilities and commercial real estate. Compared to Europe, North American dry ports tend to be larger, but covering a much more substantial market area.

SOUTH AMERICA

A discussion of location of distribution activities in South America is very recent, as in the past distribution activities have principally been located close to the ports. An exception are the developments and discussion in relation to the two landlocked countries, the Plurinational State of Bolivia and Paraguay. The development of distribution activities for these two countries have focussed on inland terminals (e.g. Puerto Seco Oruro), whether located along the river network of the Paraguay-Paraná river system or in the form of inland terminals served by road transport. In the case of landlocked countries port hinterland connections comprise multiple national jurisdictions and complex challenges in region with a relative low level of regional integration, and thus form a specific case that is not discussed in this report

The discussion of distribution activities has been disconnected from the discussion of port development, mainly due to the absence of integrated logistics policies and strategies in the past. A further reason for the little spread of inland terminals is the poor state of railway infrastructure in the region, which would allow for high volume trade corridors. This lack of infrastructure has led to a transport system that is principally based on road transport in the port hinterland relations.

Given the absence or early stage of implementation of national integrated logistics policies, inland distribution and terminal development are mainly private sector driven or emerge from local and regional public sector initiatives. Ecuador develop a strategy document including inland terminals in 2013. Colombia published a national logistics policy in 2008, but is still trying to find the right strategy to implement it. In Peru and Argentina such strategies are still absent. Uruguay has recently started to discuss the development of a logistics strategy in relation to the port, driven by the congestion caused by the port in Montevideo. in Chile the development of inland terminals are left to the private sector (the ZEAL in Valparaiso being an exception (see below).

As a result inland distribution and terminal development in South America is multifaceted and terminals for distribution activities are developed as “puertos secos” (dry ports), ZAL (zonas de actividad logística), multimodal terminal or similar names, but not necessarily fulfilling different functions. The definitions of the type of terminals vary between countries and thus a clear classification of the existing terminals is difficult.

By way of example, the Colombian national government (2009) identified the need to develop different types of distribution centres and in order to promote the development this type of infrastructure has been included in the Free Trade Zone regime (Law 1004 (2005): While the national government sets general goals the financing of these infrastructure is left to the private sector. Currently the national planning authority is developing guidelines on the location and development of logistics centres at municipal level (http://transport-namas.org/wp-content/uploads/2014/11/CONPES-3547.pdf).

In the metropolitan context the development of “puertos secos” can be traced back as far as 1995, when Medellin, Colombia, presented plans to build its first dry port, to facilitate cargo flows to the this Metropolitan region. The discussion has become more prominent again driven by rapid or urbanization and the emerging challenges to supply metropolitan agglomerations in the region. From the perspective of logistics companies distribution activities are becoming more difficult due to increasing imbalance of population growth and transport infrastructure development. This is paired with a high level increase in motorisation and thus increasing levels of congestion.

Best practice examples from the region are few in number and none are embedded in wider national government strategies. A good example is the ZEAL in Valparaiso, Chile. This inland terminal at short distance from the port of Valparaiso, was built to overcome the limitations at the waterfront, as the container terminal had no room for further extension of storage capacity and the access to the port suffered from high levels of congestion in the city's centre. The project temporarily has lifted the capacity restrictions in the port, but at the same does not solve the inland distribution to the capital's metropolitan region, which is only 120km east to the port. Thus, inland distribution after leaving the ZEAL is realized by truck to other distribution centres in the metropolitan region. The competing port of San Antonio on the other hand recently inaugurated a container rail service connecting the port and the metropolitan region and thus increasing the potential of high volume flows. However, this new offering suffers from the fact that customs procedures and inspections cannot be made in the interior of the country. Thus limiting the role of the inland site and the integration between the port and the inland terminal.

This case is one example showing the multidimensional challenges in the efforts to exploit the competition and complementarity of seaports and inland terminal. Integration efforts face a dilemma where in many cases institutions and public sector entities at various levels promote and encourage the development of inland terminals (in different forms), but on the other hand few concrete incentives are given to the private sector to convert these visions into reality, which might be linked to lack of planning frameworks (reservation of space/locations), lack of actual transport infrastructure (i.e. transport infrastructure that allows for the development of multimodal access). It is also not uncommon that institutions at different levels with one country undermine each other's efforts (cf. Ng el al., 2013 for the case of Brazil). One cause for the lack of institutional frameworks and capacity is that institutional and infrastructure development were not able to keep pace with accelerated economic growth (cf. Ng et al, 2013) in the past decade.

Bureaucracy in the public sector (e.g. customs) on the one hand and informality and lack of training in the logistics and transport sector on the other hand often jeopardize efforts to integrate and to exploit the complementarity of port and inland terminals.

ASIA -CHINA

Logistics and distribution in China is a complicated sector still predominantly controlled by domestic companies. However, the distribution sector in China is developing fast and since 2004 more room is given to large international logistics service providers to expand their distribution channels in this vast country. Using their superior operational ability, foreign distributors are exerting huge pressure on Chinese competitors (see

Table *3*). Although foreign companies such as DHL dominate 80% of China's express delivery system, they still lack the support and structure necessary to cope with demand in the more remote regions of China. As a result, a large number of local logistics agents cater for local transportation needs.

