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PORT CITIES AND URBAN LOGISTICS

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Introduction

Cities and metropolitan areas serve a wide variety of functions. Those cities which have a port function may be subject to significant increases in traffic flows (Allen, Browne and Cherrett, 2012, Woxenius, 2016). Thus in recent years port activities have at times been viewed as a problem by those responsible for traffic planning in the city with which the port is connected (Olsson *et al.*, 2016). This paper considers the port-city interactions over time and highlights how these have changed. A new phase of these interactions may be at hand with significant implications for urban freight movements. Ports' strategies are constantly evolving and port managers seek to make better use of the port's assets. One of the main assets is land and here there are some emerging trends that have important implications for the port-city interface. In addition, city authorities are increasingly looking for opportunities to use non-road modes for some of the movements of goods to, from and possibly within their cities. Cities that are connected to a port have some interesting opportunities in this area. These developments imply a new period of more intense port-city interaction.

The research is exploratory and considers the following sources: (1) Journal papers that provide insights into the port-city interface and the hinterland transport issues; (2) Reports and other grey literature from a sample of ports that highlights changes in planning and policy with regard to land use that is under the control of (or can be influenced by) the port authority; (3) A short case study of developments in Gothenburg to illustrate the issues involved.

The paper is structured as follows. In section two port-city developments and the port-city interface are discussed. Section three considers the implications for traffic and land use while section four summarises two important initiatives that are relevant to the port-city interface involving land use planning and the use of non-road transport. Section five contains a short case study of Gothenburg to illustrate the impact and potential for these developments to lead to greater port-city interactions. The final section contains the conclusion.

Port-city development stages and the port-city interface

When ports develop, so do the surrounding cities and of course also the port-city interaction. Hoyle (1968) and Hayuth (1982) were among the early researchers to comment on and assess this topic resulting in many citations in more recent work. However, a series of studies by the OECD concerning the competitiveness of global sea-ports (Merk, 2014) and the international port city organisation AIVP's edited book Port-City Governance (AIVP, 2014) and its conferences added much momentum to the field. Journal and other publications (see, e.g., del Saz-Salazar and García-Menéndez (2016); Tichavska and Tovar (2015); Dooms, Haezendonck and Verbeke (2015) and Fenton (2015)) have helped to establish the field as a topic of applied research.

The size of the port in relation to the size of the city is central to port-city interface studies. Ducruet and Lee (2006) illustrate this in a matrix based on 'Centrality', an urban functional measure, and 'Intermediacy', a maritime-based measure (see Figure 1).

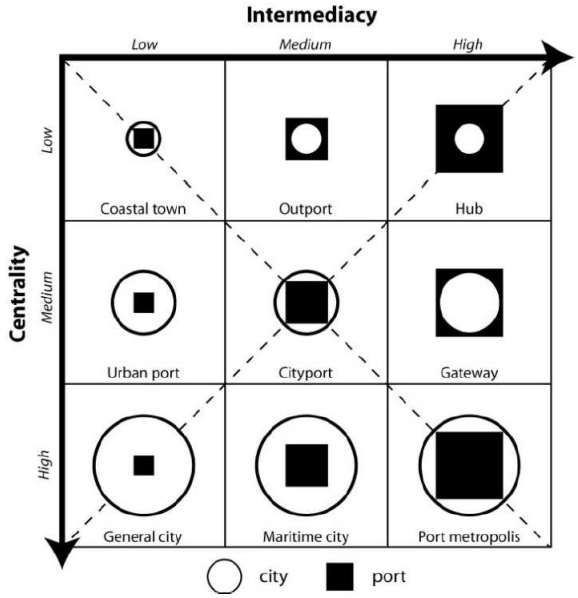


Figure 1: A matrix of port–city relations (Ducruet and Lee, 2006).

Hayuth (1982) used the term port-urban interface and Hoyle (1989) described the interface as:

> *"…a geographical line of demarcation between port-owned land and urban zones, or an area of transition between port land uses and urban land uses. Equally, an interface may be conceptualised as an interactive economic system, especially in terms of employment structures; or as an area of integration in transport terms or of conflict in policy formulation and implementation." Hoyle (1989) p. 1.*

As both ports and port cities are dynamic phenomena, port-cities' character often move within the matrix over time. Reasons behind such changes include developments in industry, trade, port competition, port and infrastructure investments as well as policy on national, regional and local levels. Merk (2014) presents a table that goes beyond the above matrix considering the question of how the port and the city may grow or shrink. To capture this development over time, Ducruet and Lee (2006) adopt a sine-like curve (see Figure 2).

