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A literature review on port sustainability and ocean's carrier network problem

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ABSTRACT

In the present paper, we aim to review the maritime literature of two interrelated concepts: Port Sustainability and Ocean's Carrier Network Problem (OCNP). The past literature did not establish a clear relationship between these two concepts, as the sustainability concept is a relatively recent approach in the maritime literature, and still a gap exists in this field. This study will have the objective to review the port sustainability concept and then to relate it to the OCNP, in order to reach a conceptual framework which will integrate port sustainability indicators in the OCNP. This will be achieved by interrelating them using the triple bottom line concept and focusing solely on the environmental approach. The conceptual framework will be our future perspective to be achieved through our upcoming work.

1. Introduction

Environmental protection and sustainable development are nowadays among the greatest challenges faced by our society. There is no single agreed on definition of sustainable development, although the most commonly accepted is the following definition: "to provide for the needs of the present generation without compromising the abilities of future generations to meet their needs" (Vilsted, 2004, pp. 40). Sustainable development should take into consideration and find a balance among economic, social and environmental factors, which are also referred to as the triple bottom line. In sustainable development, the economic aspect does not take into consideration only the economic benefit but also the environmental and social benefits the company gains by acting responsibly (Elkington, 1994). A company can at the same time concentrate on profit maximization and take into account the social demands (Quazi & O'Brien, 2000). Social responsibility can be perceived as long-term profit maximization (Carroll, 1999). Companies should focus on obtaining long term profits rather than quick short-term profits, which are often easy to achieve by violating standards and regulations (Brockhaus, Kersten, & Knemeyer, 2013). These long term profits should not only be monetary profits, but also social and environmental benefits, which are often challenging to measure and can be seen only after a while (Grewal & Darlow, 2007).

In maritime ports and related activities, environmental issues are continuously emerging and becoming a competitive factor. Shipping and ports are essential components of the international trade and goods movement (World Shipping Council, 2010). Shipping represents one of the largest, most difficult to regulate and control source of air and water pollution in the world. Ports are major economic, industrial and logistics centers that also contribute significantly to pollution in coastal urban areas (Marine Insight, 2011). Thus, focusing on the protection of the environment and the sustainable development has become a primordial focus in the research field, and still attract the attention of many scholars.

In this study, we will mainly focus on the importance of incorporating the sustainability concept in an ocean's carrier network problem by reviewing the literature with a specific focus on the environmental aspect as other aspects were largely tackled in the literature. This paper is organized as follows: Section 2 presents the literature review of the port sustainability, and that of the ocean's carrier network problem. Next, Section 3 explains the interrelationship between the port sustainability concept and the OCNP, by identifying the sustainability indicators that can be used to connect them together and provide a future conceptual framework. Finally, in Section 4, conclusions are drawn along with a summary of the paper with a future insight to the study.

2. Literature review

2.1. Methodology

In this part, we will review the literature of the port sustainability and the OCNP. We will focus first on the port sustainability, and finally explain the importance of implementing this concept for the OCNP, in order to optimize this maritime operation and provide a new insight in the traditional network problem. The review was achieved through searching all the maritime literature, especially the port sustainability and OCNP concepts from 1987 till 2013. The search for related publications was conducted mainly as a structured keyword search of the following terms: *maritime logistics*; *port sustainability*; *green vehicle*

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routing problem; *logistics network optimization*; and *network design problem*. Major databases were used to search for related papers, such as those provided by major publishers, Elsevier (www.sciencedirect.com), Emerald (www.emeraldinsight.com), Springer (www.springerlink.com), Wiley (www.wiley.com) or library services (e.g., Ebsco www.ebsco.com; Scopus www.scopus.com). Taking these delimitations into account, a total of 198 papers were identified, but 49 papers were used in the literature review. This selection was based on the fact that these 49 papers were the most influencing and stated ones in the maritime and logistics fields. We estimated that they influenced our concerned fields of research by the number of citations, as shown on the search engine of Google scholar. The number of citations as found by the search engine is estimated to be approximately within the range of 25 to 125 per paper. We selected the highly cited papers in comparison with less cited ones. We assume that this may be introducing a bias to the results as some articles could have contributed but we can assume that this range covers the most important contributions in the maritime and port sustainability literature. Therefore, they represented a cornerstone to our upcoming study, as they are considered the most influential academic work.

Fig. 1 presents the number of articles published on port sustainability and logistics network optimization between 1994 and 2015. We can note that these two concepts received more interest from scholars from the late 1990s.

Fig. 2 shows the journals in which the papers appeared. We clearly see that maritime journals, such as Maritime Policy Management and Maritime Economics and Logistics, are increasingly publishing and that four journals account for about 50% of the reviewed publications. We divided the different journals into four distinct groups: maritime, transportation, operations management, and the sustainability field (Table 1).