Table 3. A comparison of domestic and foreign distributors in China

	Domestic distributors	**Foreign distributors**
Network	Regional; more confined in their service networks	National; tend to have wider footprints
Services	Focus mainly on simple services including invoicing and selling, warehousing and transportation	Provide a broader menu of value-added services including merchandising, business intelligence, cargo tracking, cold-chain logistics, promotion and marketing and capital financing
Distinct advantage	Government "guanxi" Network reach (especially in towns and counties) Highly price-competitive	Good corporate governance State-of-the-art facilities

Source: adapted from Li & Fung Research Centre (2012)

The international distribution systems in China initially were very much focused on the large export flows centred around major gateways along the coastline, mainly in the Pearl River Delta and the Yangtze River Delta. Conventional cargo flows of consumer products and industrial fabricates were consolidated in or near seaport areas, stuffed in containers and sent overseas to major markets in Europe and North America. Containers hardly ever travelled inland. In more recent years, the growing consumption in China has also given a strong impetus to the development of distribution structures for import flows. This shift has made many export-oriented enterprises to start engaging in both domestic and foreign logistics. In geographical terms, the distribution systems in China are no longer only located near the main gateways along

the coastline, but have expanded to major inland locations in the West (e.g. in cities such as Chongqing, Chengdu or Wuhan) and fast growing seaport regions in the Northeast (e.g. near the Bohai rim ports of Dalian, Yantai, Qingdao, Tianjin and Yingkou). Major infrastructure investments in highways, railways and inland terminals have facilitated the increased participation of these regions in distribution networks and a rising penetration of containers inland.

Despite advances made in the past decades, distribution networks in China remain much more fragmented than in Europe or the US. Distribution networks sometimes exhibit 6 to 7 tiers involving a complex grid of distributors, wholesalers and retailers. There is a strong pressure towards disintermediation or the removal of intermediaries in supply chains. Though there has been an increase in the quality of service like warehousing, packaging and processing over the past decade, many domestic logistics service providers are still heavily focused on transportation only and lack knowledge on advanced supply chain and distribution solutions. Consequently, many companies are hesitant to outsource a significant portion of the distribution processes. The rapid development of e-commerce is challenging domestic distribution networks.

The fragmentation is also felt at the level of transport services. In 2012, China counted 790,000 road transport companies with the top 20 companies only making up less than 2% of the market share. Transport companies often operate fleets of smaller vehicles given the importance of distribution in densely populated and congested urban areas. In 2012, around 78% of cargo was dispatched by road with barge and rail mainly concentrated on a number of important corridors, such as the Yangtze basin. The rapid development of China's rail system, the standardisation of cargo fares, and the reduction of a significant amount of paperwork has greatly increased the viability of using rail as a logistical alternative.

Chinese sea ports are rapidly developing dry (i.e., inland) ports to compete for hinterland access and to gain a competitive advantage. They do so by establishing a coordination mechanism for the construction, operation and management of dry ports between the coastal ports and the inland areas and to guarantee a seamless connection of inland areas to international transport. A good example is the port of Tianjin Port which has built and helped to build 21 dry ports in Northern and Western China. Another example is the cooperation between the port of Dalian (Liaoning Province) and Changchun (Jilin Province) in Northeast China. At the same time, many inland areas are promoting the construction of dry port logistics parks. Not all dry port and logistics park developments are oriented to the maritime gateways in the east to reach overseas markets. In the western provinces, many logistics areas have also developed a strong orientation towards the Eurasian rail connections.

The growing interest in inland ports coincided with main changes in ownership structures of inland ports. For example, some 60% of the inland ports on the Yangtze River, representing 84% of total throughput, have outside ownership, among them the Shanghai port operator SIPG (Shanghai International Port Group) and COSCO (Veenstra and Notteboom, 2011). The inland strategy of terminal operator SIPG proved to be instrumental for the creation of a strong regional distribution system connected to Shanghai, SIPG's home-port.

Zeng et al. (2013) discuss the recent development of dry ports in China and summarize the existing dry port network. They point to increasing port competition, a growing inland production and domestic consumption, and logistics costs and environmental considerations as the main drivers for the rapid growth of dry ports and associated logistics parks in inner China. Also other papers on Chinese inland ports (e.g. Hanaoka and Regmi 2011; Beresford et al. 2012; Lu and

Chang, 2013; Monios and Wang, 2013) have pointed to the fast growth of the inland networks and the complexity of the governance system for inland port development in China.