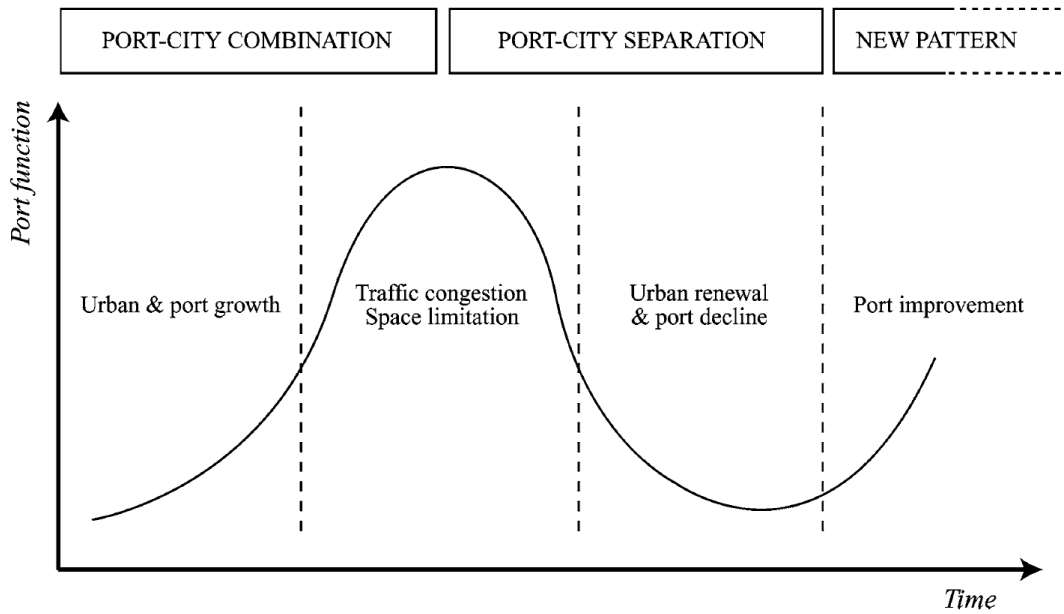


Figure 2: Port–city spatial and functional evolution (Ducruet and Lee, 2006).

Dramatic changes in world trade in the post-war years resulted in saturation in city-centre ports. In the ***Port-city combination*** era, with simultaneous *Urban and port growth*, shipping lines used break-bulk ships and flexible general cargo ships for manual stowage of units such as pallets, slings, nets, piles, sacks and drums. Loading and unloading was very labour intensive and ships could be in port for weeks. Finger pier construction and the use of larger dock side warehouses alleviated but did not solve the problem. Major technological developments were needed and with the coming of larger and more specialised ships (for many different types of cargo) the era of ***Port-city separation*** began. However, it was the advent of containerisation with standardised load units and much improved mechanical handling that finally overcame the problems of the port as the bottleneck for general cargo**.** Also container handling required new port areas with straight quays, vast container stacking surfaces as well as new highways and railway lines.

With a surrounding city, the new areas were often found closer to the ocean for the many older ports established a bit upstream in rivers like London, Bremen and Gothenburg, but many container ports are still located within cities (Hall and Jacobs, 2012) as they have continued to grow around the port. In many cities, shipyards also abandoned vast down-town areas ready for *Urban renewal* (see, e.g, Hayuth (1982); McCalla (1983); Hoyle (1989) and (2001); Merk (2014) and Wang (2014)). Ducruet and Lee (2006) combine the urban development phase with *Port decline*, but most large ports actually saw growing volumes at their new sites due to increased trade and productivity gains. This was, however, difficult to comprehend by the citizens and even by many local policy makers. Attempting to generalise upon the development, Hoyle (1989) describes five stages of the port-city interface.