Next, we classified our literature review using the triple bottom concept: economic, environmental, and social aspects. Fig. 3 shows the different articles per type of research in the maritime literature using economic, environmental and social aspects. The environmental aspect has engendered more interest in the maritime literature. We found 28 influencing papers reviewing both the social and environmental aspects, and 33 referring to both the economic and environmental approaches. This clearly represents that the environmental approach has a primordial interest in the maritime field, which will be a main concern for the coming years.

Last, we identified the different methodologies used in the selected publications. Tables 2 and 3 summarize respectively the methodologies in the port sustainability literature and logistics network optimization based on the different keywords search. The most common method used in port sustainability literature is the review process and few used structured interview as a method of strengthening existing literature.

The other methodology used other than the literature review is the genetic algorithm as shown in Table 3. This is in accordance to the trend in port sustainability research where genetic algorithm is well utilized along with the logistics network design problem. We can note that structured interviews with port authorities and shipping lines are not represented but may be interesting methodologies.

2.2. Port sustainability

The concept of port sustainability includes three main perspectives (or the triple bottom line concept): 1) an economic perspective including returns on investment, efficiency of the use of the port area, and provision of facilities for companies to maximize their performance; 2) a social scope such as the direct contribution to employment in port companies and activities connecting to the port (indirect employment, the interaction and relationship between port and city, the contribution to knowledge development and education, and the liveability of the area surrounding the port); and 3) an environmental performance and management including noise pollution, air quality, dredging operations, and dredging disposal (UNCTAD, 2009). These three aspects are depicted in the below figure (Fig. 4).

Through corresponding improvements in sustainability, the port can achieve more economic stability and continuous improvements in subsequent performance within the bounds of the environmental regulations (Pinder & Slack, 2004; Robinson, 2002). All these sustainable motivations and opportunities are encouraging a port so as to adopt a policy of active and advanced environmental and social management (Lloyd's List, 2010; Neef, 2012; Notteboom & Vernimmen, 2009; Urminsky, 2001; Vilsted, 2004). For example, annual sustainability reports published on port websites, suggest guidelines and strategic advice towards port sustainability to address issues related to sustainable port operations and development with economic, social and environmental considerations (Dicken, 2003; Elkington, 1994).

The concept of sustainability in ports necessitates the simultaneous pursuit of economic prosperity, environmental quality and social responsibility (Panayides, 2006). In the shipping and ports industries, with broadened port functions as an economic catalyst for revenue and employment and a central position for industries related to international trade (Notteboom & Rodrigue, 2005; Olivier & Slack, 2006), economic stability (highlighted by the economic crisis in 2008) and corporate responsibility issues may shed new light on port operations. Moreover, recently, owing to the growing environmental and social concerns regarding potential environmental impacts, "sustainability" has been progressively framed in port operations and development literature (Burke & Logsdon, 1996; Eide, Longva, Hoffmann, Endersen, & Dalsøren, 2011; Slack & Fremont, 2005). Sustainable port development strategies "Not only address problems in port areas including safe handling of goods or environmental management, but also includes the actual capacity development for the ports and the establishment of related training capacities in the region, aiming to develop a port and the area surrounding the port through a systematic approach working with the ports and addressing their specific needs" (UNCTAD, 2009).

Sustainable development themes such as safety, health and environment should already be high on the shipping companies' list of priorities

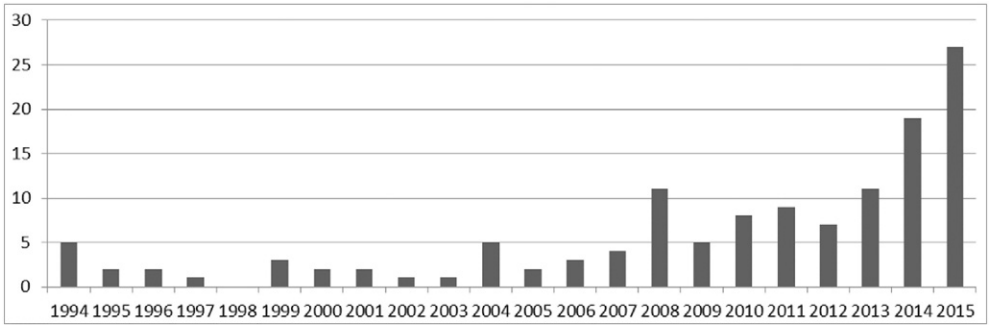

Fig. 1. Number of Articles Published per year between 1994 and 2015.