

Green Port Strategy for Sustainable Growth and Development

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Abstract

The recent years have seen growing interest in the environmental impact of port operations and development due to pressing global issues such as climate change and energy consumption. The port industry is facing increasing challenges since it is subject to closer scrutiny in terms of environmental regulatory compliance. The focus on environmental issues is especially felt at the level of vessel and cargo handling operations, port extension projects and hinterland accessibility. At the same time, providing adequate capacity, quality services and cost-effective solutions are essential. As such, devising a green port strategy fulfilling both economic and environmental objectives would be desirable and contributes to the port's sustainable growth and development. The literature to-date has yet to fulfill the much desired industry demand. The study aims to fill the gap by formulating a framework in green and sustainable port strategy. The research objective is firstly achieved by comprehensive literature review and conceptual development. Then three port case studies from North America, Europe and Asia, namely Los Angeles/ Long Beach, Antwerp and Hong Kong are chosen due to the high shipping traffic and cargo volume handled, as well as adopting greener approach in recent years. The case studies are presented with the aim to relate the concepts to policies and industry practices. The case studies also add value by representing an international perspective from the major ports in the three key geographical regions. Accordingly, an original framework in green and sustainable port strategy and propositions have been developed. The framework is built on key constructs of stakeholder involvement, green market development, cost effective green policy as well as sustainable port operations and development. Practical and research implications will be discussed.

Keywords: green port, port strategy, sustainable development, stakeholder analysis, green market development

1. Introduction

After long pursuing trade growth, industrialisation and the associated economic benefits since the modern era of globalisation, the society started to concern about environmental and social issues such as resource depletion, climate change and pollution. Maritime trade and the port industry have experienced phenomenal growth over the past decades. Having acted as trade facilitators, ports are important players in the global economic system. While port efficiency, connectivity and capacity have always been important topics, the recent years have seen growing interest in the environmental impact of port operations and development due to pressing global ecological issues. The port industry is facing increasing challenges since it is subject to closer scrutiny in terms of environmental regulatory compliance. The focus on environmental issues is especially felt at the level of vessel and cargo handling

operations, port extension projects and hinterland accessibility. At the same time, providing adequate capacity, quality services and cost-effective solutions is essential. The critical issue is to strike the right balance among economic, social and environmental values in order to achieve sustainable development of the port and the local community.

Other than the reason of environmental legislation enforcement, enterprises start to make business decisions based on the need for sustainability and turn in to its potential marketing value. A recent survey showed that around 82% of businesses are willing to increase spending on green marketing (Environmental Leader, 2009) since the enterprises recognise the opportunity to charge higher price due to the enviable green image. Those who manage to translate sustainability into sources of competitive advantage and a key value driver for their customers, stakeholders and, ultimately, their bottom lines, will emerge as winner in this new competitive landscape (Esty & Winston, 2006; KPMG International, 2011). As such, devising a green port strategy fulfilling both economic and environmental objectives would be desirable and contributes to the port's sustainable growth and development. The literature to-date has yet to fulfill the much desired industry demand.

The study aims to fill the gap by formulating a framework in green and sustainable port strategy. The research objective will be firstly achieved by comprehensive literature review and conceptual development. Next, three port case studies from North America, Europe and Asia, namely Los Angeles/Long Beach (LA/LB), Antwerp (ANT) and Hong Kong (HK) are conducted due to the high shipping traffic and cargo volume handled, as well as adopting greener approach in recent years. The case studies will be presented with the aim to relate the concepts to policies and industry practices. The key constructs and propositions will be established accordingly.

2. Literature Review

2.1 Sustainable development

The central notion of sustainable development is that the goals of environmental preservation and the goals of business need not be disparate and conflicting (Barbier, 1987). The concept of sustainability can be defined in terms of the triple bottom line (3BL): economic prosperity, environmental quality and social justice (Elkington, 1997). In relation to corporate performance, Savitz and Weber (2006) noted that sustainability means operating a business in a way that causes minimal harm to living creatures. Sustainability is regarded as the integration of environmental, social and economic criteria and keeping an equitable balance among the three aspects that supports an organization for long-term competitiveness (Sikdar, 2003; Carter and Rogers, 2008). To be sustainable in business, any green measures should contribute to the commercial aspect in improving economic performance (Rao and Holt, 2005). The importance of sustainable development has been recognized over the years. It is strategic to a firm since it affects the firm's core business and its growth, profitability and even survival (Corbett and Klassen, 2006; Kolk and Pinkse, 2008).