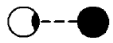
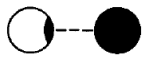
STAGE	SYMBOL ○ city ● port	PERIOD	CHARACTERISTICS
I Primitive port/city		Ancient/medieval to 19th century	Close spatial and functional association between city and port
II Expanding port/city		19th-early 20th century	Rapid commercial/industrial growth forces port to develop beyond city confines, with linear quays and break-bulk industries
III Modern industrial port/city		mid-20th century	Industrial growth (especially oil refining) and introduction of containers/ro-ro require separation/space.
IV Retreat from the waterfront		1960s-1980s	Changes in maritime technology induce growth of separate maritime industrial development areas
V Redevelopment of the waterfront		1970s-1990s	Large-scale modern port consumes large areas of land/water space, urban renewal of original core

Figure 3: Port-city evolution focusing the waterfront (Hoyle, 1989).

Written much later, Ducruet and Lee (2006) observed that many port cities, entered a ***New pattern*** era with a *Port improvement* phase. One way was to add services to the port portfolio, including distribution warehousing, advanced logistics and auxiliary services in new stakeholder constellations (Pettit and Beresford, 2009). This development has strengthened over the last ten years.

<u>Traffic and land use issues arising from the port-city interface</u>

Road transport to and from ports adds severely to congestion affecting the sustainability of port cities in terms of economy by, e.g., lost working time, capital cost for goods and higher fuel expenses; environment through unnecessary emissions, as well as social welfare through noise and reduced mobility. Port related road traffic affect citizens severely causing DePillis (2015) to denote ports "the new power plants" in terms of a non-wanted neighbour.

In some cases, however, it seems that policy makers overestimate the contribution of port traffic to urban freight flows (World Bank, 2017) as parts of this traffic has an origin or destination at industries located in the proximity to the port but not related to maritime transport. Much port traffic is nevertheless still moved on city streets and roads on its hinterland journey and this causes problems for the city that is connected or near to the port. In many port cities (e.g., Los Angeles/Long Beach, Rotterdam, Southampton and Gothenburg) have accordingly made major efforts to shift port-related traffic to non-road modes (van den Berg, 2015). Usually this has meant the scope to shift movements from road to rail but it can also include opportunities for waterborne transport in the capillary parts of the route (Roso *et al.*, 2015).

In a study on freight transport and urban form (Allen, Browne and Cherrett, 2012) demonstrated that major freight generating or transhipment points located within the urban area (such as a large freight-handling sea port in the case of Bristol and Southampton) can result in an urban area attracting truck movements from remote locations. The research considered 14 cities in the UK and Southampton and Bristol (both of which have large ports relative to the size of the city) had significantly higher levels of tonnes lifted per square metre of commercial and industrial floorspace than the other cities (which included London where the major port activity is outside the metropolitan boundary). Road freight activity in Southampton measured in tonnes lifted, was 10 tonnes per square meter of commercial and industrial floorspace and Bristol was 8 tonnes compared with an average of less than 4 tonnes for the other 12 cities. Vehicle kilometres performed by heavy goods vehicles on journeys to, from and within these two cities were also considerably higher than for the other 12 cities (160 vehicle kilometres per square meter of commercial and industrial floorspace in Southampton compared with an average of 50).

Alongside the development of strategies to deal with port related traffic in port cities there has also been an increase in the development of distribution property near ports - in part as a result of increased interests in port-centric logistics but also as port authorities seek new sources of revenue. Being landlord for port facilities is not so different from being landlord for warehouses.

Developments influencing the port-city interface

Ports are changing and the view of city policy-makers about ports is also changing. The trend towards 'port-centric' logistics has influenced thinking among policymakers and highlighted the role the port can play in bringing employment to the city region in which it is located. In addition, cities are searching for ways to increase the non-road options for freight movements to, from and possibly within the city. The role of ports could be important here. Referring to Figure 3, it could be argued that a sixth stage is developing in which there will be a re-integration of the interests of the city and the port. This change will however also lead to tensions since the size of the port is very significant in terms of land use and the behaviour is a complicated mix between public and private. Two developments are relevant to this discussion:

- land use planning decisions by port authorities and port cities that have led to increased focus on distribution property near ports;
- scope to use waterway links for urban freight which then connects to the role of ports as part of the urban logistics system;

Each of these is reviewed in more detail in the following paragraphs and illustrated in the case of Gothenburg in the next section of the paper.

