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Port competitiveness now and in the future: what are the issues and challenges?

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Port competitiveness more than ever has to be considered from a chain perspective: not only what happens inside terminals and the port, but also changing circumstances in the maritime side and in particular in the hinterland can heavily impact on the success of an individual port or terminal. Moreover, the historical distinction between the three chain segments is disappearing: further integration takes place.

Port competitiveness has been studied widely during the past decades. But the nature of changes in and around ports is fundamentally different today: often disruptive, and very often located outside the port area and therefore often out of control of the pure port actors. This volume undertakes the challenge of dealing with a number of such key developments. Each paper in this volume illustrates the impact that the specific issue has on port competitiveness, and the challenges that ports face as a consequence. Moreover, to do that, each of the papers develops and applies a scientifically validated instrument that helps in measuring impacts, and that therefore is of immediate use to policy-makers, port authorities and chain operators.

A first radical change has to do with increased environmental awareness. Shipping was long known to be a very polluting mode of transport, expressed per 'vehicle': the type of fuel used on board ships was among the most polluting any mode of transport is using. Especially Sulphur emissions dramatically contribute to diseases among those living in the neighbourhood of coastal areas and busy port zones. This has changed dramatically lately, as the International Maritime Organisation and regional governments like the European Commission have taken action against such pollution, by introducing ECA zones and by developing standards, like EEDI. This volume pays attention to such measures, with for instance a contribution by van Hassel et al. (2016), on the impact that the introduction of the ECA zone in the North Sea has on port competition in Europe. A common hypothesis was that such ECA zone would lead to a shift away from Northern-European to Southern-European ports. The findings by van Hassel et al. (2016) bring substantial qualifications to this hypothesis. As opposed to ECA zones, which are top-down measures, the volume also looks into bottom-up environmental improvements, for instance by shipping companies through improved network planning. Sislian et al. (2016) show the circumstances under which network optimization manages to reconcile higher cost savings for operators with better environmental performance, also impacting on ports.

A second crucially important dynamic is that of guaranteeing the cargo-generating role of seaports. Seaports historically have played a strong role as gateways to a country's importing and exporting activities: they once were the origin locations of trade, and expanded that role to an ever larger hinterland over time. Through the reshuffling and bundling of maritime trade flows, shipping companies started to introduce the concept of 'transshipment'. Thereby, a port's total traffic volume was no longer solely depending on 'local' traffic, which proved to be quite well linked to 'local' economic activity (industrial activity, GDP, etc.), but also on the hubbing strategies of container shipping lines. The latter have much less or even no link at all with available cargo volumes in or to the hinterland of the concerned port, but depend on strategic location of the port in international

networks and chains, and on specific features of the port, like available capacity, efficiency of operations, price levels, etc. Nevertheless, transshipment decisions also impact on traffic destined for or originating from the port's immediate hinterland: without transshipment volumes, the port may be unfit for calling at only to handle 'local cargo', due to insufficient critical mass. In that respect, the paper by Russo et al. (2016) provides interesting insights, as it models containerized origin-destination flows at international scale. Thereby, in its case study on the Mediterranean, it includes the free zone concept. At the same time, having a substantial volume of 'local' traffic can be important so as to be able to attract shipping companies that intend to establish a hub. To that purpose, it remains important for a port to have an industrial base in its immediate neighbourhood, or be well connected to one, so as to assure some captive market. Stavroulakis and Papadimitriou (2016) in their contribution in this volume focus on the conditions for successfully establishing such industrial cluster, and more in particular a maritime one. They also measure the effect that establishing such cluster can have on the national economy. Both contributions are helpful to port authorities and policy makers in order for them to create the right conditions and aim at the right level of investments for their port to fit best in international supply chains. Shi and Li (2016) in their contribution view hinterland development as an essential source of cargo generation, and view the establishment of a hinterland from physical, logistics, and macroeconomic perspectives. They analyse shippers' chain choice factors in terms of three driving forces: spatial, value, and organisational. They provide a model that allows simultaneously optimizing the different perspectives, which they apply to the Shenzhen area.

A third challenge is the digitalization of the transactions in supply chains. Very quickly, shippers and other actors in those chains are moving away from a paper-based to an electronic communication chain that runs in parallel with the physical flow of the goods. Ports as central nodes in international logistics chains for long have stayed behind in this development. However, they are under heavy pressure from other actors that want more transparency and efficiency in their supply chains. Following the example of airports, which have in quite some cases successfully introduced platform concepts, seaports now start to roll out similar platform structures. Some ports have been forerunners into this, and have been experimenting since quite some years ago already with preliminary versions of such platform. For that reason, but also for the fact that not all ports need or want the same functionalities in their communication platforms, a typology of seaports from the point of view of communication systems can be developed. That is exactly what the contribution by Carlan et al. (2016) does. A large variety of involvement seems to exist, both in width (number of functionalities) and depth (involvement of specific actors). Furthermore, the paper conceptually identifies the nature of benefits that the various actors enjoy when connected to one or several of the platform modules. The latter is especially relevant as one wants to convince actors to join such platform, so as to provide transparency as to what can be gained from what type of investment.