Increased competition and fragmentation in the Chinese inland port system can undermine economies of scale on intermodal routes and decrease the return on public investment (Monios and Wang, 2013). In some areas, government has stepped up to fight fragmentation by developing very large terminal facilities with associated logistics parks. Chongqing provides a very good example of this tendency. In its ambitions to become the logistics hub in western China and to face competition from nearby cities such as Chengdu in Sichuan Province, the Chongqing government has centred dry port development around two very large facilities along the Yangtze River: the Cuntan terminal with a total capacity of 2 million TEU and the Guoyuan terminal with a capacity of 1.2 million TEU in the first phase and the potential for 2 million TEU when fully developed. Both facilities feature large logistics parks right behind the terminals. Recently, a government policy was designed aimed at the development of pilot free trade zones in some coastal port cities. For example, the planned China (Shanghai) Pilot Free Trade Zone will comprise four areas under the special administration of Customs: Waigaoqiao Free Trade Zone, Waigaoqiao Free Trade Logistics Park, Yangshan Free Trade Port Area and Pudong Airport Free Trade Zone. The entire zone covers an area of close to 29 square km. These zones mark a new stage in China's opening-up policy as they will be open to foreign market players and offer the possibility to set up distribution systems for a broader Asian market without the burden of having to pay customs duties in China. It is expected that these free trade zones will attract distribution centres which focus on East Asia.

AFRICA

In Africa, accessibility to the hinterland remains challenging, which impairs port development prospects. Ports that could in theory have access to a larger hinterland simply from a distance-based consideration (accessibility), have their hinterland access constrained by the dual impacts of limited corridor development and the additional friction imposed by borders. This creates accessibility and market distortions, particularly at border crossings, further challenging port development. Geopolitical considerations that are mostly the outcome of the colonial era have produced national hinterlands in Africa that are not necessarily natural hinterlands, implying that several ports are “boxed in”. Additionally, few river systems offering a comprehensive long distance access to the hinterland are present, imposing a reliance on road and rail transportation.

African countries have yet to develop comprehensive national highway systems, leaving national and cross-border connectivity a recurring issue. There are limited if any rail services, undermining the setting of economies of scale over the hinterland. Traffic which under normal circumstance should be circulating on rail is forced to use long distance trucking, adding costs and delays. Still, corridors are being developed such as for Durban in South Africa, Maputo in Mozambique and Walvis Bay in Namibia, serving Sub Saharan Africa, while in East Africa corridors exist linking Dar es Salaam, Tanzania and Mombasa, Kenya with landlocked countries Uganda, Rwanda and Burundi, in addition to a corridor linking the port of Djibouti with Ethiopia. However, the condition of the infrastructure on many of these routes is poor, which, even when functioning, limits overall capacity as well as causing delays. The inconvenience and unreliability outweigh any potential savings in transport costs, as more time has to be built into the supply chain and higher inventory levels are required for stock buffering. Since rail transportation in many African countries is, therefore, either not present, operational or able to provide adequate hinterland services, the load is usually dominantly assumed by road transportation.

Port congestion at African ports is an ongoing problem. Despite some use of satellite terminals around the port of Mombasa to ease congestion, in 2010 it was operating at over twice its design capacity of 250,000 TEU. A new container terminal is due to open in 2016. Such inefficient processes not only cause delays but make storage or processing goods at the port an extremely costly option. The cost structure of servicing African ports is thus usually different than at other ports around the world (CPCS Transcom, 2010). A share of the logistics costs are standard transport and terminal charges such as sea shipping rates and port handling charges. The shipping lines charges are more controversial since they include fees such as delivery order fee, bill of lading fee and piracy risk surcharge (the freight forwarding community often call these "junk fees"). All these charges put together can be almost equivalent to the sea shipping rate.

The inland routing costs are the contracted rate of a local trucking company. More than 40% of the total logistics costs are indirect costs due to delays that include additional and inventory demurrage costs, but also bribe costs paid at a wide variety of police checkpoints and weighting stations, which can alone add more than $1,000 for an import container, depending on the value of the cargo. Inefficient regulation provides another source of increased costs; for example, in both Kenya and the Tanzania, road hauliers can only be licensed either for domestic or transit traffic, which leads to additional empty running and reduces triangulation possibilities. Costs can be incurred by following regulations, enforcing them or evading them; for instance, despite an agreement in 2008 for EAC countries to harmonise axle load limits, individual countries have not implemented such changes and physical inspections are still required. Yet, due to low profit margins trucking companies have a tendency to overload and pay a bribe at the weight stations to be allowed to go through. Therefore, such a system hinders economic development because supply chains tend to be unreliable while consumers and manufacturers pay higher prices for goods and inputs. In such a setting, various public authorities are using freight transportation to generate income in a rent seeking (predatory) fashion.

Despite attempts to increase the use of ICDs, both for customs purposes as well as to rationalise and balance container movements, access to containerisation services can be a problem for inland regions of Africa. High demurrage charges encourage operators to return containers to the port as quickly as possible without waiting for an export load, while exports in the same region may simultaneously be driven to the port in order to be containerised. Around 135,000 containers of Ethiopian goods are transloaded to/from trucks at the port of Djibouti each year, but in 2010 a political dispute occurred between the governments of Djibouti and Ethiopia over a decision that this activity could no longer be performed by Ethiopian freight forwarders but solely by the Maersk Djibouti Container Freight Station. Due to a lack of port competition in the region, shippers have no real alternative.