In terms of how to achieve sustainable development, Elkington (1997) examined sustainability in relation to corporate governance and argued that the key to establishing the triple bottom line is stakeholder consultation. Carter and Jennings (2004) analyzed the role of purchasing in corporate social responsibility and claimed that external pressures from customers such as request to choose environmentally responsible suppliers must be taken into account. Anderson and Brodin (2005) highlighted the importance of effective customer participation in order to understand customers' requirements and expectation in ecological concerns. Dougill et al. (2006) echoed and stated that by taking local interests and concerns into account at an early stage, it would enhance the project design and increase the likelihood that local needs and priorities are successfully met. Other than stakeholder and customer participation, there is evidence that linking sustainability goals and measures to corporate strategy helps to integrate sustainability into what the organization does (Wagner, 2011). Corporate proactive stance and tangible commitment, often in the

form of a written environmental policy is a significant contributor to sustainability (Ramus and Steger, 2000).

There have been an increasing number of studies on sustainable development. In recent years we see a trend in establishing holistic frameworks encompassing sustainable strategies and practices particularly in the field of supply chain management (SCM). Zhu and Sarkis (2004) presented a model consisting of the components of green SCM, empirically validated by a survey on Chinese manufacturing firms. Carter and Rogers (2008) developed a framework of sustainable SCM based on literature review and conceptual theory building. They demonstrated the relationships among environmental, social and economic performance in the supply chain context. At the intersection of the three aspects, there are activities that organizations can engage in which not only positively affect the natural environment and society, but which also contribute to the long-term economic benefits of the firm. Also founded on literature survey, Seuring and Muller (2008) presented a conceptual framework addressing more on supplier management and product development. Pagell and Wu (2009) performed case studies of ten exemplar firms from various industry sectors for building a testable model of the elements necessary to create a sustainable supply chain. Shang et al. (2010) identified 6 green SCM dimensions, namely green manufacturing and packaging, environmental participation, green marketing, green suppliers, green stock and green ecodesign, and carried out an empirical investigation in electronics-related manufacturing firms in Taiwan. Sharma et al.'s (2010) and Lee and Lam (2012) developed their respective framework focusing on industrial marketing. Based on literature review, the former developed a sustainable market framework in the supply chain context for achieving environmental sustainability objectives, while the latter demonstrated a framework integrated with sustainable operations management by studying a case of a medical product manufacturer.

2.2 Environmental issues in ports

Port research has also been increasingly addressing ecological issues. It is found that studies in earlier years were driven by environmental legislation. Bateman (1996) discussed Australia's environmental regulations and their impacts on the ports and maritime industry. The concern on higher costs of environmental protection to the stage that such costs would become a community responsibility rather than an industry one was raised. Hence Bateman suggested public consultation and more coordinated approach in maritime and oceans policy. Wooldridge et al. (1999) studied how the UK ports sector responded to environmental legislation. The paper focused on the importance of monitoring mechanism for ports and harbours in maintaining their environmental sustainability. Biological indicators such as presence/absence of individual marine species and abundance of dominant species for monitoring purpose were suggested. Also related to monitoring, Darbra et al. (2009) studied 26 European ports' requirements for environmental information via interviews. The major environmental parameters that ports required to be monitored were marine related issues, water quality, meteorological parameters, turbidity and sediment processes.

One of the major environmental impacts generated by ports is air pollution and there are several studies which specifically addressed this aspect. Liao et al. (2010) analysed the impact of using Taipei Port in Taiwan on the carbon dioxide emissions CO₂ of inland container transport. Via activity-based method, the estimation results showed that there are greater reductions in CO₂ when transshipment routes are changed from other major ports in Taiwan to Taipei. In addition to CO₂, dominate emissions from ships at ports include SO₂, NO_x, PM₁₀, PM_{2.5}, HC, CO and VOC. Studying Taiwan's case also, tankers and container ships were found to be the first and second largest groups of ships emitting such pollutants in Kaohsiung Port (Berechman and Tseng, 2012). The health effects to residents of the local community include asthma, other respiratory diseases, cardiovascular disease, lung cancer and premature mortality (Bailey and Solomon, 2004).

Another major environmental concern is water pollution and the effect on marine ecosystems. Ng and Song (2010) assessed the environmental impacts generated by routine shipping operations on ports, and conducted an empirical analysis on Port of Rotterdam. Water pollution comes from ballast water, fuel oil residue and waste disposal from ship operations as well as cargo residue. The need for upgrading and maintenance of navigation channels at port waters would lead to contaminated sludge from dredging. There may also be a need to alter the sea floor and natural geographical feature causing disruptive impact on marine ecosystems due to dredging and civil works (Peris-Mora et al., 2005). A case study on the port of Valencia in Spain was conducted.

