

# Directional inland port development: Powerful strategies for inland ports beyond the inside-out/outside-in dichotomy



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## ABSTRACT

Considerable scientific attention has been paid to inland port research and many of the papers are driven by an Outside-In perspective where the seaport is often regarded as leader and the inland port as follower. Increasingly, Inside-Out approaches where inland ports themselves are taking the initiative are receiving scientific attention. However, it is argued that both processes can be at play simultaneously within the same port and that these processes are reinforcing each other. The focus of this paper is therefore on defining powerful strategies for inland ports also from an Inside-Out and bi-directional perspective. We observe that not all developments connected to inland ports acting as extended gates for seaports are positive: for inland ports traffic conditions might worsen, and external effects increase (i.e. seaport problems are 'exported' inland). New powerful strategies for inland ports are amongst others: redefining their role versus seaports with a central role for the inland port, governments should give more attention to the inland port and seek the development of strategic plans and strategies for the inland port as to realize their own objectives. Seaports and container carriers increasingly seek partly ownership of inland ports and terminals and inland port themselves should analyze if these developments suit their ambitions. Inland ports could also develop network strategies that not solely focus on the closest seaports but also consider adjacent inland ports. Cooperation with other inland ports can also be developed into a strategy that strengthens the role of the inland port versus seaports.

## 1. Introduction

Scientific attention to inland ports' research has sharply increased in the past decade. In the period from 2007 to 2017 the research related to dry ports has grown from 2 to over 115 journal and conference publications in the Scopus database, showing that the field is new and emerging (Khaslavskaya and Roso, 2018). The publications cover a variety of themes such as inland port concept development, network optimization or environmental perspectives on inland ports and actor constellations. The majority of the papers however also deal with the differences and similarities between inland ports in one way or another (see for a recent overview Witte, Wiegmans, & Ng, 2019). Within this academic debate, most papers are driven by an Outside-In perspective (Wilmsmeier, Monios, & Lambert, 2011) where the seaport is often regarded as 'leader' and the inland port as 'follower' (following and accommodating the needs and desires of the seaports). There are very few papers that deal with an Inside-Out perspective, where the inland port takes the leading role versus the seaport which then acts as

follower (e.g. Bask, Roso, Hämäläinen, & Andersson, 2014; Monios & Bergqvist, 2015). Many papers deal with inland ports and inland container terminals, but in these papers the focus is often not on the relationship with the deep-sea port but solely on the inland port or terminal. However, it is argued that both processes can be at play simultaneously (bi-directional) within the same port and that these processes are reinforcing each other (Debrie & Raimbault, 2016; Raimbault, Jacobs, & van Dongen, 2015). The focus of this paper is therefore on analyzing and defining powerful strategies for inland ports.

Local governments should give more attention to the inland port and seek the development of strategic plans and strategies for the inland port as to realize their own objectives (Witte, Wiegmans, Braun, & Spit, 2016). Defining own strategies is important for inland ports because not all developments associated with inland ports are positive for the hosting locality and its inhabitants: for instance, inland ports traffic conditions worsen (Roso, 2008), and external effects increase (i.e. seaport problems are 'exported' inland). Furthermore, seaports

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increasingly seek partly ownership of inland ports and inland ports themselves should analyze if these developments suit their own ambitions. For example, the Port of Rotterdam (in the Netherlands) is building its own inland network including terminals and rail and inland waterway services, such as the ECT terminal near Venlo that acts as an extended gate for the Port of Rotterdam (Raimbault et al., 2015). In the light of the often-lacking inland port strategies, inland ports could also develop certain network strategies that not solely focus on the closest seaports but also take adjacent inland ports into account. Therefore, in this paper, after identifying different existing classifications and deriving common subjects in inland port classifications, the focus is on defining more powerful roles for inland ports from the Inside-Out perspective; i.e. the inland terminal facility taking the initiative according to Wilmsmeier et al. (2011) and also from the bi-directional development perspective as these strategic inland port perspectives clearly lack in the scientific literature on inland port development.

The research approach used for this study was of qualitative nature and based firstly on a literature review on the subject of inland ports, inland intermodal terminals, dry ports, hinterland transport and seaport inland access. According to Golicic and Davis (2012), this qualitative approach provides researchers with access to deeper levels of understanding new phenomena. To get a better understanding of the issues discussed, six cases were used as illustrations. The data for the case description were collected by the researchers in their previous studies (including Witte et al., 2016), in addition through face-to-face interviews, phone interviews and mail conversions with managers at the selected inland facilities. To ensure validity of the findings, triangulation with multiple means of data collection was used, including field observations at the port sites, participant observations during stakeholder meetings and policy document analysis, as well as data collection by multiple researchers (inter-researcher reliability). Secondary data to support the findings (Golicic & Davis, 2012) were obtained from, amongst others, companies' internal reports, companies' websites and newspaper articles.

In the next section, important inland port classifications are given and common elements in these classifications are selected. Next, based on this an analytical framework is presented to structure the strategies for the three development perspectives, as to identify the possible strategies for inland ports. Section 4 contains the case descriptions and applies the analytical framework to the cases. Section 5 ends with the conclusions and recommendations for further research.

## 2. Inland port definitions and classifications

The role, function, and operation of inland ports has been the object of considerable confusion since there is no specific consensus, even concerning the definition of the term 'inland port' itself. For instance, Notteboom, Parola, Satta, and Risitano (2017) highlight the wide diversity of concepts concerning terminals, inland ports and logistics (Fig. 1). It is interesting to notice that Notteboom et al. (2017) completely pass by the concept of inland ports in their taxonomy, whereas Rodrigue, Debie, Frémont, and Gouveral (2010) mention that the

term 'inland port' appears to be an accurate construct to reflect facilities of different sizes, function and ownership, some having a close relation with port terminals as they can be the outcome of port authorities or global terminal operators establishing an inland facility. Roso and Andersson (2017) summarize terms and definitions related to intermodal terminal facilities, some of which have been used to characterize inland ports, amongst others; and conclude that depending on their role in the transport chain and the services available the transport industry operates different kinds of terminals under different names.