Land use planning

With growing population, urbanisation and densification, there is increasing competition for land within urban areas surrounding a port. Land use is both direct by the maritime cluster in terms of fenced port terminals, access infrastructure and increasingly also by detached container depots for stuffing and stripping, inspections, repair and empty stacking, road hauliers' facilities, intermodal

terminals and warehouses and indirect by port-dependent industry. In addition, keeping an appropriate safety distance around port terminals, industries and along infrastructure to limit effects of accidents with hazardous cargo and disturbance by noise implies high opportunity costs of land use (Olsson *et al.*, 2016). Planning agencies also reserve land around ports and other terminals and along roads and railway lines to safeguard coming expansions of infrastructure.

Land use planning decisions can have a major impact on the nature of the development in and around port cities. In many cases ports have significant influence on land use planning, either attributed national infrastructure interests or being important revenue generators for cities owning the ports. Over time many port-related activities have been re-located away from ports – a typical pattern in container transport is for import containers to be transported to the port from inland terminals and export containers move in the other direction. This means that employment is shifted to such inland locations and in addition, value adding services may also be created far away from the port. Many of these changes have been argued to be highly efficient from a logistics perspective, but from the port and port city perspectives this may be seen as a loss of revenue.

To counter this trend ports have begun to focus on the use of land near the port for distribution and logistics activities. This has meant that land which traditionally was reserved for port-related activity becomes available for a wider range of uses – often still with a logistics function but not necessarily with a specific link to the port. The past ten years has seen a major rise in the demand for large distribution properties in strategic locations (i.e. with access to good transport infrastructure, main consumer markets and an appropriate workforce).

The impact on the port-city interface is complex. The economic development and job creation has positive impacts. In addition, the scope for products to be stored and distributed from nearer to the city may also have an impact on reducing the distance travelled by products – leading to a reduction in transport externalities. However, distribution activity typically leads to increased transport activity and much of this is likely to be road based. As a result, there are additional infrastructure costs that must be borne by the city or region. There is also the impact on congestion that can result from such developments. Despite attempts to shift activities in distribution to non-peak hours it remains the case that much of the transport activity takes place at times that overlaps with peak car travel trips.

Waterborne urban freight

Despite the fact that so many cities are located on major rivers or near to the coast the use of water for urban freight has not reached a high level. Nevertheless there are some examples of waterborne urban freight projects/initiatives especially in the Netherlands and France (Arvidsson *et al.*, 2017):

- the Beer Boat (Utrecht) for deliveries to local shops, hotels and restaurants;
- Mokum Maritiem (Amsterdam) for deliveries to local shops and waste transport;
- Vert Chez Vous (Paris) for parcel deliveries;
- DHL floating distribution centre (Amsterdam) parcel deliveries;
- Franprix (Paris) Supermarket deliveries;

Janjevic and Ndiaye (2014) analysed a range of waterborne freight initiatives arguing that there appeared to be significant potential for such actions and that a wide range of goods could be dealt with in this way. They also noted that road transport would have to be combined with the waterborne movement in cities where the waterway network density was low. Lindholm *et al.* (2015) also showed that waterway transport could be applicable for the movement of bulk materials. In their research, they noted that the use of large vessels would lead to the most sustainable system (i.e. compared with the use of road or even rail). Arvidsson *et al.* (2017) investigated how waterborne freight transport can relief the streets of Stockholm and Gothenburg. The main applications were found to be removal of waste, moving excavated material from infrastructure construction to port

extensions and distribution vans from parcel terminals to the city centre. A simulation approach was adopted by van Duin, Kortmann and van de Kamp (2017) to consider the opportunity for waterborne transport in Amsterdam. The study concluded that a waterborne city logistics concept with a small number of hub locations can compete with truck deliveries and seems to be a sustainable solution for other cities with large canals as well.

The impact on the port-city interface may be rather modest at present given the scale of the activity related to waterborne urban freight transport. Importantly if the opportunities and initiatives grow then it does provide a new role for port related infrastructure. In addition, the skills of those involved in port and maritime management may be a vital asset for cities wishing to develop such initiatives.

