



The effect of green supply chain management on green performance and firm competitiveness in the context of container shipping in Taiwan



Chung-Shan Yang^a, Chin-Shan Lu^{b,*}, Jane Jing Haider^c, Peter Bernard Marlow^c

^a Department of Aviation and Maritime Transportation Management, Chang Jung Christian University, No.1, Changda Rd., Gueiren District, Tainan City 711, Taiwan, ROC

^b Department of Transportation and Communication Management Science, National Cheng Kung University, No. 1, University Road, Tainan City 701, Taiwan, ROC

^c Logistics and Operations Management Section, Cardiff Business School, Cardiff University, Cardiff, UK

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ABSTRACT

This study empirically examines the relationships between internal green practices, external green integration, green performance, and firm competitiveness in the container shipping context. We collect data from a survey of 163 container shipping firms in Taiwan, and apply a structural equation model (SEM) to test the research hypotheses. We confirm that internal green practices and external green collaboration have positive impacts on green performance, which in turn helps to enhance firm competitiveness. The findings show that a firm's green performance and external green collaboration act as mediator variables between internal green practices and firm competitiveness, and they influence firm competitiveness positively. We also discuss in this paper the managerial implications for container shipping firms to improve their green performance and competitiveness.

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1. Introduction

The globalization of business has a tremendous impact on the way companies operate. Global operations require the integration of global manufacturing with efficient container shipping transport support for business success (Evangelista and Morvillo, 2000; Notteboom and Winkelmann, 2001; Lu, 2003; Lu and Yang, 2006). Maritime transport is a dominant mode of transport since over 90% of the global trade volume is carried by sea (IMO, 2008). Shipping plays an important role in providing low-cost and efficient transportation service. The world's total container ship deadweight tonnage (DWT) has increased from 11 million DWT in 1980 to 169.0 million DWT in 2010 (UNCTAD, 2010) reflecting the vital role of shipping in global supply chain management. At the same time, globalization has led to a much more intense global competition and changed the way shipping companies operate nowadays. To meet the increases in trade volume, cargo size and number of ships, the rapid growth in the maritime sector has raised serious concerns about its environmental impacts, i.e. hazardous/harmful/toxic materials, noise pollution, greenhouse gases, waste and demand on energy. As ships are getting bigger, the pollution is causing more and more problems. Marine oil spills can cause catastrophic damage to marine life, the components in crude oil are very difficult to be cleaned up, and can last for years in the sediment and marine environment (Panetta, 2003). Although discharging of cargo residues from carriers can pollute ports, waterways and oceans, and foreign and domestic regulations prohibit such actions, vessels still intentionally discharge illegal wastes. Ships also create noise

* Corresponding author. Tel.: +886 6 2757575x53243; fax: +886 6 2753882.

E-mail addresses: yangcs@mail.cjcu.edu.tw (C.-S. Yang), lucs@mail.ncku.edu.tw (C.-S. Lu), Haider@cardiff.ac.uk (J.J. Haider), Marlow@Cardiff.ac.uk (P.B. Marlow).

pollution that disturbs natural wildlife, and water from ballast tanks can spread harmful algae and other invasive species (Meinesz, 2003). Ballast water taken up at sea and released in port is a major cause of unwanted exotic marine life.

The International Maritime Organization (IMO) and the United Nations (UN) noted the negative impact of non-indigenous organisms transported in the ballast water of ships. Consequently, measures were taken with the aim to minimize ballast water mediated species invasions through IMO Marine Environmental Protection Committee (MEPC) Resolutions. As a result of long-term IMO efforts, it was determined that an international convention would best meet the needs of the global community, hence the International Convention for the Control and Management of Ships' Ballast Water and Sediments was adopted. The International Convention for the Prevention of Pollution from Ships (MARPOL) was adopted by IMO, it covers pollution by oil, chemicals, harmful substances in packaged form, sewage and garbage (Gollasch et al., 2007). The combined instrument is referred to as the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). The Convention includes regulations aiming at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations; it currently includes six technical Annexes. Protecting environment from shipping is not just about specific regulations in preventing ships from dumping oil, garbage or sewage. Shipping industries are required to improve the environmental performance of their transportation service to cope with the growing importance of global environmental issues. Environmentally friendly shipping has gained more and more interests in recent years because of increasing awareness of environmental issues such as climate changes, along with growing concerns for environmental impacts of shipping-related activities (Gavronski et al., 2011).