In scientific papers, the term 'inland port' was first used by Hayuth (1981). The further development of inland ports is part of a trend involving a closer integration between maritime and inland freight transport systems, a process that has been labeled as port regionalization (Notteboom & Rodrigue, 2005). So far, the inland port development has been mostly analyzed from the maritime (deep-sea ports and carriers) point of view. According to Rodrigue et al. (2010), however, a wide variety of scales can be observed as some inland ports are just simple container terminals while others are complex entities that include terminals, logistics zones and a governance structure, such as a port authority. This is interesting as the first part (simple terminals) refers to a terminal location while the second part (complex entities) refers to a larger area including the terminals. However, there is a tendency here to define inland ports as the level of the port area (the complex entity).

Rodrigue et al. (2010) define three crucial aspects in the definition of inland ports. First, an inland port is dominantly linked with the handling of containers, both maritime and domestic, but other intermodal activities, such as swap-bodies also might play a role. This raises an interesting issue of the position of bulk handling in the larger inland port area which – in terms of volume – is often much more important to the inland port than the container terminal. Second, an inland port must be linked with a port terminal with a high capacity corridor (rail or IWW). Third, an inland port must permit economies of scale in inland distribution by being able to handle larger volumes at a lower unit cost. Monis and Wang (2013) build on this and provide an in-depth analysis of the different definitions of inland ports. Their main conclusion concerning the definition of inland ports is that there are different levels of inland port geographies (spatial scales), actors, regulatory settings and functions.

It was not until about a decade ago that researchers, but also practitioners, started to show increasing interest in the concept of dry ports due to the green solutions it might have to offer to many hinterland transport issues. This green perspective of dry ports was brought up by Roso, Woxenius, and Lumsden (2009), where the dry port was defined as 'seaport's interface inland potentially generating many benefits for the actors of the system'. This definition emphasized that the dry port concept goes beyond the conventional use of rail shuttles for connecting a seaport with its hinterland. It emphasizes the use of high capacity transport means, which includes rail, however, the word "dry" has raised many discussions which in the case of use of barges would be contradictory.

Therefore, where the inland 'dry' port has rail as its main modality,

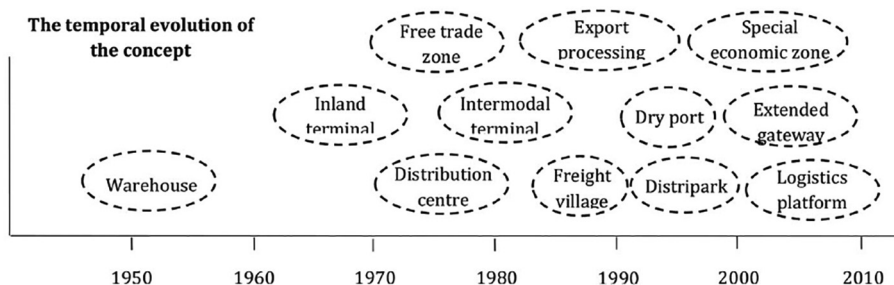


Fig. 1. Evolution of the 'logistics sites' concept.  
Source: Notteboom et al. (2017).

