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A Review of Research on Environmental Issues in the Logistics Industry

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Abstract: The logistics industry plays an important role in the global supply chain system. While environmental issues have become critical concerns all over the world, there is a challenge for logistics practitioners and academics to include environmental issues in logistics operations. However, scant attention was paid to environmental issues in the logistics industry. This article aims to understand the trends, gaps, and research opportunities of environmental issues in the logistics industry. Reviewing related literature suggests three broad research areas: the substance of environmental logistics practices, the determinants of environmental logistics practice adoption, and the consequences of implementing environmental logistics practices. Advice for logistics practitioners and opportunities of future research for academics are discussed.

Key words: *Environmental issues, logistics industry, literature review*

1. Introduction

While people are increasingly condemning behaviors that cause damage to the environment, environmental issues have become critical concerns all over the world. Many companies are constantly to comply with environmental regulations, to address the environmental concerns of their customers, to mitigate the environmental impact of their production and service activities, and to enhance their competitiveness through improvements in their environmental performance, (Bacallan, 2000; Srivastava, 2007). In the last two decades, environmental issues have become critical concerns of business research. A body of evidence reveals that, for the manufacturing sector especially, compliance with regulations, potential legal findings of financial liability for environmental damage, and increasing customer scrutiny of environmental effects related to product manufactures have made the environmental factor a key strategic variable with implications for the design of products, the design of processes, and business operating procedures.

A body of literature has concerned with environmental issues in manufacturing industries; however, the corresponding literature involving the logistics industry has been still small but expanding (Gunasekaran & Cheng, 2008; McKinnon, 1995; Murphy & Poist, 2000). It is not surprisingly that much research involving environmental issues at the industry level has focused on manufacturing sectors generally acknowledged as "dirtier" or "waster," most notably the energy industry, the chemical industry, the automotive industry, the forestry/pulp/paper industry, and the electronic industry. The service sectors are traditionally assumed to have a much smaller environmental impact (Ramus & Montiel, 2005). It is likely to expect that the firms most likely to formulate environmental plans are those in the manufacturing sector which may consume more natural resources and generate more contaminants, while firms in the service sector less likely to do so (Henriques & Sadorsky, 1996; Hutchinson, 1996). Although research on environmental issues in the manufacturing sector can provide some guidelines for the development of environmental management in the service industry, it is still required to conduct more research on environmental issues in the service industry, as firms in different industrial sectors may exhibit dissimilar attitudes toward environmental issues (Etzion, 2007; Henriques & Sadorsky, 1999; Zhu, Sarkis & Lai, 2008).

The logistics industry is a provider of logistics services that performs all or part of a client company's logistics functions including transportation, warehousing, packaging, and information flow. To fully satisfy the increasing requirements of customers for one-stop services, many logistics service providers have taken

initiatives to broaden the scope of their services (Murphy & Daley, 2001). In addition to transportation and warehousing functions, logistics service providers can also provide other services such as material management services, information-related services, and value-added services. To improve the operation efficiency of diversified logistics services, many logistics companies have continuously adopted various innovative technologies such as information and automation technologies (Lin & Ho, 2009; Sauvage, 2003). Furthermore, as many realize that customers and other stakeholders do not always distinguish between a company and its suppliers (Bacallan, 2000), more and more companies have started to undertake significant efforts towards establishing green supply chain management initiatives (Srivastava, 2007; Zhu et al., 2008). With the rapid development of the green supply chain management, the importance of environmental management for the logistics industry has increased dramatically (Skjoett-Larsen, 2000).

The concept of green supply chain management encompasses environmental initiatives in inbound logistics, production, outbound logistics, and reverse logistics, including and involving materials suppliers, service contractors, vendors, distributors and end users working together to reduce or eliminate adverse environmental impacts of their activities (Beamon, 1999; Vachon & Klassen, 2006). As the rapid growth of concerns on environmental issues leads to a dramatic rise in green supply chain, the logistics industry needs to pay more attention on environmental technologies and management systems to provide environmentally-friendly services. To deliver products and services to customers more environmentally, logistics companies need to address more efforts on environmental issues (Murphy & Poist, 2003; Sarkis, Meade & Talluri, 2004). For example, to reduce the emission of greenhouse gas as well as to save fuel consumption, United Parcel Service (UPS), a global logistics service provider, uses route-planning software and an internet matching system in their logistics service process. Some logistics companies begin to fuel their transportation vehicles with bio-diesel. Integrating environmental management and logistics services has become an important topic for the logistic industry.

The operation of logistics services often leads to several negative impacts on the natural environment, including air pollutants, hazardous waste disposal, solid waste disposal, fuel consumption, and others (Murphy, Poist & Braunschweig, 1994; Rondinelli & Berry, 2000). The logistics industry may be "dirtier" and "waster" than other service sectors (Skjoett-Larsen, 2000; Wu & Dunn, 1995). This suggests that it is necessary to study environmental issues in the logistics industry. Up to date, only a few researchers studied environmental issues for the logistics industry (Lin & Ho, 2011; Murphy & Poist, 2000, 2003; Murphy et al., 1994, 1995, 1996; Rodrigue, Slack & Comtois, 2001; Rondinelli & Berry, 2000; Szymankiewicz, 1993; Wong & Fryxell, 2004; Wu & Dunn, 1995). There is much space left for conducting research on environmental issues in the logistics industry. This paper aims to understand the needs, trends, gaps, and research opportunities of environmental issues in the logistics industry according to reviewing research on environmental issues in the logistics industry. This paper represents the analysis of studies related to the environmental issues in the logistics industry that emerged in several logistics journals: International Journal of Physical and Distribution Management, Journal of Business Logistics, Logistics Information Management, Transportation Journal, Transportation Research, Supply Chain Management: An International Journal. It is expected that the reviewed articles can provide sound advice for logistics operators and a rich stream of future research for academics.

