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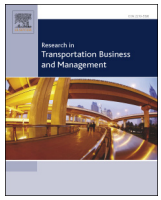

A systems framework for sustainable development of Port City: Case study of Singapore's policies

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ABSTRACT

Port city, which serves as a link between the local economy and the global economy, is an interaction of both urban and port systems, giving rise to its complex and dynamic nature. While the development of a port city is an aspect that requires continual research and monitoring, the current literature addressing the issue of sustainable development in port cities is rather limited. In addition, empirical studies often analyse the port system and the urban system separately, with little research attempting to integrate the two systems. This paper aims to narrow the gap by adopting the systems theory to develop a systems framework for sustainable development of port city, and in particular illustrating its application in the case study of Singapore. The three aspects of sustainability for the port system, city system and port-city policies are discussed. The analysis shows that the positive relationships between the port and the city in Singapore far outweigh the negative relationships. Singapore could continue developing its port, to maximise the positive relationships economically and socially, while minimising the negative relationships environmentally.

1. Introduction

Port cities have undergone tremendous changes throughout the course of history. Almost every coastal city has had a port at some point in the past, and every of those ports sustained a city. In this respect, ports have been considered as engines of economic development for the cities and regions where they are located. According to Campbell (1993), ports have traditionally been centers of economic and cultural activities in cities. During those times, the positive relationship between ports and cities was very significant – businesses wishing to import or export goods by sea found it advantageous to locate their operations near a port so as to minimize land transportation costs. Furthermore, cargo handling activities at the initial stage of port cities development were considered to be a key generator of local jobs, taxes and economic activities (Zhang & Lam, 2013).

However, with recent advances in transportation technology, the role of ports in local economic development has altered. This observation is best described by Norcliffe, Bassett, and Hoare (1996), who held the view that until well after the Second World War ports created cities, and big ports created big cities. Since then, however, the relationship has become more complex. Containerisation and automated processes have made cargo movement much more capital intensive, thus decreasing the local employment benefits of having a port. Another factor could also be the rising concerns on cheaper imports, which may also displace existing local production. While the economic contribution of a port seems to decline, societal and environmental costs are increasing. Issues include traffic congestion and pollution arising from port activities in areas adjacent to ports, and increasing competition for land use between port and urban development (Liao, Tseng, Cullinane, & Lu, 2010; del Saz-Salazar & García-Menéndez, 2012). All in all, these factors led to a key question concerning whether ports and their host cities should develop together as integrated functional-economic spaces.

Despite the perceived negative externalities in their urban development, ports in many big cities have still experienced phenomenal growth over the past decades. In fact, majority of the world's top ports at present are located in populous urban cities (Hall & Jacobs, 2012). Singapore, for example, being a small island city-state located at the end of the Malayan Peninsula in Southeast Asia, The land area of Singapore is only about 719.1 km^2 as at end June 2015; 49 km from east to west and 25 km from north to south (Singapore Department of Statistics, 2016). However, there are annually more than 130,000 ships calling at Singapore with a total shipping tonnage of more than 2.5 billion GT in 2015. The total container throughput has been constantly above 30 million TEUs for the past few years, making Singapore the second busiest container port in the world. At the same time, Singapore also ranks in the top 10 largest registries all over the world with 4739 ships (86 million GT equivalent) registered as of year 2015 (Singapore Department of Statistics, 2016).

While ports and cities have both positive and negative impacts in their interaction, there are insufficient comprehensive studies on how these interactions come into play, and what the corresponding impacts

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are. Existing studies often analyse the port system and the urban system separately, with little research attempting to integrate the two systems. There is a need for better understanding of sustainable port city development in relation to regulatory and policy changes. Hence, this paper aims to narrow the literature gap by employing the systems theory to develop a systems framework for sustainable development of port city, and in particular illustrating its application in the case study of Singapore. This systems framework is well aligned with the systems approach originated from the General Systems Theory (Van Bertalanffy, 1969) which allows researchers to examine the interaction of multiple entities working together to improve outcome. Central to the systems perspective is holistic thinking (Patton, 2002) which is usually qualitative and views things as a whole embedded in various contexts. The paper also adopts the holistic thinking and proposes to redefine the approach to planning the development of port city and to understanding the balance between economic, environmental and social objectives by means of government policies.

The organisation of the paper is as follows: The next section will provide a review of port-city relationships and identify the research areas that are insufficient in the literature. Section 3 will introduce the research approach and a systems framework for port city. Discussion on the framework will be elaborated in Section 4. Section 5 is a case study on Singapore, which will demonstrate how the framework can be used to analyse the situation of a specific port city. Section 6 concludes the paper.