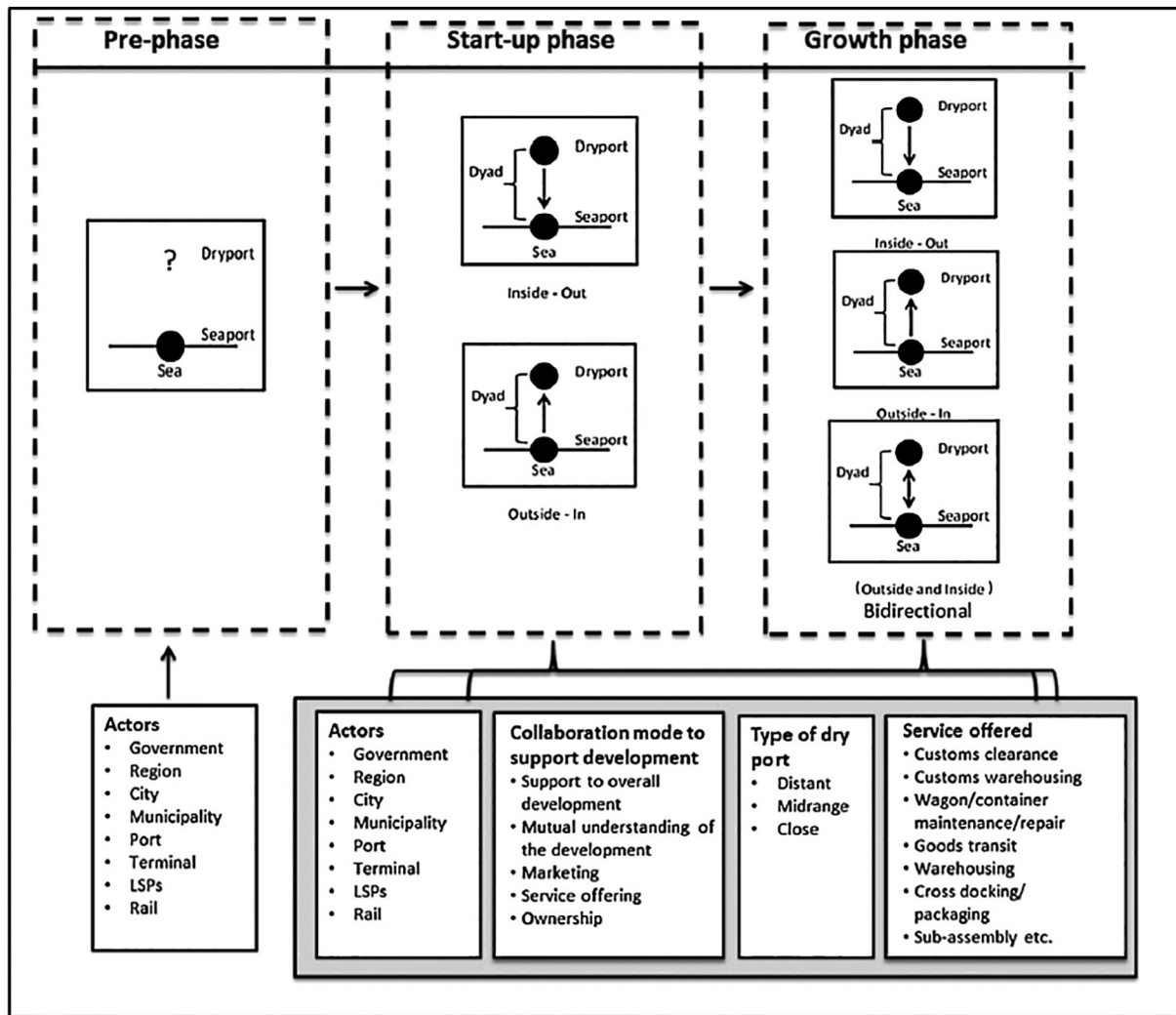


Fig. 2. Extended directional development framework (Bask et al., 2014).

for the inland ‘wet’ port the main important transport mode is IWW. Inland wet ports are referred to here as if they are built on inland waterway transport connections. In Wiegmans, Witte, and Spit (2015) inland wet port geographies can range from an individual company with a quay, to a container terminal with IWW connections, to a number of companies with quays concentrated in a certain location, to the inland port local government level, to the hinterland of the inland port, up to the IWW connections with the deep-sea ports. Any location with a quay in a local place can be called an inland wet port as long as there is a water connection. In general, a town or city along a waterway might be expected to have at least one, but often more than one location with a quay and facilities for loading and unloading vessels. In this respect, dedicated container handling services that are provided at inland waterway container terminals are sometimes also called inland wet ports.

The inland (dry or wet) port thus is an extension of a seaport ‘located’ inland and offering services usually available at the seaport (Andersson and Roso, 2016). However, as the popularity of the concept grows, so does the discussion on definitions and the use of the terms. For instance, Wilmsmeier et al. (2011) question the use of the term dry port beyond the inland terminals in landlocked countries or regions that suffer from poor maritime access. This discussion argues that the aim of developing the inland site was to improve access for poorly-connected regions to global trade flows (Wilmsmeier et al., 2011) but uses an existing Inland Container Depot (ICD) definition coined into the term

dry port (Roso et al., 2009). Furthermore, Rodrigue et al. (2010) and Rodrigue and Notteboom (2012) discuss differences between dry ports in Europe and North-America, calling them “two of a kind” not only due to different functions but also due to peculiarities of different railway systems. A point of recurring discussion over the recent years is the Outside-In/Inside-Out directional development discussion related to inland ports. It is to this discussion that we turn now, by also adding the bi-directional development perspective.

### 3. Outside-in, inside-out and bi-directional development: Towards an integrated perspective on inland ports

#### 3.1. Inside, outside, or bi-directional: Different views on inland port development

In their work on the directional development of dry ports, Wilmsmeier et al. (2011) distinguish between two concepts of the vertical control of the development process: Inside-Out and Outside-In. In an Inside-Out arrangement, inland ports (or terminals) seek higher collaboration with amongst others seaports, terminal operators, rail operators, forwarders or local governments. On the other hand, the Outside-In model of development is driven mainly by the seaport side, such as by port authorities, port operators, or ocean carriers. This ‘directional development’ approach offers potential as a (regionalized) conceptualization of inland ports, beyond the more traditional satellite

and empty depot functions (Rodrigue et al., 2010). The authors further claim that the Outside-In model is the conscious use of an inland intermodal facility as a tool for the seaport to improve their inland access and expand their hinterland. The directional development model has been further developed by Bask et al. (2014), where these authors suggest that development of port–dry port dyads includes three development phases: the pre-phase, the start-up phase, and the growth phase; concluding that bi-directional development (outside-and-inside) is an additional alternative in the growth phase. Eventually, the fourth phase might be decline. Raimbault et al. (2015) approached the directional development discussion from a relational perspective, using the inland port of Venlo (the Netherlands) as a case study. They found that actor-specific practices and processes across territorial scales can shape the outcomes as to how a certain inland port develops in the future. This relational approach is in line with the suggestion of bi-directional development (outside-and-inside). Once established and operating, a dry port becomes part of a competitive transportation system that has numerous stakeholders with diverse strategies and interests. According to Bask et al. (2014) inland terminal facilities, no matter the original directional development orientation, gradually get into the growth stage referred to as “bi-directional development or Outside-and-Inside model”. This bi-directional development implies joint efforts on inland port development in the growth phase by different actors engaged in the seaport hinterland transportation, and coincides with active operations and business improvement phase (Fig. 2 and Table 2).