Slow and unreliable transport in addition to delays, charges, bribes and damage/theft incurred at border crossings all increase costs for local shippers. Even though some customs reform has been achieved, administration procedures at border posts are often not much changed. Efforts such as escorted convoys and priority systems for authorised companies are beginning to have some effect, but delays remain the norm. From a distribution perspective, this situation encourages large stock buffers close to the consumption base rather than near the port or at an intermediate location.

MAJOR INFLUENCES ON PORT AND INLAND LOCATIONS FOR DISTRIBUTION ACTIVITIES

PRODUCTION AND TRANSPORT ECONOMICS

Traditional deepsea ports generally have less land available for distribution activities and higher labour costs, as in large European ports such as Rotterdam and large US ports with highly unionised labour. Secondary ports using port-based distribution to attract tenants tend to have higher availability and lower cost of land and labour (e.g. Teesport in the UK), although skilled labour may be more difficult to obtain. The same is true of inland locations; well-developed inland distribution hubs will have higher cost of land and labour, with less availability of land but potentially high availability of labour, particularly skilled labour. Public subsidies available to develop new distribution locations are used not only for land purchase or superstructure development but also for training schemes for local employees.

The extent to which transport economics favour port or inland based distribution can be regionally specific, but key issues are transport prices and (cross-)price elasticities, transport time and associated congestion, and additional empty movements caused by locating a DC at the port if distribution patterns in the region are more centralised. For port-based distribution, import containers are offloaded from ships, shunted to the warehouse, stripped, and the empty then returned for repositioning. The load will then be reconfigured for inland movement. This is mostly likely to be just transloading into a truck, or even some cross docking or simple sorting.

Removing the inland DC from the chain may potentially reduce distance travelled and raises the possibility of using rail. A related (and fixed) factor is the distance of the port to the market, and whether secondary distribution direct from a port-based DC is feasible. However, this model may reduce the value of intermodal transport if the unitised load is stripped at the port rather than completing a seamless door-to-door journey, which reduces handling costs and improves security. Shippers of high value goods prefer fewer handlings of their cargo throughout the transport chain.

Regional differences play a key role. Centralised distribution strategies generally reduce the attractiveness for port-based DCs in continental Europe and the UK, evidenced by the difficulty of the new port London Gateway in attracting clients to its huge planned logistics platform at the port. On the other hand, the port of Antwerp offers more than 6 million square meters of warehouse space, more than Rotterdam, Hamburg, Bremerhaven and Le Havre combined. The port plays a key role in mainland Europe as a warehousing and distribution node for bulky commodities such as fertilizers, oil products, forest products and steel, and containerised commodities such as coffee, cocoa, tobacco and bananas. De-stuffing containers at the port is also attractive in other parts of the world with very long inland distances, whereby taking the container inland can incur additional empty flows due to repositioning.

The cases also showed that regional differences play a key role. Developed countries tend to have higher availability of containerisation and related processes inland, therefore containers can be stuffed at the shipper's warehouse. In developing countries, such as Africa and to some extent Asia, it is more common to drive goods to and from the port and stuff/de-stuff containers in or near the port. De-stuffing import containers at ports reduces inland container availability for exporters, although an import dominant region may not require large numbers of containers for export.

Relative size of unitised transport options in the region is also relevant. In the USA, goods shipped in 40ft maritime containers are often transloaded into 53ft domestic containers, as the handling cost is outweighed by the saving in transport costs. A similar issue exists in the UK regarding 45ft domestic containers, but inland distances are insufficient to warrant transloading between containers. Different container types can also lead to backhaul and equipment balancing difficulties. If the DC is in the port, then the goods will be distributed from the DC to the stores in articulated trucks, but the majority of trucks coming to the port may be bringing maritime containers on trailers, so it can be difficult to match these flows.

CAPACITY AND CONGESTION

Congestion within the port and road congestion in the proximity of the port is one factor behind the increase in the use of inland ports to secure hinterland flows. This can only be done if hinterland links are of high quality and capacity, which has tended to be lacking in developing countries. Ports are being proactive in developing inland terminals as tools of port competition, initially in developed countries (e.g. major ports such as Rotterdam and Barcelona, De Langen and Chouly (2004) and Van den Berg and De Langen, 2011) but also in developing countries (e.g. Veracruz, Mexico, Wilmsmeier et al., 2015; Tianjin, China, Monios and Wang, 2013). The hinterland freight geography of North America is generally serviced as a landbridge and Europe is serviced by coastal gateways and inland load centres (Rodrigue and Notteboom, 2012). The East Asian hinterland model has been categorised as coastal concentration with low inland coverage. This model is now changing, with increasing penetration of the Chinese hinterland westward facilitated by the development of inland ports along major rivers such as the Yangtze and the upgrading of the rail network (Monios and Wang, 2013). Regions with poor hinterland infrastructure (e.g. Latin America, Africa) continue to rely on long distance road transport to reach distribution centres in the hinterland. In such cases the inconvenience and unreliability of using rail outweigh any potential savings in transport costs, as more time has to be built into the supply chain and higher inventory levels are required for stock buffering. These are mostly transport rather than distribution decisions, but they also relate to the market structure.