The above studies led to a better understanding of ecological issues in ports. Nevertheless, their scope did not directly cover port strategy and did not involve any strategic framework. There was no theoretical development or analysis on the appropriate constructs which can holistically address these ecological issues. There is also a gap in the literature to integrate economic and social aspects with environmental concerns to address port's sustainable growth and development. With regards to empirical investigation or case study, it is observed that prior studies are mostly devoted to a local situation or at best regional focus, i.e. Darbra et al (2009)'s analysis on Europe. Our research adds value to the literature by filling these four major gaps identified.

3. Research Methodology

Considering the target of theory building, this study is based on literature review and three comprehensive port case studies. Case studies can contribute to improved validity and reliability by providing qualitative evidence for understanding the underlying rationale or theory (Yin, 2002). Another advantage of using case study is the inherent flexibility of the method (Dubois & Araujo, 2007) which fits the nature of the complex, dynamic relationships and interactions in the port industry.

The ports that are chosen should be international and major ports having high shipping traffic and cargo volume handled hence the cases would be comparable. We define this by limiting the possible ports to one of the top ranking ports in their respective region, namely Europe, Asia and North America, in terms of total cargo throughput in tons. The three regions are selected for the similar reason that they are the top regions in the world in terms of maritime trade volume. There is no fixed rule suggested by the literature for the appropriate number of cases to use in multiple case research. But a maximum of seven cases were stated by Eisenhardt (1989) for the reason of human's limitation in mental process. We also agree that a relatively low number is preferable since too many cases will defeat the purpose of conducting case study which is meant to be in-depth for each object. For those previous port researches utilising multiple case study, the number of cases mostly ranged from two to four. Since very little was found in terms of green port strategy in the literature, three cases, i.e. one major port from each geographic region would be a good attempt.

Data and information collection for case studies was conducted from the second quarter of 2011 to the first quarter of 2012 at the three port locations through various methods, namely interviews, field visits to each of the ports and searching library and credible internet sources. The research design is to achieve the benefits from triangulation, whereby multiple data collection methods can mitigate biases and lead to stronger substantiation of constructs and hypotheses (Eisenhardt, 1989). One interview was performed for each port targeted at a management executive related to sustainability profile of a terminal operator which would be at the most appropriate position interfacing public authorities, commercial customers and various stakeholders for the purpose of the study topic. The field visits which were hosted by different personnel provided authors with a thorough understanding of the port's practice. As suggested by Carter and Rogers (2008), a profound understanding of the motivations of case object's practices and strategies can be obtained through ethnographic inquiry. This approach enables an experimental investigation into organisational phenomena, including management philosophy, environmental measures and processes,

port performance and shortcomings. The cases greatly strengthen the industrial inputs for the research. In addition to previous studies, the conceptual framework and propositions are based on the analysis of the cases, enhancing the research relevancy to the port industry.

This study utilizes qualitative approach involving compilation, summary, comparison, classification and analysis of the data, information and opinion. Specifically, the process can be divided into two parts. First, within case analysis was performed as a data reduction and organisation technique. Each port's data and information became more structured and usable. The second procedure involved cross case analysis which was concerned with pattern recognition and matching across the various ports (Miles and Huberman, 1994). Table format will be used for presenting the case comparison.

4. Case Analysis and Discussion

The importance of stakeholder involvement was established in generic sustainability literature. Various stakeholders are concerned with port operations and they also play a vital role in the development of a green port. We classify various stakeholders into four categories, namely market players, public policy makers, internal stakeholders and community. In order to identify the patterns across the three ports, the key is to analyse the level of stakeholder involvement and the type of environmental projects involved, i.e. the 'who' and 'what'. Considering various ecological aspects of air and water pollution, energy consumption and waste treatment during port operations, expansion and hinterland connection, seven types of projects are studied in focus. The findings are summarized in table 1 and the analysis is discussed below.