3.2. A bi-directional development perspective for understanding inland ports development

To get a better grip on the different aspects of inland port development, and to see how these are dealt with either from an Outside-In, or an Inside-Out, or a bi-directional approach, an adapted framework is introduced here. The framework is based on Witte, Wiegmans, van Oort, and Spit (2012) on bottlenecks in intermodal freight transport and their subsequent work (Witte, Wiegmans, & Rodrigue, 2017). Their initial framework consisted of four general dimensions of bottlenecks (infrastructure, spatial structure, governance structure, and economic structure), which are then subdivided into eight specific areas of interest. The advantage of this approach is that it covers the diverging transport, economic, spatial and institutional dimensions of inland port development and operation in one coherent framework. This framework can also be used for structuring the directional development debate on inland ports (Table 1). The starting point is the infrastructure dimension, in which the evolution of port systems is a major focal point. The process of port regionalization is of interest here (Notteboom & Rodrigue, 2005), which is further elaborated in the directional development discussion mentioned before (Bask et al., 2014; Wilmsmeier et al., 2011). In contrast to the infrastructural dimension, which

remains rather focused on a generic or static treatment of the transport network design and its operations or functions, the spatial and governance dimension introduce context-sensitivity with regard to e.g. the geographical setting and the variety of stakeholders and institutional structures involved. As an example, the actors and institutions operating in inland ports have underlined the issue of inland port governance (e.g. Debie & Raimbault, 2016; Raimbault et al., 2015; Witte et al., 2016). This links closely to the notion of bi-directional development as mentioned before.

3.3. Outside-in, inside-out, bi-directional: Inland port strategies for whom?

A question that remains is how the directional development debate relates to the four dimensions for understanding inland port development. The general impression that arises from the literature is that when inland ports are viewed from an Outside-In perspective, the infrastructural dimension dominates over the spatial, governance and economic dimensions. The focus of the analysis is mainly on the positioning of the inland port relative to the seaport in the transport network (e.g. Notteboom, 2010; Veenstra & Notteboom, 2011; Veenstra, Zuidwijk, & Van Asperen, 2012) or on the functions and operations of the inland port (e.g. Rodrigue et al., 2010; Wilmsmeier, Monios, & Rodrigue, 2015). When looking at the spatial, governance and economic dimension from an Outside-In perspective, it is noticeable that very few studies on the connection between port and inland port bother with geographical differences or varieties in actor and institutional constellations. As an illustration, the studies mainly focus on discussing the role and influence of the seaport authority on hinterland operations (e.g. Van den Berg and de Langen, 2011) or the internal institutional/governance design of the inland facility (e.g. Flämig & Hesse, 2011). The bi-directional development and operation point-of-view refers much more to the actual operational phase, where the initial directional development phase (Outside-In or Inside-Out) grows into a much more balanced inland port development that captures aspects from both points-of-view.

From an Inside-Out perspective, it seems that attention to either the infrastructural, spatial, governance or economic dimension is more balanced, especially because a lesser focus on the infrastructural dimension is giving room for more attention to the other dimensions. In a way, this is not surprising, because when the focus within the infrastructural dimension is on the own role of the inland port in the hinterland, this implies that more attention should be paid to the positioning within the urban fabric (i.e. spatial dimension), actor network (i.e. governance dimension) and regional economy (i.e. economic dimension) as well. In the infrastructure dimension, the studies from an Inside-Out perspective do not typically start from a supply chain perspective, but rather take other conceptual approaches (e.g. geographical, actor-relational, etc.) to explain inland port development (see for instance Caris, Limbourg, Macharis, Van Lier, & Cools, 2014;

Table 1  
Four analytical dimensions of inland port development direction.

<p>Infrastructure</p> <ul style="list-style-type: none"> <li>- Port system evolution (position of inland ports in supply chains, hinterlands and corridors)</li> <li>- Variety of functions (service, warehousing, distribution, handling, customs, etc.)</li> </ul>	<p>Spatial structure</p> <ul style="list-style-type: none"> <li>- Different geographical settings (North-America vs. Europe; variety of scales and modes involved)</li> <li>- Multi-level port-city challenges (different land-use claims, fragmented ownership structures, externalities, etc.)</li> </ul>
<p>Governance structure</p> <ul style="list-style-type: none"> <li>- Variety of actors (port authorities, terminal operators, real-estate managers, municipalities)</li> <li>- Variety of institutions (formal governance structure, laws and regulations, development orientations)</li> </ul>	<p>Economic structure</p> <ul style="list-style-type: none"> <li>- Spatial proximity (how does spatial proximity of inland ports influence agglomeration externalities?)</li> <li>- Agglomeration externalities (how do agglomeration externalities differ between different inland port types?)</li> </ul>

Source: adapted from Witte et al. (2017).

**Table 2**  
The four analytical dimensions of inland ports connected to directional development.

	Outside-In	Inside-Out	Bi-Directional
Infrastructure dimension	Port regionalization from a supply chain perspective	Port regionalization from a actor-relational perspective	Port regionalization dependent on context-specific actor constellations in dedicated parts of the supply chain
Spatial dimension	Optimizing the location of intermodal terminals, co-location of terminals and logistics companies	Dealing with inland-exported negative externalities of seaports, dealing with inland port-city challenges	Making space available for inland port extensions (e.g. in peripheral areas), redeveloping inland port sites close to the urban fabric
Governance dimension	Role and influence of seaport authority on hinterland operations (mainly site level)	Actor-network constellations, different scales of inland port governance (site level to city level)	Power vs. influence balance of different internal or external stakeholders varies, depending on the (lack of) governance structure of the inland port
Economic dimension	Concentration of logistics activities, relieving seaport congestion, mainly direct employment	Linking a region to the global supply chain, facilitate investment and employment in the regional economy	Using the specialization of a specific inland port to increase the competitive position of the inland port-city in the regional economy

Source: authors own.

