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Shipping design for compliance and the performance contingencies for shipping firms

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ABSTRACT

Increasing number of shipping firms adopt green shipping practices that emphasize environmental management throughout their operations. To balance productivity with the environment, the design of shipping activities in compliance with energy saving and resources conversation is an important part of greening efforts by many shipping firms. This study investigates how the green practices on shipping design for compliance (SDC) adopted by shipping firms is related to their financial and service performance with the role of company policy and procedures and shipper cooperation examined. We find that SDC is beneficial for the financial and service performance of shipping firms. Based on the contingency theory, we argue further that company policy and procedure as well as shipper cooperation differentiates the performance outcomes of shipping firms in their SDC for environmental management. Our empirical findings show a positive relationship of SDC with service performance particularly when their company policy and procedure and shipper cooperation are characterized at high than low levels in the process. However, such strengthening effects are not found for the relationship between SDC and the financial performance of shipping firms.

1. Introduction

Shipping is one of the world's most globalized industries playing a fundamental role in supporting international trade through transport of cargoes in a cost effective manner (Lun et al., 2013). While serving such an imperative role in facilitating international cargo movement, carbon emission by the shipping industry is estimated to increase in 20 years by 72% in 2020 by the International Maritime Organization (IMO) as world trade volume continues to grow (Vidal, 2007). Even though the shipping sector is not subject to the emission reduction requirement under the Kyoto Protocol,[1] shipping transport is acknowledged as a significant source of CO_2 emissions. Considering the potential harms caused to the environment, the shipping industry needs to curb the environmental damages arising from their activities, both locally and internationally. The importance of environmental concern has led many shipping firms to respond by embracing green shipping practices (GSPs) to improve operations efficiency while preserving the environment. Such development is driven and supported by giants in various business sectors, e.g., Carrefour, Home Depot, LUSH, IKEA, Marks and Spencer, Tesco, Wal-Mart, and so forth, to reduce environmental harms through improving routes and scheduling, modal shift, using alternative fuels. Container shipping firms such as Maersk Line have also committed to provide constant care for the environment with environmental protection policy to better utilize resources, improve operations, and reduce wastes. In addition to the industrial efforts, the IMO imposes protocol to prohibit deliberate emissions of environmentally depleting substances by ships (e.g., CO_2). Although compliance to the pro-

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[1] An international treaty agreed by the United Nations Framework Convention on Climate Change (UNFCCC) for prevention of global warming.

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tocol is expected, knowledge about the performance impact of such compliance is seriously lacking, and most importantly, under what conditions would such compliance be beneficial to business performance. This omission in the shipping literature is highly undesirable as it remains uncertain for shipping firms as to whether they may benefit from financial and service performance due to the compliance.

While shipping is closely related to logistics and supply chain management, prior studies on environmental management has primarily focused on logistics management as management practice (Lai and Wong, 2012), closed-loop supply chain (Wong et al., 2012a; Zhu et al., 2008b), and reverse logistics (Kocabasoglu et al., 2007). Until recently, there are studies examining CO_2 emission from international shipping (Heitmann and Khalilian, 2011) and marine energy consumption (Chang, 2012). Indeed, there are increasing public attentions on the link between transport and pollution in particular CO_2 emission caused by shipping activities. For instance, the European Commission has made a joint statement on emission from shipping on 1st October 2012. The Commission recognizes shipping as a global industry that needs global solutions to tackle the resultant environmental footprint. It plans to develop a system to monitor, report, and verify emissions on the basis of fuel consumption to embark on this green shipping initiative in 2013. There is also an Energy Efficiency Design Index (EEDI) developed by the IMO for application to new ships from 2015 onwards targeting to reduce their emissions.[2] The EEDI is a technical measure aiming to promote the use of more energy efficient (less polluting) equipment and engines from the design phase. Indeed, the IMO considers reduction of Greenhouse Gas (GHG) emissions by ships a high priority to address and develops the Energy Efficiency Operational Indicator (EEOI) as a voluntary tool for monitoring the operational transport efficiency of ships.[3] For reduction of CO_2 emission and consumption of fuel oil, the IMO has also adopted the Ship Energy Efficiency Management Plan (SEEMP) as an approach for shipping firms to better manage ship and fleet efficiency performance over time.[4] Ship owners and operators need to consider new technologies and practices when they seek to improve the performance of a ship under the SEEMP. Other than the concerns on CO_2 emissions, the IMO also has sulfur oxides (SOx) and particulate matter emission controls applicable to all fuel oil with the upper limit set at 1% level on July 2010 with stricter requirement at .1% level on January 2015 respectively inside the Emission Control Areas.[5] These different regulatory controls suggest that GHG emissions (CO_2, SOx, NOx, etc.) by shipping activities are pollution sources and the shipping industry has been responsive undertaking different measures to enhance energy efficiency, reduce fuel consumption, and control emissions. The importance of energy use and emissions in the international shipping sector receives increasing attention in a recent report on maritime transport by the United Nations.[6]