MARKET STRUCTURE AND TRADE STRATEGY

Latin America and Africa retain a coastal concentration due first to a difficult inland physical geography, and second due to governance challenges constraining the ability to develop and maintain high quality intermodal infrastructure to support load centres in the hinterland. The need to cross national borders is another source of increased costs. The historical trade role of a region can also exert significant influence on future developments, such as the dominance of Northern Range ports to serve central Europe rather than Mediterranean ports, and the initial dominance in the US of east coast ports which was overtaken by west coast ports with the growth of the Asia trade. This pattern has shifted due to the expansion of the Panama Canal and labour difficulties at west coast ports. Nevertheless, major inland hubs retain their roles. In countries like China where coastal regions have traditionally dominated trade, it has required a concerted strategic push and large infrastructure investment by the central government to enable inland regions to play a larger role, not only relieving congestion but spreading economic development to traditionally poorer, less-connected regions.

The export of consumer goods from Asia to other parts of the world has produced an imbalance that results in empty container repositioning. Greater transport distances mean more empty

tonne-km, unless the operator can triangulate, and is exacerbated by equipment differences. Additionally, highly fragmented markets in developing countries can involve 6 to 7 tiers of distributors, wholesalers and retailers, which results in many intermediate movements and handlings. This is exacerbated by a high number of small transportation companies enjoying none of the benefits of highly integrated globalised logistics providers.

Port capacity restrictions can be overcome by upgrading port infrastructure and superstructure or by using efficient hinterland connections to access inland load centres (Cullinane & Wilmsmeier, 2011). This depends on the level of cooperation or integration between the port and inland actors; close cooperation favours integrated strategies of moving blocks of containers on container rail/barge shuttles to inland terminals. The port could take a financial stake in the inland node in order to recoup revenues lost from storage or logistics activities, but even without direct involvement in the site, such a strategy enables the port to retain (or attract) customers. If, however, a port has space for storage and other activities, then a port-centric strategy may be pursued. Such ports are often secondary ports with land available or new developments on brownfield sites. Therefore, locating the DC inside the port tends to be a less common strategy, while simpler activities such as transloading and basic sorting continue to be performed within or near traditional ports as essential parts of the port logistics service.

SUPPLY CHAIN MANAGEMENT

While some operational and economic decisions are more transport than distribution focused, the supply chain management strategy of individual shippers and their freight forwarders and logistics service providers is key. This is a reflexive relationship as to some degree transport requirements are derived from distribution choices but to an extent distribution structures are path dependent based on earlier decisions regarding the development of transport infrastructure. In most countries, a traditional high inventory model based on NDCs and RDCs remains common, with the active use of inland terminals being less likely.

Moreover, supply chain management strategies are specific to particular actors, rather than being generic to a region. Strategy convergence means that the penetration of global operators into new markets (e.g. DHL now operates up to 80% of China's express delivery system) rapidly produces recognisable market structures in new contexts. The locational decision will depend on the requirements of the shippers, based on their market sector, time limitations and mix of foreign- or locally-sourced goods. In order to make such decisions, shippers and 3PLs need to find a balance between the cost and time of primary and secondary distribution legs. It also depends on the secondary distribution strategy of the shipper. For example, sending a full load from NDC direct to store is different to sending less than truckloads from NDC to RDC where further goods can be added to an order. This optimisation of distribution can be related to Weber's conceptualisation of weight-gaining and -losing industries. Heavy containers can be kept off the road network, used on primary legs from ports to inland intermodal terminals, then into trailers only for the secondary haul, which therefore favours inland-based DCs. Alternatively, DCs can be located in the port and stock can then be picked and put on trailers direct to stores rather than via a diversion to an inland DC. Terminals can also be built into the supply chain as stock buffers to save inventory and storage costs at the DC. This is evidenced more in Europe where a much more atomised distribution network exists and shorter distances are the norm. Long distances tend to favour higher inventories to absorb delays or to cope with inflexibility in rail shuttles that require additional consolidation.

POLICY AND REGULATION

The impact of policy and regulation on distribution activities in a region will depend on the roles the public or private sectors play in developing transport infrastructure and logistics real estate. In most markets the former is managed by the public sector, and regional differences are explained largely by the existence of integrated policies for port and hinterland development. In Latin America and Africa, some large port projects are in evidence without suitable connecting infrastructure, while in Asia some proactive government policies have supported the development of inland ports and upgraded rail lines. A common issue in developing a high capacity intermodal sector is that freight rail networks in developing economies tend to be focused on bulk transport which needs large investment to upgrade. The potential for double stack container trains in China is beginning to produce a more recognisable intermodal sector.

