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The impact of environmental policy on ports and the associated economic opportunities

Jong-Kyun Woo^a, Daniel S.H. Moon^b, Jasmine Siu Lee Lam^{c,*}

^a Tong Myong University, Busan, Republic of Korea

^b World Maritime University, Malmö, Sweden

^c Centre of Excellence in Maritime Energy and Sustainable Development, School of Civil and Environmental Engineering, Nanyang Technological University, Singapore

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ABSTRACT

The purpose of this paper is to investigate environmental policy issues in ports concerning how and how much an environmental policy affects the cost-benefit structure in a port from the economic and environmental perspectives. To mitigate negative environmental impacts in ports, there are stricter regulations that target creative designs for minimizing pollution. Nevertheless, such policies to mitigate environmental impacts result in a cost for the relevant parties, especially the ports themselves. To analyze the impact of environmental policy on ports, a simulation technique based on system dynamics is introduced with the case of Busan port as an illustration. Results show that both the environmental policies (EPs) and the policy options (POs) create positive effects and negative effects on ports. Although EPs and POs seem to increase the negative effects on the port in the short term, they are helpful to strengthen the competitiveness of ports by the vitalization of port activities and the port cluster.

1. Introduction

1.1. Background

Rapid growth in international trade has contributed to significant port developments in the last couple of decades. In other words, economic growth and trade activities accelerate the development and demand of ports. It is evident that many countries and societies benefit from developing ports. However, port development has also brought environmental challenges. Particularly in recent years, increasing environmental awareness has created new challenges for the development and management of ports.

Environmental externalities are generated in ports from the construction of infrastructures and facilities to the stage of operations (Lam and Notteboom, 2014). Ports are durable coastal assets that exist for a very long time, so the environmental impacts are long lasting. Pollution comes from various sources including ships, terminals and port hinterland transportation (Homsombat et al., 2013). To mitigate these negative environmental impacts, there are stricter regulations that target creative designs for minimizing environmental impacts and aim for sustainable operations over the long-term.

During the last couple of decades, international bodies and many scholars have provided various ideas, theories and regulations in environmental protection (Lee et al., 2016). The European Sea Ports Organization (ESPO) and World Ports Climate Initiative (WPCI) have suggested strict principles and guidelines: the ESPO Environmental Code (ESPO, 2003), ESPO Green Guide (ESPO, 2012) and

* Corresponding author.

E-mail addresses: jkwoo@tu.ac.kr (J.-K. Woo), dm@wmu.se (D.S.H. Moon), sllam@ntu.edu.sg (J.S.L. Lam).

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C40 World Ports Climate Declaration (WPCI, 2008). Apart from the sole perspective of environmental concern, the United Nations Environment Programme (UNEP) (UNEP, 1972) and World Commission on Environment and Development (WCED) (WCED, 1987) have presented a concept of 'sustainable development' and today, this concept is generally accepted to cover much more than strictly environmental issues. The concept of 'sustainable development' provides an important context for the growth of green ports.

Economic prosperity does not necessarily compromise the environmental performance of a country or an organization. We echo the concept of green growth put forth by OECD (2011). In particular, transport is an important field related to green growth and ports as nodal points or hubs are one of the most important infrastructures to contribute to sustainable development and green growth (OECD, 2011). In recent times, the World Association for Waterborne Transport Infrastructure (PIANC) has provided guidelines on the approaches to become greener and sustainable ports referring to exemplar ports in the industry. The effectiveness of these ports and the economic potential can be used as references for other ports (PIANC, 2014).

Nevertheless, such policies to mitigate environmental impacts result in a cost for the relevant parties, especially the ports themselves. Cost is a key performance driver of an organization. Therefore, some ports are reluctant to implement environmental programs in their own region. Much of the challenge of choosing and implementing an appropriate policy solution comes in how to create more economically viable outcomes considering institutional conditions and the limitations of the port and the country.

Actually, these environmental policy instruments would benefit the regional economy if they are implemented in conjunction with proper economic policy options; that is, enhancing the environmental performance of a port could also be an economic opportunity in a more fundamental way, using the main drivers that could be identified in creating economic value from the ports (OECD, 2014). For instance, the port of Rotterdam provides incentives to renewable energy sector to not only develop technology but also adopt this technology to port and related industries. This policy leads to not only vitalize the renewable energy sector but also improves the environmental condition in the port of Rotterdam. Moreover, the port of Singapore has been concentrating to develop environmental technologies and industry, *i.e.* environmental ship repair technology, eco fuel provision, and solar panel technologies, with increasing investment in the maritime cluster (Lam, 2016).

1.2. Aim of study

The purpose of this paper is to investigate environmental policy issues in ports concerning how and how much an environmental policy affects the cost-benefit structure in a port from the economic and environmental perspectives. If an environmental policy generates just additional costs or expenses without creating additional valuation, the port authorities, although they recognize the necessity of it, will reduce the level of policy intensity or delay the enforcement of any policy as much as they can. On the other hand, if an environmental policy also creates economic value, the port authority will support and promote the environmental policy actively.

For this purpose, as a methodology, a simulation technique based on system dynamics (SD) is introduced with consideration for the case of Busan port, R.O. Korea. Furthermore, a sensitive analysis is conducted to simulate the changes of cost-benefit structures by the changes of the amount of created additional valuations in port. This paper is composed of five sections. In Section 2, the concepts and definitions of environmental port policy: environmental policies (EPs) and policy options (POs) are explained, and followed by a proposed simulation model in Section 3. Section 4 then presents the main results of the simulation and sensitive analysis and finally Section 5 summarizes and concludes the paper.

2. Definition of environmental policy and policy option

2.1. Environmental policies: EPs

Environmental policies (EPs) are defined as the encompassing policy tool introduced for applying and improving the environmental management standards in a port based on the regulations and international conventions (OECD, 2011). The common element of all EPs is that they operate on a case-by-case basis in the world, except for regulations. A major challenge in practice is to weave more flexible environmental instruments into the existing policies in the country.

As a reference, there are more than 30 environmental issues in the European port sector although priority issues change their ranking in time as shown in Fig. 1 (ESPO, 2012; ESPO and EcoPorts, 2013). Moreover, according to Ocean Shipping Consultants (OSC)'s report (Stenvert and Penfold, 2010), there are fifty ways, *i.e.* tools of environmental policies, to ease air pollution for shipping lines, port operators, inland transport companies and others. In the case of port of Busan, Busan Port Authority investigates the environmental priority every 2 years. According to the last investigation, top 5 environmental priorities were air quality, port waste, noise, road congestion and hazardous cargoes.

Due to the significance of exhaust emissions in recent years (Tichavska and Tovar, 2015), this study focuses mainly on EPs related to mitigating exhaust emissions and the associated air pollution. Fig. 2 shows major examples in environmental policies to ease air pollution in ports. These can be grouped into four drivers (or policies) to make ports (or terminals) greener: regulations, information, incentives and technology upgrades. Various policy instruments are used to tackle the main environmental impacts associated with ports, through various levels of intervention, ranging from global to local. A broad range of solutions has been identified to reduce air emissions in ports from 5 groups of polluters.

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