In view of the concerns on CO_2 emissions, scholars have established a transport cost model to determine whether to ship or produce locally from Korea to supply the automotive supply chains in the United States and European markets (Nieuwenhuis et al., 2012). The results show the local option rather than seaborne sourcing from home country is more preferable for lower emission. Other than shipping emission, fuel consumption is also an important challenge for the shipping industry to address (Qi and Song, 2012). These studies reflect that environmental harms are attributable to shipping activities and the problems should not be ignored. Therefore, it is timely to investigate greening for shipping activities that are important parts of global supply chain operations and how far these activities are friendly to the environment and to the bottom-line of shipping firms.

In environmental-based shipping research, past studies are confined to environmental technologies adoption to improve ecological efficiency of ships (Viana et al., 2009). Studies have also been conducted on the use of biofuels in shipping (Bengtsson et al., 2012). To mitigate shipping emission, (Chang, 2012) advocated a focus to enhance energy efficiency in designing ships engines and hulls. There are also investigations on environmental management in shipping contexts (Yang, 2012; Lun, 2011b; Wuisan et al., 2012). Nevertheless, little empirical knowledge is available on the performance impact of shipping design for compliance as well as the organizational conditions favorable for the greening effort on the design for compliance by shipping firms to bring performance outcomes. Such compliance in shipping pertains to energy saving shipping equipment design, shipping equipment reuse, recycling of waste, recovery of waste, and reducing environmental damages. This study answers two important research questions, "*What are the performance benefits of shipping design for compliance? Under what organizational conditions such greening effort on shipping design for compliance will bring better performance outcomes to shipping firms*?" The objective of this study is to investigate the performance impact of *shipping design for compliance (SDC)*, which is concerned with the design of operations and equipment in conformance with the control of energy consumption, waste, and pollution in shipping. SDC is valuable for shipping firms to reap performance gains by saving energy, reusing shipping equipment, recycling, and recovery of waste.

In answering these two questions, we examine both internal and external organizational attributes as they relate to the performance outcomes of SDC from the contingency theory perspective. The contingency theory suggests that performance is conditioned to the "fit" between the strategic practices of firms and their internal and external environmental conditions (Van de Ven and Drazin, 1985). This theoretical perspective views firms as an open system where firms face conditions and factors that may or may not be controllable. Firms will adapt their structures to strive for a "fit" with the different contextual

[2] (http://ec.europa.edu/clima/news/articles/news_2011071801_en.htm).

[3] IMO (2009), Guidelines for voluntary use of the ship energy efficiency operational indicator (EEOI), MEPC.1/Circ.684.

[4] IMO (2009), Guidance for the development of a Ship Energy Efficiency Management Plan (SEEMP), MEPC.1/Circ.683.

[5] Emission Control Areas (ECA) include Baltic Sea area, North Sea area, North American area, and United States Caribbean Sea area. The upper limit control outside the ECA is set at 3.5% level on January 2012 and at .5% level on January 2020, respectively.

[6] Review of Maritime Transport 2012, United Nations Conference on Trade and Development, United Nations, New York and Geneva, 2012.