Table 1: Stakeholder involvement and type of environmental projects involved in the 3 ports

		ANT	HK	LA/LB	
Stakeholders Involved (Who)	Market players	Shipping companies	Y	Y	Y
		Logistics/Inland transport operators	Y	N	Y
	Public policy makers	Port authority	Y	L	Y
		Environmental department	Y	Y	Y
	Internal Stakeholders	Employees	Y	Y	Y
	Community	Non-government organisations (NGO) & Environmental groups	Y	Y	Y
		Residents	Y	Y	Y
	Specific projects involved with stakeholders (What)	Lower emission and low sulphur fuel for ships	Y	Y	Y
Onshore power supply for ships		L	L	Y	
Clean truck (at port)		Y	Y	Y	
Green multimodal connection (to inland)		Y	L	Y	
Renewable and conservation of energy		Y	Y	Y	
Waste management		Y	Y	Y	
Ecological port development		Y	N	Y	

Note: Y = yes, engage in the activity significantly; N= no engagement; L= limited engagement.

Source: Authors, based on various primary and secondary sources (see section 3)

4.1 Market players

The fundamental function of a port is a connection or 'interface' point where market players transact and interact. All the ports in the three cases collaborate with major customers, i.e. shipping companies in reducing air pollution. They all adopt schemes to reduce greenhouse gas (GHG) emissions and to switch to low-sulphur fuel for ships. One of the programs implemented by LA/LB called Green Flag Speed Reduction Program (Port of LB, 2009) is cost-effective for shipping companies. By slowing down, ships

can reduce emissions and shipowners in return get discounted fees the following year as an incentive, hence the scheme combines environmental protection with economic benefits. ANT and HK do not adopt similar project but they use other measures. In terms of HK, in addition to government initiatives, shipowners under Hong Kong Shipowners Association supported to adopt a lower global sulphur cap of 0.5%. Craft operators also take initiatives to reduce vessels' fuel consumption. Hong Kong's largest tugboat operator the HUD Group commits to become the world's first tug company being completely carbon neutral (Galbraith et al., 2008) which is a huge step taken in the tug industry. ANT also introduced low-sulphur fuel for the Port Authority's own tug and dredger fleet (Port of Antwerp, 2010). Hence, such move is not market players' initiative. Furthermore, the three ports started/planned to implement the onshore power supply scheme by which ships get electricity on shore. Ships are recommended to install converters that incur additional cost for shipping companies. This also incurs higher cost for ports on power stations. LA/LB is by far more aggressive in this aspect which aims to have 100% onshore power supply (IHS Fairplay, 2011) while ANT and HK implement such projects only for barge and cruise terminals respectively.

Other than shipping companies, truckers, logistics and other inland transport operators are also involved in green port initiatives. The three ports have clean truck programmes which require vehicles to switch to low-sulphur diesel. Both ANT and LA/LB take active initiatives to cooperate with inland transport sectors like rail track operator and build a green multimodal connection to hinterland. The two ports are on the way to increase the proportion of barge and rail in modal split since the two modes generate lower GHG emissions than trucks. In HK, we do not see stakeholder involvement directly in this area. But 60% of traffic coming into HK from its hinterland Mainland China is already via barge (Galbraith et al., 2008).

4.2 Public policy makers

Viewing ports as strategic assets in a country, public policy makers represented by government departments and agencies act as a central party and need to be actively involved in decision-making. The involvement of public policy makers will ensure that the green port strategy is aligned with the country's interest and such strategy can have a better chance of being sustained. In the three cases, the governments are all involved in the development of green port, however, the level of involvement and governing area differs.

ANT's Port Authority intends to act as a "responsible householder" (Port of Antwerp, 2010). On one hand, it monitors the overall situation and will take corrective actions wherever possible. On the other hand, it aims to develop into a centre of knowledge for environmental matters related to port activities, such as the evaluation of water quality. As for LA/LB, the port authorities serve as the driving force in ports' environmental protection. The cross-city partnership driven by the governments between the two neighbouring ports serves as a good model. The ports jointly adopt the San Pedro Bay Ports Clean Air Action Plan successfully reducing air pollution to a large degree. Supported by South Coast Air Quality Management District, California Air Resources Board and other related departments, this programme is also considered as an innovative attempt. As different from the other two ports, HK's green initiative is currently led by the industry largely due to *laissez-faire* policy adopted (Schiffer, 1991) which means transactions between private entities are free from government intervention. The port and stakeholders such as shipowners may invite government representatives to attend the meetings held by them and gradually expand the involvement of the government. Action has also gradually been taken by the government to form the cross-city partnership with Shenzhen learning from USA as mentioned above. However, to incorporate ecological concepts in port development such as in land reclamation, dredging, terminal redesign and terminal construction, the government has to play a more active role in such issues since they are beyond the maritime sector's control to involve urban planning and coastal management.