The case of Gothenburg

With its 550 000 citizens, Gothenburg is a medium sized city with a comparatively large port situated at the mouth of Göta River. Half of the annual volume of 40 million tons is petroleum, almost half is unitised as lorries, semi-trailers and maritime containers and the rest consists of vehicles. There is no dry bulk handling. The port-city separation era (Ducruet and Lee, 2006) in the 1970's resulted in dedicated terminals and transport-intensive industry located further out to the sea. The oil and vehicle flows are mostly local to the port area, relating to the three oil refineries and two Volvo factories for cars and trucks in the vicinity of the Port of Gothenburg (PoG), but much of the unitised traffic transits the city. Starting in the 1990's, the abandoned port and shipyard areas are revitalised into high-end residential areas and offices like in many other cities (Hall and Jacobs, 2012). Hence, there are conflicting interests complicating the port-city interface.

Like many ports, PoG is owned by the city, which affects the port-city interface, and PoG operates the energy port itself but the ferry/RoPax, RoRo, container and vehicle terminals are privately operated on concessions since five years.

Land use planning

The city is responsible for the city streets and the Swedish Transport Administration for the main roads and railway tracks. The intermediate governance level, Region Västra Götaland with 1,7 million inhabitants, has a planning role for the transport system and recently issued a freight transport strategy and an action plan for West Sweden. The Swedish municipalities have a land use planning monopoly and they are significant land owners, but as PoG is identified as a "national interest" in the infrastructure planning process the national level has its say in the land use planning affecting port access and the state also has a land use veto on environmental grounds.

Being a small export-dependent country, Sweden has a tradition of intense cooperation between industry and the public sector. In Gothenburg it means that Volvo Cars and Volvo Trucks influence city politicians affecting land use in the port area as their factories and logistics facilities are located in the proximity of the port. PoG is obviously also influential being owned by the city feeding back dividends and attracting industry and jobs to the city.

PoG has shifted from being strongly focused at developing railway shuttles for containers and semi-trailers to developing logistics facilities in the port area (Heitz *et al.*, 2016), implying that containers are to be stuffed and stripped in the vicinity of the port rather than transited directly into the hinterland. In cooperation with real estate developers, PoG has influenced the municipality land use planning and it also invests directly in warehouses widening the concept of being a landlord beyond port terminals (Kårestedt, 2016).

Waterborne urban freight

Moving vans from the logistics service providers (LSPs) parcel and general cargo terminals into the city centre avoiding congesting the river crossings. Gothenburg grows significantly and the road and

rail infrastructure has to be improved. Several projects involves tunnels and larger construction works resulting in the need to relocate significant masses. One option is to use the masses to construct new port terminals in the river mouth and barges are investigated as a tool avoiding congesting city streets (Arvidsson *et al.*, 2017).

Rivers constitute old transport routes and it is common that road and rail infrastructure follows the river to connect to cities along the river. Gothenburg is no exemption and the major LSPs have located their consolidation terminals along these roads and, hence, also along the river. River crossings are bottlenecks in Gothenburg's traffic and Arvidsson *et al.* (2017) found a potential for using barges to move distribution vans between the consolidation terminals and the city centre on the other river bank. The revitalised port and shipyard areas are planned for less car ownership implying that more goods need to be transported to the area by LSPs and the river is seen as a high-capacity infrastructure connecting the area with the LSPs' terminals further up the river. A pilot test using barges for bringing in consumer goods from the LSPs' terminals and moving out waste to a waste-fuelled power plant is under preparation by Svanberg *et al.* (2016) .

Conclusions

Major changes have occurred in the port-city interface. This has resulted in changes in traffic patterns and the growing importance of a coordinated and well thought out land use strategy. However, this is a complicated topic because ports are many cases able to act in their own interests and these may not always be in the interest of their adjacent city. To understand the changing nature of the port-city interface it is essential to take a long-term view and relate this to growing body of research that has taken place since the 1970s. Indeed, the changes go back further than that, starting with the major shifts in international trade in the post war world. The paper argues that despite the tensions between the port and the city there are signs of new opportunities for close cooperation and indeed a new era in port-city interfaces. The case of Gothenburg can be used as a starting point to explore this development and future research will test the validity of this proposition.

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