An issue related to digitalization and communication is standardization of communication. One of the reasons for inefficiencies often cited in research on supply chain communication is the lack of a common standard, and the unwillingness of partners to give up their own standard. This phenomenon typically occurs when the power balance between partners is spread unevenly. Ports are often in a difficult position in this respect. On the one hand, they are no longer the most powerful partners in logistics chains: that balance has shifted in favour of shipping companies and large forwarders and shippers. Those players in the first place are interested in pushing through the standards they developed in house. On the other hand, ports are exactly the points in the chain

where the various actors meet, where the goods have to be transferred between modes of transport, and where also goods ownership most often shifts. Therefore, of crucial importance for them is efficient communication and well-functioning platforms to which as many as possible port users are connected. Ringsberg and Lumsden (2016) present a framework based on Electronic Product Code Information Services (EPCIS) to smoothen communication between different actors. Their quantified analysis shows the benefits of such efficient communication to the different involved stakeholders.

A fourth and last challenge for the future development of seaports is the growing importance of hinterland connections, where battles between ports can be won, but unfortunately many are lost too. Various studies have shown how over the last decade, in the total cost structure of international logistics chains, the share of hinterland transportation has increased strongly. This trend is caused by on the one hand the economies of scale gained at sea and to a somewhat lesser extent also in ports, and on the other hand by the fact that hinterlands got more crowded and no structural solutions could be given in many cases for the already existing inefficiencies and congestion. Moreover, due to the complexity of such international chains, land mode choice is not necessarily made by the same party making choices elsewhere in the chain, and therefore often not aligned so as to optimise the overall chain objectives. Thereby, it is important to know in the first place what are the important criteria from the point of view of the decision maker. Nugroho et al. (2016) apply stated preference methodology to test which are the important criteria in inland mode choice, and what can be done to achieve a mode shift from road to alternative modes. Their results for the Indonesian situation can be implemented by local policymakers.

In particular for stimulating rail transport in port hinterlands, bundling of flows is needed, to allow for economies of density to be gained. The problem with the current port hinterland system in most ports is that rail is very dispersed, with either many smaller or niche operators, whose networks are not interconnected, or a just a few players or even a monopolist, who is often not interested in making full use of the port's bundling potential, but rather just in picking the cherries from the hinterland traffic pie. Kreutzberger and Konings (2016) develop a conceptual model for setting up such bundling system, with the particular feature that they combine traffic from various seaports.

A further development in hinterland connections is the role that inland ports can play, and the limitations they face. Witte and Wiegmans (2016) in their contribution show that in the context of increasing global freight transportation and transnational corridor development, inland ports are becoming more important in enhancing hinterland accessibility for deep-sea ports. At the same time, when considering the 'weakest link' principle, the increasing reliance on inland hubs can also pose a threat to efficient transnational corridor development, especially in relation to adjacent urban regions. They show that in cases in which the port and urban administrations open up the policy process to other private stakeholders and the public, common strategies for inland ports development are more likely to occur. The authors identify a number of obstacles that prevent bundling and its economies from materializing. One such reason is lacking clarity towards the role of different actors in the rail sector and port authorities. Another one is the high investment of (hub) terminals in relation to the segmentation of the rail operational field. A further one might be the lack of visionary managers in the world of (hub) terminal development. Finally there is the perceptual shortcoming of affinity with operational acceleration.

Related to the inland port issue from the previous paragraph, is the choice of locating inland ports in optimal locations. This is important, not only from an economic efficiency point of view, but also from an environmental sustainability one. Ambrosino, Tei, Sciomachen and Ferrari (2016) develop a mathematical model for solving an actual location problem, comparing current logistics park locations to some proposed alternatives. Their application handles the Ligurian ports and their hinterlands. Their framework allows considering alternatives in terms of paths and transport modes (i.e. road, rail, intermodal transport) in order to better discuss not only the effects of the new inland port facilities but also an integrated approach on network flow rationalization.

Ultimately, despite the long-standing history to promote alternative modes of hinterland transport, one should not overlook that in the majority of ports, road transport remains by far the dominant mode of hinterland transport. Clearly, road transport often best matches the criteria that decision makers find important. This encompasses a number of problems related to road transport, in particular linked to bottlenecks and congestion, that cannot be solved with suggesting a shift towards other transport modes. Motono et al. (2016) devote their contribution to proposing ways to normalize trailer drivers' behavior and thereby ease land-side traffic congestion based on the experiences of Japanese ports. At the same time, the authors propose a cooperation scheme among stakeholders, i.e. trailer drivers, trucking companies, forwarders and terminal operators. This cooperation scheme can properly function only if all the drivers carry complete documents and head to the gate in a timely manner, therefore, a consensus among stakeholders in each port must be built and reviewed periodically. Salient points toward building such a consensus are identified.