Transporting the entire distance in the container can increase security, which is attractive for hinterland access in Africa and Latin America, but cross-border checks and long delays increase likelihood of damage and theft. Slow customs reform in Africa is an ongoing challenge, while in most other continents the use of online documentation and fewer checks have reaped rewards, in addition to use of subsidised FTZs. Low levels of regional integration in Africa and South America cause additional difficulties for landlocked countries. Inefficient regulation provides another source of increased costs; for example, in both Kenya and the Tanzania, road hauliers can only be licensed either for domestic or transit traffic, which leads to additional empty running and reduces triangulation possibilities. Costs can be incurred by following regulations, enforcing them or evading them; for instance, despite an agreement in 2008 for EAC countries to harmonise axle load limits, individual countries have not implemented such changes and physical inspections are still required. Yet, due to low profit margins, trucking companies have a tendency to overload and pay a bribe at the weight stations to be allowed to go through.

Successful inland distribution strategies thus depend on publically managed infrastructure, but also private sector business interest, particularly with regard to developing the site itself, which is often managed by real estate developers. A contrast can be observed between inland-driven sites often focusing on domestic distribution as well as export processing, and port-driven sites which tend to be about solving port congestion and are more focused on transportation rather than distribution activities. In contrast to inland facilities, there is some evidence that port-centric logistics tends to have more private sector involvement via port owners and operators. This could be because it is primarily a competitive strategy between ports for anchoring tenants, rather than public sector goals such as jobs, modal shift or rationalising the use of publicly funded infrastructure.

SUMMARY OF INFLUENCES AND FACTORS

Table 4 summarises the major influences on port and inland locations for distribution activities, as well as those that influence a near-port rather than in-port location. There are also a number of factors influencing the level of distribution activities undertaken within the port. In each case, however, the choice of distribution strategy (e.g. simple de-stuffing or more value-adding processing and customisation) will be context dependent and based upon a number of factors that may be firm-specific rather than regionally derived.

Table 4. Major influences on port and inland location of distribution activities

<table>
<tr><td rowspan="3">Factor category</td><td rowspan="3">No.</td><td rowspan="3">Individual factors</td><td colspan="4">In-port</td><td>Near-port</td><td>Inland</td></tr>
<tr><td>I.</td><td>II.</td><td>III.</td><td>IV.</td><td>V.</td><td>VI.</td></tr>
<tr><td>Factors favouring only stuffing/de-stuffing at port</td><td>Factors favouring value-added activities (sorting, light processing or customisation) at port</td><td>Factors favouring port-based single-tier DC (i.e. direct to final customer or store from here)</td><td>Factors favouring port-based first-tier DC (i.e. goes from here to a second-tier DC)</td><td>Factors favouring near-port location for DC and/or related activities (may still go to second-tier DC)</td><td>Factors favouring inland-based DC and/or related activities</td></tr>
<tr><td rowspan="3">Production and transport economics</td><td rowspan="2">1</td><td rowspan="2">Relative availability and cost of land and labour</td><td rowspan="2">Medium availability of land inside port</td><td colspan="3" rowspan="2">Higher availability of land inside port
Need for large sites for large-scale multi-purpose warehousing complexes, based on long-term land concessions (land ownership remains with landlord port authority)</td><td>Higher availability of land in port region</td><td>Higher availability of land in inland region</td></tr>
<tr><td colspan="2">Need for more specialised single-user distribution centres combined with preference for ownership of land
Compulsory use of costly and unionized dock labour pool for distribution activities in seaport area</td></tr>
<tr><td colspan="5">Higher availability and/or lower cost of skilled labour in port region</td><td>Higher availability and/or lower cost of skilled labour in inland region</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Diminishing returns such as congestion, energy and empty movements</td><td colspan="3">Higher availability of suitable equipment at port, ability to lower transport costs by using larger units</td><td colspan="3">Lower availability of suitable equipment at port, less ability to lower transport costs by changing unit</td></tr>
<tr><td colspan="2">Less ability to balance flows</td><td colspan="3">Better ability to balance flows</td><td>Less ability to balance flows</td></tr>
<tr><td rowspan="3">Capacity and congestion</td><td>3</td><td>Congestion in the port and access infrastructure</td><td colspan="5">Low congestion at port</td><td>High congestion at port</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Quality and capacity of hinterland connections</td><td colspan="6">Low quality and capacity of medium and long-distance intermodal inland links. High reliance on trucks for inland transport.</td><td rowspan="2">High quality and capacity of medium and long-distance intermodal inland links</td></tr>
<tr><td colspan="4">High quality/low cost intra-port links between (container) terminals and distribution sites in port (e.g. intra-port shuttle services by barge)</td><td>High quality and capacity of inland links between port and satellite locations in immediate vicinity</td></tr>
</table>