**Table 3**  
Different orientations connected to directional development.

	Inside-Out	Outside-In	Bi-directional
Inland port ownership	Initially municipality	Initially municipality, later seaports partly steps in	Competition between inland and seaport
Infrastructure investment	Combination of local, regional and national government	Seaport infrastructure	Combination of local, regional and national government and seaport
Freight flow orientation	From inland port to seaport	From seaport to hinterland	Port to/from hinterland, inland-inland
Economic orientation	Encourage regional-economic growth	Relieve seaport problems	Use strategic alliances between seaport and inland port to strengthen regional-economic competitive position

Source: authors own.

Raimbault et al., 2015; Debrie & Raimbault, 2016). In the spatial dimension, more attention is paid to the positioning of inland ports in the urban fabric, which is captured in the port-city challenges perspective (e.g. Witte, Wiegmans, van Oort, & Spit, 2014). The governance dimension discusses the importance to focus on specific actor-constellations (e.g. Raimbault et al., 2015) and different scales of inland port governance (e.g. Monios, 2015; Wilmsmeier & Monios, 2015). Finally, in the economic dimension, the benefits of investment in inland ports to the wider regional economy are stressed (e.g. Ng, Wang, Yang, Li, & Jiang, 2016).

One of the conclusions based on the foregoing is that strategies for inland port development can differ considerably between the different directional development perspectives. This leads to the question: inland port strategies for whom? Many authors writing from an Outside-In perspective seem to highlight the terminal operator as main actor to which strategies should be targeted (e.g. Ghaderi, Cahoon, & Nguyen, 2016; Liedtke & Murillo, 2012; Smid, Dekker, & Wiegmans, 2016). On the other hand, in Inside-Out oriented studies, the municipality or even joint regional strategies are more central (e.g. Debrie & Raimbault, 2016; Wilmsmeier & Monios, 2015). In a bi-directional approach, the context and specific actor-constellations seem to matter for who is involved, and who is not.

In practice, combinations of directional development approaches can be observed, as is also underlined by Bask et al. (2014), Raimbault et al. (2015), Debrie and Raimbault (2016) and Witte et al. (2016).

#### 4. Towards new strategies for inland ports

##### 4.1. Six illustrations of directional inland port development

Six inland port cases in the Netherlands, Sweden and Germany (i.e. Bleiswijk, Alphen aan den Rijn, Skaraborg, Hallsberg, Düsseldorf/Neuss, and Mannheim) have been selected and explored on the analytical dimensions of the framework to illustrate the directional development of the respective inland ports and derive consequences for possible future development strategies.

##### 4.1.1. New rail terminal Bleiswijk, Netherlands

Currently, the development of a rail intermodal terminal for trailers is under study in the area of Bleiswijk (a serious connection currently under research and development is Berlin). Although the distance from Bleiswijk to the Rail Service Center is not too far (30 km) or to the Maasvlakte (60 km) the drive to bypass lacking truck drivers via trailers on train leads to an interesting inland terminal initiative in Bleiswijk. Several studies have been conducted into the feasibility of the project and show that rail can be offered in a competitive way (given certain assumptions). In terms of supply chains, the proposed terminal and its surroundings are an important origin of plants, flowers, and vegetables. Transport and logistics operators execute functions like collection, warehousing, and transport but increasingly there is a lack of truck drivers leading to the wish of a rail terminal to handle the truck trailers via rail. The geographical setting of the terminal development at the moment is locally oriented and the port-city challenges appear to be quite limited as the planned location is in an industrial area. The connection to the plant, flowers, and vegetables producing companies results in possible interesting agglomeration externalities.

Infrastructure dimension	Focus is on terminal development on a specific site in a municipality. The core function is handling of trailers and intermodal units.
Spatial dimension	Geographical focus is mainly on the terminal site and on the site different land use and ownership issues arise.
Governance dimension	Different policy makers from the municipality are involved, several transport companies and consulting firms advising the municipality. Also the Dutch rail infrastructure provider ProRail and several lobby groups are involved. Governance structure is flexible and adapted on a case-by-case basis to solve the respective issues.
Economic dimension	Spatial and agglomeration externalities are not of major concern. The initiative is driven by the desire of transport operators to put trailers on trains and built a terminal to facilitate this.

Sources: reports, personal communication Bleiswijk.

##### 4.1.2. Inland waterway terminal Alphen aan den Rijn, Netherlands

The inland waterway terminal was initially developed a number of

years ago to facilitate the export flows from the Heineken brewery towards the port of Rotterdam. Heineken also participates in the terminal ownership. The terminal function for Heineken is purely focused on handling and storage while the logistics and warehousing takes place at the Heineken factory. The geographical setting is almost global as main important export flows are handled by this terminal. In the meantime a growing pool of small and large important customers have also started to use this terminal and more balance in import and export flows has arrived. The governance structure is relatively simple with a terminal operator and Heineken involved. The multifunctional container terminal is important for goods distribution in Zuid-Holland and is leading to conflicts with residents, who complain about the increasing noise pollution in their surroundings. Therefore, also the connections with the municipality are of growing importance in order to discuss and mitigate these negative external effects. Furthermore, the terminal grows fast leading to capacity issues at the current terminal now and then, which in the future might lead to the need for terminal extension where also the municipality is needed. The agglomeration externalities are limited as no adjacent logistics sites are available yet. The policy documents are rather general with respect to inland navigation, and an integrative vision or development strategy on the port level is lacking.

Infrastructure dimension	The terminal has been developed initially to facilitate the export flows from Heineken. The functions at the terminal are limited and the chains are global export chains.
Spatial dimension	Not too much spatial challenges and the location is at the border of the municipality.
Governance dimension	Governance relatively simple with a major launching customer, the terminal operator and the municipality.
Economic dimension	Agglomeration economies are limited as initially the development was focused on export flows.

Sources: personal communication, Witte et al., 2014.