4.3 Internal stakeholders

We consider employees as a major category of internal stakeholders of a port. The employees' knowledge, understanding as well as enthusiasm towards a green port have a great impact on the port's development. The governing board of the port needs to take green education into account during the transformation. The three ports have taken steps to actively involve employees from top management to front-end staff in the process. For instance, they provide training on waste management and conservation of energy to employees so that they can handle such issues more proficiently. ANT has adopted a people-centric policy. In order to improve internal communication, an internal communication officer was appointed in 2010 in the Port Authority (Port of Antwerp, 2010). Practical measures have been taken by the internal communication department, such as proposed green port projects are discussed across various functions in the Port Authority. Associated information is also disseminated via the intranet which is tailored to its employees. HK also emphasized that employee engagement is one of the keys to the implementation of green port strategy. Similar to the above discussion, initiatives are led by the private sector. For example, Hongkong International Terminals, the largest terminal operator in HK communicates environmental objectives throughout the whole company. Managing Directors, General Managers and Department Heads are all members of the HIT Environmental Steering Committee. LA also pursues employee involvement and provided various training programmes to over 900 employees at the Harbor Departments (Port of LA, 2011). LA/LB incorporate a sustainability ethic into all port activities and communicate this ethic to employees and seek commitment accordingly. It is highlighted that being green also means protecting employees' rights since their working environment and health issues will be taken care of in green port strategy.

4.4 Community

Environment conservation is a public issue. Hence, when building a green port, the involvement with the public is not only indispensable but also beneficial for port image and sustainable development. In the three cases, all ports have made efforts to outreach to the public. They all form a relationship with NGOs and environmental institutes dedicating to pollution reduction and environmental research. ANT and LB go further and set natural conservation areas to protect wildlife with other organizations. Another common factor is that they all engage in community development by providing educational trips to the young, holding open house and so on. Strategies may vary from port to port.

ANT focuses on ecological port development with NGOs. Now the port has a 400 ha nature conservation area equipped with ecological infrastructure that provides a safe habitat for species commonly found in ports (Port of Antwerp, 2010). HK tends to lay special emphasis on reducing the effects of pollution on the residents. Various measures to combat GHG emissions are explained above. An example on improving water quality is marine department's maritime oil spill response plan and anti-oil pollution operations (Marine Department, 2012). As for LA, it stresses on education for the young. It provides School Boat Tour Program and Speaker Series to the young in order to raise public awareness (Port of LA, 2012). Port of LB, on the other hand, attaches importance to publicize on green port using different marketing strategies. There are Open House and television programs featuring their green port branding (Port of LB, 2005).

4.5 Overall comparison

The case studies add value by representing an international perspective from the major ports in the three key geographical regions. The analysis above shows even though the ports adopt different schemes, various stakeholders are extensively involved in their green efforts. Further as the results in the table shows, when comparing the engagement with various stakeholders, LA/LB and ANT are more committed to adopting green port strategy. It can be explained as Hong Kong started fairly late and is learning from USA and Europe. Furthermore, the government's non-intervention policy accounts for HK's slower green development compared with the other two ports. Stakeholders have diverse interests and needs, but they must collaborate as a whole for the port's sustainable growth and development. Such collaboration could be formed through joint projects and technological innovation which are preferably coordinated and

supported by public policy makers who play a central role in strategic planning and development. They are also the most suitable party to resolve conflicts, offer monitoring, incentives and enforcement in environmental issues.

5. Green and Sustainable Port Framework and Propositions

Based on the literature review and case studies, the following constructs are proposed to be included in the green and sustainable port framework as shown in figure 1.



Figure 1: Green and sustainable port framework

Source: Authors

Stakeholder involvement: Ports cannot act alone while carrying out any green port strategies and they need collaborations from stakeholders of all four categories including market players, public policy makers, internal stakeholders and community, because most strategies are not unilateral. Apart from functional requirements on ports, social and ecological responsibility is one of the concerns of port stakeholders. Only through the efforts made by every group of stakeholders can the objective of a green port be achieved.

Green market development: Having understood the stakeholders' requirements, ports are required to define the market segment based on environmental consciousness of these stakeholders, especially customers in order to achieve economic, social and environmental sustainability simultaneously. Realizing competitors' competency and examining strengths and weaknesses of the port can devise the appropriate tactics for segment target. By utilising appropriate marketing campaign, services can be promoted and green culture can further facilitate green market development.