Factor category	No.	Individual factors	In-port				Near-port	Inland
			I.	II.	III.	IV.	V.	VI.
			Factors favouring only stuffing/de-stuffing at port	**Factors favouring value-added activities (sorting, light processing or customisation) at port**	**Factors favouring port-based single-tier DC (i.e. direct to final customer or store from here)**	**Factors favouring port-based first-tier DC (i.e. goes from here to a second-tier DC)**	**Factors favouring near-port location for DC and/or related activities (may still go to second-tier DC)**	**Factors favouring inland-based DC and/or related activities**
	5	**Availability of inland distribution centres, customs clearance, container depots and logistics facilities**	Lower availability of good inland facilities			Less availability of good inland facilities		Higher availability of good inland facilities
Market structure and trade strategy	**6**	**Trade structure of the region: physical geography, resource endowment, centrality/ intermediacy, mix of foreign and locally sourced inputs, regional specialisations**	Port located far from market	Port located close to main DC	Port located close to market	Port located close to second tier DC	Port located close to second tier DC or market	Port located far from market
			Decentralised distribution structure			Mix of centralised and decentralised distribution structures		Centralised distribution structure
			Dominance of foreign sourced inputs					Dominance of locally sourced inputs
	7	**Degree of vertical cooperation and integration between port and inland transport operators**	Low cooperation between port and inland actors		Some cooperation between port and inland actors			High cooperation/integration between port and inland transport operators favours pushing containers to inland ports (e.g. extended gates)
	8	**Port competition driving new initiatives, either securing hinterlands or anchoring tenants at the port**	Port competition from (often secondary or greenfield) ports with available land and less congestion				Port competition between (often similar regional) ports without port land but land near the port	Port competition between similar major ports therefore driving attempts to secure hinterlands. Strong incentive to bundle (long-distance) intermodal cargo of different ports in hinterland hubs
Supply chain management	**9**	**Supply chain strategy of local shippers and distributors (e.g. push vs pull, high or low**	High inventory, push strategy, able to place large orders and store goods at the port if not needed Cargo flows characterised by high demand uncertainty (strong fluctuations in inventory levels) or subject to speculation by commodity traders.				High inventory, push strategy, able to place large orders and store goods at the near-port DC if not needed	Low inventory, pull strategy, able to use inland terminal as stock buffer

Factor category	No.	Individual factors	In-port				Near-port	Inland
			I.	II.	III.	IV.	V.	VI.
			Factors favouring only stuffing/de-stuffing at port	Factors favouring value-added activities (sorting, light processing or customisation) at port	Factors favouring port-based single-tier DC (i.e. direct to final customer or store from here)	Factors favouring port-based first-tier DC (i.e. goes from here to a second-tier DC)	Factors favouring near-port location for DC and/or related activities (may still go to second-tier DC)	Factors favouring inland-based DC and/or related activities
		inventory, primary/secondary distribution needs)						
	10	**Dominance of merchant vs carrier haulage**	Dominance of carrier haulage but combined with a lack of hinterland network development by carriers. Container stays at port: non-containerised cargo flows get containerised in port area.				Dominance of carrier haulage, container goes back to nearby port	Dominance of merchant haulage, more flexibility to take container inland and/or triangulate Strong hinterland network development under carrier haulage (push strategy of shipping lines linked to inland terminals)
Policy and regulation	**11**	**Economic development strategies of public sector agencies leading to favourable land use policy, zoning, financial incentives**	Port region is considered by government as zone for economic development. Key focus on the creation of economic rent in ports: maximize value-added creation to cargo flows passing through the port and attraction of cargo-related logistics and (semi-)industrial activities in and around port areas.					Inland region is considered by government as zone for economic development Port regions are considered as transit areas with value-added activities taking place inland.
	12	**Policies related to foreign trade zones and customs procedures**	FTZs encourage activities to take place in the port				FTZs can also be located near ports in bonded sites	FTZs can also be located inland in bonded sites
			Lack of customs reform incentivises clearing container within the port				Customs reform makes clearance of container outside the port easier allowing the development of extended gate strategies	
	13	**Cargo safety and security**	Lengthy clearance processes for entry/exit favours containers not leaving the port				Smooth admin and security processes favour taking container to DC before opening (and fewer handlings)	
	14	**Regulatory labour framework (e.g. unionization)**	Flexible labour market in port region, lack of collective bargaining agreements for dock workers				Collective bargaining agreements for dock workers incentivises DC outside port	Flexible labour market in inland region. Collective bargaining agreements for dock workers incentivises DC outside port

DISCUSSION AND CONCLUSIONS

This report has presented a systematic review of the relative merits of ports and inland locations for the setting of distribution activities. Comparing the factors and influences of port-based versus inland-based logistics helps understand the inertia of supply chains that were constructed in different contexts. The difficulty in establishing a port-inland dichotomy lies in predicting which factors influence the likelihood of port or inland distribution in a specific case, which will always be context dependent. Some factors offer the ability to reduce costs; for instance, the use of rail shuttles to inland ports with ICT and information sharing can encourage inland-based distribution, but, as the cases show, inland-based DCs remain the most likely strategy even in the absence of high quality connections. Therefore whether the container has been transported inland in a low cost, secure, efficient manner or whether it was cleared at the port after lengthy delays and then trucked all the way to the inland DC, the DC location choice remains the same. Yet, it remains a factor that makes inland-based distribution more attractive. Therefore, the framework presented in this report aims to identify key influences on distribution choices rather than to act as a predictive model.