#### 4.1.3. Skaraborg dry port, Sweden

Skaraborg Dry Port in Falköping situated about 120 km from the Port of Gothenburg is an open access terminal that runs five rail shuttles a week to/from the port, handling about 25,000 TEUs. The facility, which has an area of 25,000 square meters with 630 m track, offers value-added services such as storage, forwarding, customs clearance and road haulage (SKL, 2017). In year 2000 the municipality came with the idea of building an intermodal terminal in the area to move goods from road to rail due to big volumes already being transported by trucks, however, it took some time until the terminal was inaugurated in 2007. After many difficulties, the facility finally reached functionality in 2013 when a large customer in the area brought the needed volumes (Khaslavskaya and Roso, 2019). The terminal was municipality owned until 2018 when the customer, retail company Jula AB, purchased the facility. Considering the implementation process historically this facility is a good example of the Inside-Out model of directional development.

Infrastructure dimension	Infrastructural development has been significant with new connection to the main rail line, warehouses and equipment.
Spatial dimension	The logistics area has developed to 6 terminals and has potential for further development. There is not too much interference with the municipality.
Governance dimension	Private ownership since 2018 before that the municipality owned the facility.
Economic dimension	Initially the terminal was developed to contribute to regional development but now with private ownership aims more to facilitate flows between port of Gothenburg and Jula warehouse in Skara in an environmentally and economically sustainable way.

#### 4.1.4. Hallsberg dry port, Sweden

The dry port Hallsberg is situated about 260 km northeast from the Port of Gothenburg. The location of this terminal has always been

considered as strategic central railway crossroads in Sweden since the terminal has rail connections with other ports such as Trelleborg, Helsingborg and Malmö. First rail shuttle to/from the Port of Gothenburg started to run in 2012, five times a week, and at the same time the ownership changed from the rail operator to the terminal operator company. Infrastructure characteristics of the terminal are following: three rail tracks of 750 m each, a 17,000 square meter heated warehouse, 4000 square meters of unheated warehousing space and a 4000 square meter train hall (Bask et al., 2014). Before the financial crisis 2008, the terminal handled 65,000 TEUs but the volumes dropped significantly to 15,000 TEUs; however, the wagonload increased due to increased flow of food transports (ambient, not chilled or frozen products) and building materials (Bask et al., 2014). Furthermore, demand for road freight within the region has increased. The facility has a heated warehouse, a cold warehouse and a train hall. The services provided at the dry port are: customs clearance, goods transit, warehousing, handling of dangerous goods, wagon maintenance, goods reception, stuffing, material control, cross-docking & packaging, re-packing and re-labelling, subassembly, kitting and sequencing. The facility originally was established in 1990 on the initiative of Kumla/Hallsberg municipality with the support of the Swedish Rail and Haulage Association which two years before created a terminal company; and as such fits into the Inside-Out model. The main reason for the establishment of the terminal was huge volume of goods on rail within Sweden that passed through Hallsberg at that time. Eventually with increase of volumes even collaboration with Port of Gothenburg increased and the later development fits into bi-directional model.

Infrastructure dimension	The location is favorable regarding freight flows in Sweden and there are no further infrastructural development plans; variety of services focus on the customers' demand.
Spatial dimension	No spatial challenges, the terminal's location has been considered as strategic since it is positioned on the main railway junction in Sweden with direct connections to many seaports.
Governance dimension	Terminal establishment has been a close collaboration between the municipality and transport operators in the area.
Economic dimension	Agglomeration economies were one of the purposes of the terminal but apart from contributing to regional development the location was considered as favorable from the national perspective.

#### 4.1.5. Inland port Düsseldorf/Neuss, Germany

Düsseldorf and Neuss are two merged ports in the south of the Ruhr area in Germany. They have a common development vision of their own (i.e. Inside-Out), but at the same time cooperate with the port of Cologne (i.e. Outside-In). This could be considered as a good example of bi-directional development, in which there is strategic cooperation between the ports both on an intra- and an inter-regional level: the ports of Düsseldorf and Neuss are merged (Inside-Out, intraregional), whereas the port of Cologne has a strategic (Outside-In) stake in the development of the port of Düsseldorf/Neuss (interregional). Although it should be noted that Cologne is also an inland port, and not a maritime / deep-sea port, the development interest outside the port's own perimeter can be considered as Outside-In driven development nonetheless. Concerning the spatial dimension, Neuss is working on residential waterfront development in a new commercial district, whereas Düsseldorf is transforming a waste disposal site into a new port area. The port of Cologne is (Outside-In) redeveloping some vacant space in the port area of Neuss. In the governance dimension, the importance of port businesses and influential family companies in the development of the port has been observed. This is also affecting the economic dimension, where it can be stressed that there is strategic potential for a bi-directional development perspective to join forces between Neuss, Düsseldorf and Cologne to have a stronger regional-economic impact.

Infrastructure dimension	Decentralization of freight flows from Neuss to Cologne (Outside-In), but also outsourcing of port activities south of Düsseldorf at a former waste disposal site (Inside-Out).
Spatial dimension	Residential development in the waterfront area of Neuss (inland port-city challenges). Lack of space for expansion of logistics activities within the former port area, so development options outside of the port area are explored. Emphasis seems to be on urban development instead of port development (Inside-Out).
Governance dimension	Merge of the initial independent ports of Neuss and Düsseldorf, sharing a common development vision and incorporation of port businesses (including influential family companies) in the planning process through mediation by institutions such as the Chamber of Commerce and the inland port authorities. (Inside-Out). Strategic cooperation with the port of Cologne (Outside-In).
Economic dimension	Not very explicit, though mainly expressed in the aim of connecting the waterfront with the inner city through creating a new commercial district in between (as an economic buffer zone in between the inner city and the port area). Also strategic potential to cooperate between the ports of Neuss/Düsseldorf and Cologne (bi-directional development).