Container shipping, as a key link in the supply chain, is critical to the trade and transportation networks (Notteboom and Rodrigue, 2008). Like other economic sectors, the container shipping sector is facing a dual challenge in terms of green performance and firm competitiveness. To address this issue, many shipping companies have proactively addressed their environmental and related socio-economic responsibilities through developing environmental management systems. In particular, the interaction between environment and supply chains has become critical in the literature of shipping operations and environment (Darbra et al., 2004). Bacallan (2000) suggested that organizations could enhance their competitiveness through improving their green performance to comply with mounting environmental regulations, address the environmental concerns of their customers and stakeholders, and mitigate the environmental impact of their service activities. Green supply chain management is a concept that is gaining popularity in the container shipping industry. Green supply chain integration and collaboration promotes efficiency and synergy among business partners and strengthens corporations, it also helps to enhance environmental performance, minimize waste and save costs (Zhu and Sarkis, 2004; Rao and Holt, 2005; Vachon and Klassen, 2006; Zhu et al., 2007a; Darnall et al., 2008). Furthermore, the changing structure of global markets and consequently sustainable demands have forced container shipping service firms to remodel their business processes to be in line with shippers' environmental requirement needs. They have involved in green shipping management practice in order to effectively manage and eco-efficiently integrate transport service supply chain systems. While the green supply chain has been widely discussed (Sarkis, 2003; Zhu and Sarkis, 2004; Rao and Holt, 2005; Vachon and Klassen, 2006; Srivastava, 2007; Zhu et al., 2008), an investigation of green management practices and collaboration, and its relationship with green performance, and firm competitiveness in container shipping operations is lacking. This paper fills this gap by providing an empirically validated approach to identify the relationships of internal green practices, external green collaboration, green performance, and firm competitiveness in the context of the container shipping industry.

In this study, internal green practices can be defined as what is deployed by a firm in its daily, internal operations; these practices reflect the firm's decisions to act environmentally friendly (Azevedo et al., 2011), whereas external green collaboration of a firm can be explained as the direct involvement and interaction with its upstream suppliers, midstream partners, and downstream customers in the supply chain regarding joint environmental plans for environmental management and solutions (Vachon and Klassen, 2008). Wagner and Schaltegger (2004) described green performance as the reduction of a firm's environmental impacts, which is achieved by the coordination between its business and environmental concerns. Firm competitiveness refers to the economic strengths of a firm, and it primarily interfaces between the firm and the market (Murths, 1998; Rao and Holt, 2005).

There are five sections in this paper. Following this introduction the next section is a review of previous research on internal green practices and external green collaboration in container shipping operations. Six research hypotheses are postulated. The third section discusses the research methodology, including measures of the survey, sampling techniques, and research methods. Section four presents the analytical results of descriptive statistics, confirmatory factor analysis, and structural equation modeling. Conclusions drawn from the research findings and the implications for container shipping are discussed in the final section.

2. Theoretical background and research hypotheses

There are a growing body of previous studies have discussed the environmental issues in the supply chain (Sarkis, 1995; Green et al., 1996; Geffen and Rothenberg, 2000; Florida and Davison, 2001; Bowen et al., 2001; Handfield et al., 2002; Zhu and Sarkis, 2004). The most emphasis, however, has been placed on investigating the relationship between "green"/environmental factors and environmental/organizational performance (Geffen and Rothenberg, 2000; Handfield et al., 2002; Zhu and Sarkis, 2004; Rao and Holt, 2005; Lee and Klassen, 2008; Vachon and Klassen, 2008). Specifically, previous studies have been demonstrated the importance of internal green practices and integration, and external integration of green

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