Production and transport economics are in most cases the primary determinant of the location of distribution activities. However, cost considerations are to a large extent derived from the structure of trade in the region in conjunction with the supply chain strategy of the actor. Some of these factors are fixed, such as physical geography and natural resource endowments, but population location and hence consumption will itself derive in some degree from the development of transport infrastructure, influencing the location of hub cities.

How efficiently these hub structures work is dependent on the capacity and quality of the infrastructure and other factors of industry organization (e.g. the degree of vertical cooperation between transport providers, shippers and forwarders). Such integration strategies allow for utilising either ports or inland terminals as part of their inventory management, choosing either push or pull strategies, including how much information is shared by supply chain partners. A mature transport and logistics system exhibits a tight integration of inland terminals, owned or operated by ports or shipping lines, pushing blocks of containers to inland ports, with full electronic customs paperwork, where agglomerations of large shippers and logistics providers will be located. This partly explains the trend in developed economies away from port-based container processing to inland ports.

The future location patterns of distribution activities will also depend on the advances made in port-hinterland integration strategies and policies. Ongoing strategies to increase the efficiency of both port and inland terminals entail increased proactive use of operational factors such as berthing windows, truck arrival slots, dwell charges, requiring a higher degree of integration between port and inland actors and a rationalisation of land use for container handling activities in comparison to administrative and distribution activities. Therefore, harmonising a distribution strategy with such decisions is of increasing importance to 3PLs and large shippers planning the location of their distribution centres and the structure of their supply chains.

What becomes clear is that simpler distribution processes such as container stuffing/stripping remain common at ports. This is perhaps more so in developing countries due to lower port-hinterland integration, lengthy procedures for clearing containers, high charges and security issues mitigating against containers being taken far inland. By contrast, in developed countries improved customs processes encourage taking the container inland, with fewer handlings, fewer delays and less cost. Yet transloading remains a common port-based distribution activity; for instance the practice of transloading from 40ft maritime containers to 53ft trucks in order to reduce inland transport costs.

Basic level processing such as sorting goods before sending them to an inland DC is a necessary function for many supply chains. Yet it is more likely to happen at a near-port location than within the port, due to space requirements. If 'port-centric logistics' is to define anything new, then it should be defined as locating the full DC in the port and distributing direct to customers from there, or basing a first-tier DC in the port and then transporting goods to a second-tier DC. From the shippers' perspective, anchoring operations close to a port might increase the exposure and dependency on a shipping lines strategy in a port, whereas an inland-based centralised model allows shippers to obtain the benefit of potentially being able to choose between competing ports and shipping lines, and thus access to more flexible routing solutions.

Complementarity between ports and inland locations thus tends to take two primary forms: the use of inland ports or location in near-port clusters. The former favours integrated strategies of pushing blocks of containers on container rail/barge shuttles to inland ports or dry ports for processing. The port could take a financial stake in the inland node in order to recoup revenues lost from storage or logistics activities, but even without direct involvement in the site, such a strategy enables the port to retain (or attract) customers. The case analysis demonstrates that this model is more common in developed countries but is beginning to be observed in developing countries.

Near-port distribution exhibits some of the advantages of both port- and inland-based models. The container still needs to leave the port and pass through any security and administration procedures, and the container will then need to be de-stuffed and repositioned, so this is in effect still an inland model. Yet, locating near the port will provide access to all the cluster opportunities that aggregate around a port, especially large ports. This will provide the pool of labour and access to all the relevant agglomeration benefits. While land near the port may be more expensive and less available than inland, it will be cheaper than within the port itself which is more limited.

Large volumes of transported goods mean that in most cases the primary leg of distribution is more likely to go inland to a DC located either near the zone of consumption, or in an intermediate location from where several consumption zones can be served. Whether a port can meet these criteria will depend in large part on its location. New trends towards marketing the port as an attractive place for a DC still require a suitable location from where secondary distribution can take place, which will always be challenged in regions with long distances. The UK's island geography and short distances inland make it rather unique in this instance. Economic development strategies such as free trade zones and other kinds of government subsidy can be very beneficial; yet these may be located in a port, near a port or inland, so it is not necessarily a port or inland issue but may depend more on the policy of the local, regional or national government regarding prioritising particular locations for economic development.

This report has produced a conceptual framework for analysis of the key factors influencing the port or inland location of distribution activities. Future research is required to apply the framework to detailed national and firm level case studies in order to obtain a deeper understanding of the role of each factor and how individual context can enhance or mitigate their effects. A case study approach can help to identify best practices in this regard, but also enables the ability to learn from failed initiatives aimed at increasing the attractiveness of specific port areas or inland locations for distribution activities. The framework can also be used to support research on the ability of actors, whether political or industrial, to construct suitable strategies based on an understanding of the framework factors.

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