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A sustainability assessment of ports and port-city plans: Comparing ambitions with achievements

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ABSTRACT

The challenge for port developments is to minimize long-term uncertainties associated with port operations, risk of increased costs, and large environmental impacts. The aim of this study is to develop a comparative methodology to assess the sustainability performance of a mixed set of ports (different locations, sizes). This methodology involves ranking various long-term port plans and port vision documents against a set of social, economic, and environmental key performance indicators (KPIs) in order to evaluate and interpret future sustainable port-city development plans. The assessment aims to determine the efficiency and sustainability of each of the case study port plans, relative to other ports. Furthermore, the assessment ranks the considered ports based on comparison of pressures within the ecosystems and society, using publically available data in order to evaluate future changes resulting from these pressures. The classification and ranking of each port have been used to gauge the ability of each port to achieve its sustainability goals for port planning as set out in their port plans. The comprehensive results have been compared with the long-term port plan KPIs to evaluate an array of measures both quantitatively and qualitatively. Most of the highest ranking ports have developed a combination of integrated plans, measures, and regulations for sustainable port developments. This indicates that green-port policies need to be interlinked via social, economic, and environmental dimensions utilizing an integrated approach in order to realize maximum potential and strengthen port processes aimed at developing a sustainable port.

1. Introduction

1.1. Port growth

On-going trends such as global trade growth, increasing vessel sizes, and the need to modernize port facilities are driving investments in ports (OECD, 2012; PIANC, 2014a). World container traffic is expected to keep growing substantially, along with the increase of world trade, continuing rapid economic growth in the developing world, and further increase in wealth worldwide (Port of Rotterdam, 2008; Port of Hamburg, 2012a; Lam and Notteboom, 2012). The summed population of the 10 middle to mega size port cities considered in this study (Antwerp, Ho Chi Minh, Dar es Salaam, Hamburg, Istanbul, Los Angeles, Melbourne, Rotterdam, Shanghai and Valparaiso) is expected to grow from a total of 70 million in 2014 to about 92 million people in 2030 (UN, 2014). The number of the population is relevant since it directly characterises the urban situation at or around a port and indirectly it indicates the type of local hinterland. Ducruet and Lee (2006) studied port-city interdependence by examining correlation between city

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population and container throughput. A growing consensus recognises the need to shift economies and social structures towards more sustainable models; quantity *and* quality (Asgari et al., 2015; ESPO, 2016). This concept of 'Green Growth' (described further below) enables policy makers and companies to identify successful strategies they can adopt, and pitfalls they can avoid, when drafting, implementing, and realising green growth policies (World Bank, 2012).

1.2. Economic, environmental and social impact of port development

Port development is beneficial for investors and for economic development of a region, but such large infrastructural developments may have negative effects on the ecosystem, which can result in adverse social and health effects. The choice for a location of a port extension is typically restricted by the administrative borders of that port. Traditional port development influences the economy (usually positively), environment (often negatively, if not mitigated) and society (both positively and negatively). Activities associated with construction (Maes and Schrijvers, 2005), transportation (Briene et al., 2011), operating, and demolishing infrastructure also make use of natural resources. Furthermore, maintenance dredging is an issue for many both small and large ports (Stronkhorst and van Hattum, 2003); since the associated costs are often very high, it can be a critical element in the economic feasibility of a port. For example, the Port of Rotterdam, located at the mouth of the River Rhine, needs to dredge about 17 million m^3 per year (Stronkhorst et al., 2003; Schipper et al., 2010) for maintaining the design water depths in their port area.

Often seaports are located in coastal ecosystems with high biodiversity. The relatively shallow depths of these systems result in high light availability for primary production (Vinagre et al., 2012). This creates favourable conditions with ample food availability and shelter for many species to utilize as nurseries and maturation during larval phases (Beck et al., 2001; Thrush and Dayton, 2002). Several biotopes exist in these coastal areas, which results in a large biodiversity with complex food web and multiple interactions between different trophic level of species. Insight into the impact of a port on the social welfare of a country can be used to identify which impacts need to be minimized and which need to be promoted. Many people move into cities for the associated economic opportunities, however, the urban environment also adversely affect the quality of life, which may cause social issues (UN, 2012a). Additionally, the social impact of maritime transport, via sources such as air pollution, has a role in human health and chronic diseases (Dawson and Alexeeff, 2001; Cropper and Khanna, 2014).

1.3. 'Green growth' sustainable port development

The rising tide of political interest in combining 'growth' with 'green' is an explicit item on the agenda of many countries, particularly in East Asia, Latin-America, Africa, and Europe. This particularly applies to ports, since they possess the ability to retain competitiveness while still taking into account the integrated (eco)system (Asgari et al., 2015; Laxe et al., 2016). Port developments following a growing (transport) market can significantly affect natural ecosystems (Gimenez et al., 2012), but also contribute positive to socio-economic aspects (Schipper et al., 2015; Carter and Rogers, 2008; Heaver, 2016). On the other hand, ports may use a sustainable approach as a selling point. Furthermore, particularly ports may adopt a 'greener' approach to streamline and speed up port developments, since such large infrastructural projects, if done in a traditional way, nowadays may meet large social resistance.

Because of the growing emphasis on sustainable port development models, increased knowledge is needed to reduce the impact of climate change effects on port activities and the influence of port infrastructures on the natural (coastal) system. Furthermore, increasing demand on space in delta areas and various external pressures – such as climate change, accelerated sea level rise, and subsidence – exacerbate the situation. This means that new multi-functional approaches for the design and operation of ports and waterway infrastructure are required (Van Wesenbeeck et al., 2016). This can be achieved through a new way of thinking that considers specific knowledge and expertise in the field of sustainable port development. Sustainable port development is defined in this paper as: new port or port extension plans that meet (or even exceed) typical operational requirements and that provide economic growth that is compatible with environmental and social needs, including ways to manage the transition to this new and balanced paradigm. Through an integrated and ecosystem-based approach, i.e. taking a broad range of requirements (operational, economic, environmental, and social) into account from the start, port development can be realised in an inclusive way, resulting in a vital and modern port that has a 'societal licence to operate'.

1.4. The no-impact port growth

The authors introduce the concept of sustainable port growth via the three common fundamental aspects: society, environment, and economy, or "People", "Planet", and "Prosperity" (PPP) (Carter and Rogers, 2008; Fisk, 2010). Recognizing its importance, a growing number of financial institutions currently incorporate the PPP approach in their businesses (Slaper, 2011). Here, within the PPP framework, we define Key Performance Indicators (KPIs) that are intended as gauges for evaluating and steering port developments. These KPIs are used to quantify the effect of the (potential) implementation of measures on the port-city development in the broadest sense. The reference in this port impact assessment is called 'the no-[negative]-impact port', which defines a theoretical port concept envisaged as the ultimate realisation of an optimal sustainable port. The challenge is, however, determining whether a no-impact port is achievable in practice related to suitability of the port for its daily operations, in combination with economic growth, and under which boundary conditions. In fact, a paradigm shift is required in the approach commonly taken to port development programmes when looking to adapt to climate change, sea-level rise, and urbanization, whereby the emphasis will, next to technical port requirements, also need to lay on the functioning of a healthy local ecosystem.

In recent years, studies were made by port authorities to design a system of sustainable indicators (Peris-Mora et al., 2005;