Source: based on Witte et al. (2016).

#### 4.1.6. Inland port Mannheim: towards a regional strategy

The port of Mannheim in Germany cooperates with the port of Ludwigshafen, which is on the opposite side of the riverbank. In this case, there is the classical discussion between port expansion and land development. Many urban districts and commercial functions are already located on the river banks, but at the same time such functions cannot extend too far into the port area because of noise nuisance, traffic congestion, safety regulations, etc., because the main activities of the port of Mannheim continue to be associated with industrial supply chains involving raw materials, chemicals, general cargo, as well as containers. To deal with these diverging interests, the port of Mannheim together with the City of Mannheim have taken the (Inside-Out) initiative to launch a master plan study which should both support the expected growth of the port's throughput, but also cater for the urban development interests in the area. It is attempting to copy the example of the inland port of Duisburg, that is also located along the river Rhine, but how does adding an additional container facility to an existing major inland port influence the local, regional and international connections and agencies? Looking at the spatial dimension, it is most likely that urban functions near the riverbank will be intensified by redeveloping brownfield sites adjacent to already existing commercial functions, but at the same time the port functions will also be intensified. This process is already going on, with the port and municipality attempting to convert old facilities and brownfield sites to serve logistics activities and more containerized traffic. From the governance dimension, there is the involvement of port companies in the development process of the master plan. Logistical solutions for the increased freight flows (e.g. developing additional terminals) likely have to be found outside of the existing port area. This is affecting the economic dimension as well, where strategic questions that still lay ahead for the port are: who will be investing, who will be operating, and who will be the major users? This uncertainty also has implications for the (bi-directional) development directions of this port.

Infrastructure dimension	Expected growth of container flows is putting pressure on the port's current operational activities. Expansion of port functions is problematic, but mainly happens through smaller logistics-supporting activities (e.g. administration offices). Issues of congestion (private car traffic) and noise pollution in the port area. Logistical solutions for the increasing freight flows has to be found outside of the port area.
Spatial dimension	Enforcement of buffer zones to create minimum distances between certain land uses in the port area. Clustering of urban land uses (housing, commercial functions) in a dedicated part of the port area. Classic discussion between port expansion and land development (inland port-city challenges). Pressure

Governance dimension	between converting old industrial sites into new urban uses and redeveloping brownfield sites to serve further logistics activities. Strategic cooperation between the port of Mannheim and the port of Ludwigshafen (Inside-Out). Formal institutional laws and guidelines (especially related to the petrochemical industry) are preventing further integration of port and urban land uses. From an Inside-Out perspective, the port authority, city authority and Port companies are involved in the development of the master plan (Hafen.Stadt.Mannheim2035+).
Economic dimension	Goal of further residential and commercial development in the port area (especially the Rhein-Galerie). Attention to the economic viability of the port in the master plan study. Regional economy might be affected by the development of new terminals outside of the current port area. Future impact dependent on strategic decisions of port and city: who will invest, who will operate, who will use? Implications for local, regional and international connections and agencies.

Source: based on Witte et al. (2016).

#### 4.2. The four dimensions in the respective directional development approaches

Below, the four analytical dimensions of the framework are concluded upon based on the case illustrations above and consequences for possible future development strategies are given. One important outcome from the analysis is the lack of policy plans for the broader inland port development besides the terminal. Following from this lack of strategic plans and based on the analysis, we indicate strategic policy directions for inland ports which can serve as further research areas and also as starting points for inland ports to develop their strategic plans.

##### 4.2.1. Infrastructure dimension

In the Outside-In approach, the seaport terminals experience capacity shortages and the terminals in the hinterland are then used as back-up facilities to enable faster movement of freight flows from the port area into the hinterland. Usually, no additional infrastructures are needed. It seems that the Inside-Out approach can be characterized by terminal infrastructure establishment where there is a close collaboration between the municipality and transport operators in the area concerned (such as the development in Bleiswijk). The bi-directional approach might more apply to already operational inland terminals and might have to do with adding new connections besides the connections to the port and also with infrastructure extensions when capacity shortages arise when demand grows.

##### 4.2.2. Spatial dimension

In the Outside-In approach, the spatial structure is initially driven by seaport authorities and by large seaport container terminal operators seeking inland container terminal capacity in order to relieve port congestion. The Inside-Out approach is much more driven by local and regional development aims where the focus is on the terminal location and its immediate surroundings. The bi-directional development is driven by both sides while often a clear strategy and focus from the municipality lacks. Alphen aan de Rijn is an example of this more bi-directional oriented approach as this was driven by a local need but also has clear global connections through major export flows via deep-sea ports such as Antwerp and Rotterdam.

##### 4.2.3. Governance dimension

In the Outside-In model, the major governance influencers are the seaport port authority and the major container terminal operators in the seaport. In the Inside-Out approach the governance structure is much more mixed. Different policy makers from the municipality are often involved, and also several transport companies and consulting firms advising the municipality are involved (such as in Bleiswijk). The overall governance structure is flexible and adapted on a case-by-case basis to solve the respective issues. The governance in the bi-directional approach is much more diffuse where the seaport seeks to safeguard its

role while the municipality tries to identify and increase its role. A notable example of this bi-directional governance approach is the combination of Outside-In and Inside-Out interests in the case of the inland port of Düsseldorf/Neuss, with the external interests from the nearby Port of Cologne.