2. Port-city relationships

A port acts as a link between the adjacent city and regional development. Major cities and industries have developed in waterfronts to take advantage of the coastal location. In addition to facilitating trade and industry, ports contribute to economic progress through the multiplier effect that port activities possess (Suykens, 1989; Zhang & Lam, 2013). However, there is generally a lack of clear consensual definition of the 'port city' concept, due to complex interactions of various networks and territories in a single place (Wang & Ducruet, 2012). Port cities are economic entities with significant maritime activities. Port cities also serve as a link between local and global environments, acting as centres of exchange where different cultures and different environments meet, at the boundary between land and sea. Their economic functions as nodes of sea-based trading networks should be highlighted (Tan, 2007). As a place, port cities are not normally constrained by political boundaries but hubs in dense networks of maritime connections through which people, goods, ideas and meanings flow. Global port cities facilitate global flows and trans-national integration (Lee, Song, & Ducruet, 2008). They play key political and social roles in influencing hinterland, creating employment opportunities for residents. For example, Singapore is a global city-state, with its port supporting its status as a global transport, logistics, communication and financial hub (Lee et al., 2008; Tan, 2007).

It has been discovered that port-city relationships vary tremendously across different regions. Ducruet (2006) studied port-city interdependence by examining correlation between city population and container throughput. He found that, in general, European port cities have relatively weak but stable port-city interdependence index, while Asian port cities have a stronger interdependence despite of a constant dropping. This is because mainland concentration of markets is predominant in Europe, while in Asia, markets tend to concentrate on coastal areas. In Europe, geographical factors such as the distance to markets and hinterlands are key factors influencing port activities; whereas port activities in Asia are more influenced by economic factors, given the concentration of economic activities in major cities. Moreover, the process of spatial and economical integration in Europe emphasizes the role of ports in the entire continent; while in Asia, ports continue to be mostly local or national-based. Therefore, most of the European port cities are especially dependent on the mainland, focusing on transport and logistics specialization. However, in Asia, the port-city concentration permits the existence of more multifunctional nodes, and such nodes suffer from rising congestion problems (Wang & Ducruet, 2012).

In a more general sense, conflicts have arisen between the port and city systems due to over concentration and spatial constraints. Conflicts between a port and its city exist because of urban traffic congestion and waterfront redevelopment (Hayuth, 2007). A typical example would be the lack of suitable and sufficient land and sea space for expansion of ports (Yap & Lam, 2013). Many port terminals, originally located close to the city centre in 1960s to 1980s, have now been facing increasing competition from commercial and high-end residential real estate developments due to gradual enlargement of the city centre (Grossmann, 2008; Rondinelli, 2001). Hall and Jacobs (2012) considered the time that ports and their host cities would develop together as integrated functional-economic entities has passed.

However, discussions on port-city conflicts tend to concentrate on the negative relationship between a port and the city, and ignore or undermine the positive side. Recently, despite the disarticulation process between ports and their host cities, Hall and Jacobs (2012) asked why maritime ports are still urban. Indeed, many port cities have continued to thrive even after their primitive advantage has become unimportant (Fujita & Mori, 1996). It seems that the port system cannot be totally separated from the city system. Hence, Hall and Jacobs (2012) called for dynamic understanding of the port-urban relationship. However, their finding is only one of the very few attempts in identifying the dynamic advantages that urban agglomerations may offer to ports; there is a lack of deeper and systematic analysis of both positive and negative relationships that both cities and ports render to each other. Also, empirical studies often analyse the port system (See Cetin & Cerit, 2010; Bekebrede & Mayer, 2006; Dinwoodie, Tuck, & Knowles, 2012 for examples) and urban system (see Baynes, 2009 for example) separately, with little research attempting to integrate the two systems. While the development of port cities is an aspect that requires continual research and monitoring, the current literature addressing the issue of sustainable development in port cities is rather limited. The work by Cavallo, D'Apuzzo, and Squillante (2015) presented a case of the Port of Naples but the urban system was not specifically investigated. Additionally, academic research on port cities from the policy's perspective is limited.

3. Research approach

Referring to the interesting dynamic port-city relationships and literature review as discussed, this study adopts systems thinking and proposes a systems-framework for sustainable development of port city. With reference to Yin (2011), a qualitative case study of Singapore's policies is presented later. The rationale of using a qualitative case study is that it helps to seek to reveal patterns and connections in relation to theoretical constructs. The case study of Singapore demonstrates how the systems framework developed in the paper could be applied to analyse the port-city relationships and assist planning of port-city development.

To construct the system-specific criteria for port city planning, a good starting point is to understand sustainable development. A landmark definition of sustainable development, given by World Commission on Environment and Development (1987), is: development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The overarching elements of sustainable development include an assessment of relevant economic, social and environmental factors, as well as consideration of the dynamic time and spatial horizons (Foxon et al., 2002; Rijsberman & van de Ven, 2000).

The most popular method used to study sustainable development would be through the identification of sustainable development indicators related to the subject in question. Sustainability should be measured in terms of a group of sustainable development indicators and the interrelation between the individual indicators should be evaluated

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