Cost effective green policy: Cost is a key concern for any commercial decision. Thorough cost and benefit analysis (CBA) will enable port decision makers to determine the feasibility of environmental investment projects by calculating the expected costs and benefits. To achieve sustainable development, ports can adopt a cost effective green policy which is to compare projects by CBA and select those with higher net benefits.

Sustainable port operations and development: While port's social-economic contributions are recognised, there are financial strain and negative social and ecological effects brought by port activities and investment. In addition to green projects to reduce pollution, existing port operations should optimise space and productivity to avoid unnecessary terminal expansion. Also in view of market volatility, mindful and gradual terminal expansion in an ecological approach would be a sustainable strategy in port development.

Stakeholder involvement is crucial in devising and implementing green port strategy. This enables understanding and prioritization of stakeholders' needs and in turn facilitate green market development. Specifically, conducting stakeholder analysis and consultation can identify the green driving forces such

as green port service demand and willingness to pay a premium (Lee and Lam, 2012). Furthermore, CBA can be conducted accordingly leading to more optimal cost effective green policy. Our port case studies indicate that the more active the stakeholders are involved, the more efficient the environmental programmes will be. The outcomes in terms of both marketing and cost effectiveness tend to be more promising. For example, the relatively lower rate of adoption in onshore power supply for ships compared to other green measures is largely due to the costs incurred by customers (shipping companies). Hence, the first two propositions are:

Proposition 1: Proper stakeholder involvement has a positive effect on green market development.

Proposition 2: Proper stakeholder involvement has a positive effect on cost effective green policy.

Sustainability requires a greater focus on integrating marketing and other corporate functions, including eco-design operations (Sharma et al., 2010). Tactics of green marketing will lead to the development of green logistics, waste management and green alliances (Polonsky and Rosenberger, 2001). Together with CBA, sustainable operations and development plans can be carried out with the aim to maximise higher net benefits for the port. The three ports demonstrate that environmental protection efforts go hand in hand with commercial tactics including marketing and costing so that the triple bottom line is met. As a whole, green port strategy consisting of green market development and cost effective green policy should contribute to sustainable outcomes on port operations and development, which lead to:

Proposition 3: Green market development has a positive effect on sustainable port operations and development.

Proposition 4: Cost effective green policy has a positive effect on sustainable port operations and development.

Empirical evidence suggests that ecologically-conscious policies lead to better customer retention which leads to better organizational performance including profitability (Sisodia et al., 2007). Commercial, ecological and social objectives can be compatible. A truly sustainable corporation is one that creates shareholder value while protecting the environment and improving the lives of those with whom it interacts (Savitz and Weber, 2006). The three ports endeavor to grow and be greener at the same time. Their customers and other stakeholders are generally supportive of the green measures, and in turn leading to customer retention. As discussed in the case, Hong Kong Shipowners Association, for example, even went for an extra mile to adopt green policy voluntarily. The fifth proposition is envisaged as:

Proposition 5: A green port will lead to positive outcome on port's customer retention and economic performance.

6. Conclusions

An original green and sustainable port framework has been proposed which contributes to theoretical exploration in green port strategy. The framework was built on key constructs of stakeholder involvement, green market development, cost effective green policy as well as sustainable port operations and development. The case studies on Antwerp, Hong Kong and Los Angeles/Long Beach illustrated their green port policy and practice in comparative light. Particularly, the involvement of four stakeholder groups and seven types of environmental protection projects involved were analysed. The study provided guidelines for ports as they adopt a greener strategy for sustainability. For instance, ports can take reference from the details of stakeholder involvement to improve their green market development in achieving customer acquisition. Ports are also recommended to conduct cost and benefit analysis for formulating cost effective green policy. Appropriate resources in green solutions fulfilling stakeholders' priority can be deployed. This would lead to more sustainable outcome of environmental protection,

social responsibility and economic performance simultaneously. Through the analysis, port stakeholders are also able to better understand the respective port's status and practices in environmental efforts.

The paper addressed a subject of immense public concern but little has been researched to date. For future research, a confirmatory factor analysis can be performed to analyse the measurement properties of the four research constructs to determine how well the items represent the latent factors. The next step would be performing examination of the propositions put forth. Although three port cases are regarded as good attempt in an exploratory work, more case studies from other countries can be conducted. Also, other methods can be employed for empirical investigation in the future. For instance, empirical test can be done in a larger scale facilitated by surveys so as to enhance research validity. It is also interesting to study more about the externalities generated by port operations and development, and the issue of internalizing the externalities through a market process.

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