#### 4.2.4. Economic dimension

In the Outside-In approach, the direction of economic development is from the seaport into the hinterland with the clear goal of relieving the seaport. In this case, there seems not much to win for the inland port other than serving the seaport. In the Inside-Out approach, the aim often clearly is to facilitate economic growth on a local to regional level (which can be observed in the case of Alphen aan de Rijn). In the bi-directional approach, the economic dimension works both ways and the focus is on maximizing the economic benefits of the inland terminal development embedded in the wider regional economy. Overall, more powerful strategies for inland ports are amongst others: redefining their role versus seaports with a central role for the inland port, identifying the impacts of synchromodal transportation on the role of inland ports, the increasing role of information and its impact in inland ports, etc.

## 5. Conclusion and discussion

This paper has analyzed (new) strategies for inland ports vis-à-vis seaports using a theoretical framework consisting of Inside-Out, Outside-In and Bi-Directional development perspectives (cf. Bask et al., 2014). From the literature review it has followed that a wide variety of theories, concepts, and definitions regarding inland ports exists. In inland port definitions, there is no single model: an “inland port” can span a range of actor involvements and available functions. The literature review has served as basis for this elaboration of the inland port concept. The main important theoretical perspectives in inland port development are the Outside-In and the Inside-Out approach (Wilmsmeier et al., 2011), supplemented with the more recent bi-directional development focus (e.g. Bask et al., 2014; Debrie & Raimbault, 2016; Raimbault et al., 2015). These three important perspectives have been combined with the bottleneck framework of intermodal freight transport (in which inland ports are an important part, see Witte et al. (2012) and with the four analytical dimensions for inland ports into the new framework (Witte et al., 2017). This framework has been illustrated by applying it to six inland port development cases in Germany, Sweden, and the Netherlands.

The initial conclusion is that for the analyzed inland ports there is a clear lack of a broader inland port development strategy. The three directional development strategies combined with the four dimensions of inland port development result in the below Table 3.

#### 5.1.1. Outside-In development approach

The basic idea in the Outside-In approach is that the seaport terminals experience capacity shortages and the terminals in the hinterland are then used as back-up facilities to enable faster movement of freight flows from the port area into the hinterland. Usually, no additional infrastructures are needed. The spatial structure is initially driven by seaport authorities and by large seaport container terminal operators seeking inland container terminal capacity to relieve port congestion. The major governance influencers are the seaport port authority and the major container terminal operators in the seaport. The direction of economic development is from the seaport into the hinterland with the clear goal of relieving the seaport from the congestion and improve sustainability. In this case, there seems not much to win for the inland port other than serving the seaport, which might be considered fine in the case when the inland port is owned by the seaport. Seaports and container carriers increasingly seek partly ownership of inland ports and terminals and inland port themselves should analyze if these

developments suit their ambitions. As an inland port strategy, this is quite simple and easy to follow. However, once more developed, the inland port might want to develop its own strategy, which might be much more inside out or bi-directional oriented.

#### 5.1.2. Inside-Out development approach

It seems that the Inside-Out approach can be characterized by terminal infrastructure establishment where there is a close collaboration between the municipality and transport operators in the area concerned. This approach is much more driven by local and regional development aims, where the focus is on the terminal location and its most immediate surroundings. The governance structure is much more mixed. Different policy makers from the municipality are often involved, and also several transport companies and consulting firms advising the municipality. The overall governance structure is flexible and adapted on a case-by-case basis to solve the respective issues. So far, the strategic focus of the municipality – often taking the lead in the developments – seems to be limited to the terminal and less to the broader inland port development. The aim often clearly is to facilitate economic growth on a local to regional level.

#### 5.1.3. Bi-Directional development approach

In the bi-directional approach, elements of both approaches can be identified. Deep-sea ports seeks to safeguard its position or even extend its control by taking over (parts of) the inland port. The inland port municipality seeks to increase its importance and position. To develop an own strategy is however, quite a challenge as detailed expertise is needed which municipalities often lack. Overall this could lead to a challenging environment for both the deep-sea port and the inland port.

Many strategies for the Inside-Out and Bi-Directional development approach carry comparable characteristics as these call for a more proactive role for the inland port. Strategies for inland ports are amongst others: 1) redefining their role versus seaports with a more central role for the inland port and a more pro-active approach instead of just following the deep-sea port, 2) governments should give more attention to the inland port and seek the development of strategic plans and strategies for the inland port as to realize their own objectives. So far, in almost all cases, strategic plans for the inland port developments do not exist while inland ports are important parts of municipalities where considerable employment and economic developments are concentrated which deserves a strategic plan, 3) inland ports could develop network strategies that not solely focus on the closest seaports but also take adjacent inland ports into account. This strategy analyses important freight flows for the inland port and seeks the development of a more balanced network besides the deep-sea port main orientation, 4) cooperation with other inland ports can also be developed into a strategy that strengthens the role of the inland port versus seaports.

The analysis results in the following more overall conclusions regarding new powerful roles for inland ports: 1) in many current cases, newly developed terminals appear to be Inside-Out oriented. This would call for an inland port development framework that can be used by any municipality to develop its inland port based on any of the development directions; 2) extensions of existing terminals appear to be either Outside-In oriented or bi-directional oriented. Initiatives are undertaken by smaller municipalities and after growing fast attract attention of large seaports. This would call for the development of own strategies for inland ports driven by the owning municipality to be able to react to issues arising from the wish of seaports to step into their inland ports.

Further research could be targeted to more case studies that are analyzed in detail and over a longer period of time. In addition, also more data is needed on inland ports to enable data-driven research. Another interesting avenue for further research could be found in measuring the importance of the different approaches for the respective inland ports. How to measure which approach is the most important to an inland port? Finally, a further specification of the bi-directional



development perspective could be interesting. More details on e.g. freight flows, investments, economic developments, and ownership (as indicated in Table 3) could help to understand inland ports better and to build better strategies for the inland ports.

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