The above-mentioned challenges show that seaports keep on facing issues, some of them caused by their own success, others by external drivers. These issues need answers. This volume makes an effort in providing steps in that direction, presented in a way that implications and requirements for practitioners and policymakers are clear, so that actual uptake is facilitated. The very useful element of the various contributions in this volume for sure is that each of them develops a framework for analysis and for answering a research question that also has a clear relevance to practitioners. In that sense, each of the frameworks is a new setup or a further development of an existing framework. Therefore, each of the articles provides a clear contribution to scholarly knowledge.

At the same time, it is clear that uptake of provided frameworks and solutions by business practitioners and policymakers is very important, so as for science to have a meaning to society in the longer run. This however is the step that often causes problems. Although this special issue does not deal with innovation per se, each of the contributions it contains in fact involve a degree of innovation, ranging from more incremental to really radical. Recent research into innovation in transport and seaports has shown that one of the main causes of failing uptake of new initiatives is the lack of capabilities among the initiators. Capabilities can take the shape of capital, time or skills. All three have become more problematic over time. Port and transport financing historically relied very often on public money and intervention. In most developing economies, government budgets tend to shrink, and more reliance on private capital – through PPPs or otherwise – seems necessary. That often leads to a focus on operational investments, and may hamper investment in research for introducing more fundamental innovation in seaport chains. Time may lead to the same kind of pressure: budget savings often imply that more work needs to be performed by less people. The focus then often shifts to operational tasks rather than freeing up staff for research tasks. Finally, increasing concentration in the wider port and shipping business leads to decisions being taken in the

headquarters, and the local terminals and offices being left with more executive and operational tasks. The type of people hired there is of a different nature, and often lacks a more strategic view. All these may hamper the effective uptake of the models and frameworks developed in this special issue.

Nevertheless, the above challenges may also bring opportunities to business practice. Less available capital reinforces the search for more efficiency, and hence the need for applying concepts developed in this special issue. Limited time available similarly may induce a search for more productivity, making the introduction of simulation, optimization and forecasting frameworks necessary. Finally, overall levels of education and training globally are increasing, and a new generation of people gets very quick access to social media, apps and online tools that are often very closely linked to the frameworks and models presented in this special issue. Think about big data applications for improving the forecasting of traffic flows, for optimizing terminal location, or for customer preference identification. Or think about the port communication platforms, the newest versions of which perfectly resemble social media used for leisure purposes. Think about real-time information tools which are the basis for synchromodality, the optimized combination of different port hinterland transport modes.

The link between the concepts presented in this volume and the ensuing applications, instruments and tools, and the type of investments and business models that are needed to generate those as well as the future skills that will be needed to operate them, was not dealt with in this issue, and therefore offers surely a wide field of further research that is needed, as it is crucial to practitioners and policymakers, now and in the future.

Financing of port supply chains, but also of port innovation actions and initiatives, is surely a key theme for a future research agenda. Most likely, there will be more than one business model for innovation to be successfully taken up by the market. However, to date, with banks more risk-averse than ever, alternative ways of financing and funding port-related innovation need to be investigated. Extensive financing will be needed also to cope with climate change, which will urge ports to build different and stronger infrastructures and superstructures, that can prevent and mitigate the impacts of heavy winds, floodings and extreme heat. Future funding will require a fundamentally different port pricing system, that is much more transparent, and based on actual marginal cost pricing. Pricing will not only need to be much more scientifically founded with respect to operations, but also for concessions. Much deeper insights are needed into how maximum value can be captured from the scarce port real estate. That all clearly can be grouped as a first research topic for ports to be able to keep their competitiveness.

Second, automation in ports needs much more scientific attention. Optimisation literature dealing with efficient ship loading, port terminals, terminal entry gates and hinterland mode loading tends to focus very much on how productivity can be increased using existing technologies, but hardly ever includes radically different developments that may disrupt the way port supply chains functions. For instance, the use of big data mining technologies may eradicate a large number of actions that need to be performed in today's terminals. Furthermore, profiling and advanced checks through data is also to be enabled, and will be crucial to guarantee safety and security of ports. Equally, the potential of port community systems goes that far as making a number of ports' current actors redundant if they don't adapt their business model. Automated ships, self-directing terminal equipment and truck

and inland barge platooning can lead to radically different needs that ports need to meet. Research into which of these technologies will emerge and be successful or not, which impacts they will generate on which players, and how they may match or rather clash in port supply chains, is definitely needed.

Third, with respect to future skills, urgent research is required, so as to map expected population evolution, register roles that people will play in the ports of the future, and identify training requirements. Lifelong learning will need to be implemented, and the potential of a learning community and how to implement it is to be investigated. Skilled labour is also to be available in the neighbourhood of ports, whereby ports will need to match the city centers where port workers are living, and to which they are typically located very closely. Research will be needed into how to reconcile growing port activity with growing cities in their neighbourhood. Failing to do so may not only deteriorate a port's competitiveness, but may even reinforce the emerging NIMBY syndrome, and bring the port in a negative spiral.

It is clear that the above developments offer strong and radically new opportunities, but at the same time may seriously hamper the port's competitiveness if not well tackled. More even than continued research into the topics tackled in this volume's papers, research done into the above-mentioned research agenda topics may determine the ultimate competitiveness of seaports and supply chains.