2. Research on Environmental Issues in the Logistics Industry

A review of the literature indicates that research on environmental issues in logistics was virtually non-existence prior to 1990. However, since the International Journal of Physical Distribution & Logistics Management devoted a special issue to "environmental aspects of logistics" in 1995, the topic was of sufficient importance and relevance and research on environmental issues has appeared periodically in the logistics literature. However, among others, most research on environmental issues in logistics studied reverse logistics in the supply chain system of manufacturing sectors. Only a limited number of articles focused on environmental issues in the logistics industry. Szymankiewicz (1993) conducted a survey of the members of the Institute of Logistics and Distribution Management in UK to explore their attitudes toward environmental pressure, and their corporate and operational responses. The survey reveals that legislation, acknowledged by the members, is the main factor influencing their position on environmental matters, followed by customer pressure, lobby group influences and employee concern. The disposal of waste and packaging material and the noise and emission levels are the two major environmental issues challenging logistics operators. The practical actions that logistics companies are taking to reduce the impacts of their logistics operations on the environment include transport control, fuel efficiency, emission control, warehousing, office and administration, and packaging. However, that article can not bring us a thorough

idea of the antecedents and consequences of environmental innovation because of its lack of the study about the relationship between environmental pressure and logistics response.

Murphy et al. (1994; 1995; 1996) conducted a survey of the U.S. members of the Council of Logistics Management to explore their attitudes toward environmental issues relating to logistics operations, and their corresponding strategies. The results (Murphy et al., 1994) indicate that the two most important environmental issues relating to logistical operations are hazardous waste disposal and solid waste disposal, and the next in importance are reducing water pollution, reducing air pollution and energy conservation. Environmental issues will have the greatest impact on the logistical functions of salvage and scrap disposal and packaging, followed by transportation and return goods handling. Recycling materials, reducing consumption, and reusing materials are the three most common strategies for dealing with environmental issues in logistics. Murphy et al. (1995, 1996) address that while environmental issues are considered to be important for many companies, and they should take a proactive approach to managing environmental issues, logistics plays a prominent role in the implementation of environmental policy. The survey also shows that the most frequently cited reason for establishing environmental policies compliance with government regulations, followed by controlling environmental-related costs, societal expectations, minimizing liability for potential lawsuits, keeping up with competitors, and providing profit opportunities. Lack of resources, lack of perceived benefits, high costs of compliance, managerial indifference, and lack of top management support are the obstacles to establishing environmental policies. Companies with different environmental perspective (progressive, moderate, and conservative) will exhibit different degrees of attitudes toward environmental issues. Although these studies can give us some hints on the substance of environmental innovation as well as the factors influencing environmental innovation, they did not tell us to what extent the influences of these factors and the impacts of the implication of environmental policies will be.

Wu & Dunn (1995) provides an overview of environmentally responsible logistics activities in the entire supply chain. Based on some environmentally-friendly practices employed by several leading edge firms, such as Federal Express and UPS, they address that proper management and awareness of the environmental implications of logistics activities, including warehousing, materials handling, logistics network planning and management, order processing, and vehicles scheduling and routing, can significantly reduce the negative impact of pollutants and fuel consumption. However, to bring awareness of environmental issues to the transport and logistics community, their article only gives a description of what environmentally responsible logistics activities should be. The topic about antecedents and consequences of environmental innovation is a lack of that article.

Murphy & Poist (2000; 2003) conducted a multinational survey of the U.S., Canadian, and European Union members of the Council of Logistics Management to investigate the strategies used to manage and respond to environmental issues in logistics as well as to explore the potential relationships between company characteristics and the strategies for managing and responding to environmental issues. They have suggested twelve environmental strategies: (1) recycling materials whenever possible, (2) reducing consumption whenever possible, (3) reusing materials whenever possible, (4) conducting environmental audits, (5) publicizing environmental efforts/accomplishments, (6) increasing education and training of company personnel, (7) redesigning logistical system components for greater environmental efficiency, (8) promoting industry corporative efforts, (9) using outside or third parties to manage environmental issues, (10) rejecting suppliers who lack environmental concerns, (11) hiring/promoting environmentally conscious personnel, and (12) encouraging greater governmental involvement/regulation. Among these strategies, recycling materials, reducing consumption, and reusing materials were the three most commonly used green strategies for the respondents. Companies with different characteristics will place dissimilar emphases on environmental strategies. While these two articles can serve as a stimulus for further research dealing with the greening of logistics as well as provide a reference for describing the picture of environmental logistics practices, much still remains to be learned about the factors influencing the adoption of these environmental strategies and the impacts of the implication of these environmental strategies.

Rondinelli & Berry (2000) argues that economic globalization, speed-to-market product delivery, agile manufacturing and business practices, and integrated supply chain management have driven the demand for multimodal transportation infrastructure and intermodal logistics services; consequently potential environmental threats increase. They address that the major negative impact on the environment caused by intermodal logistics services is the generation of air, soil, ground water, and surface water contaminants.

The major sources include petroleum product disposal, organic hazardous air pollution emissions, water and soil pollution from waste solvents, cleaning and de-icing fluids, fuel spillage, degreasers, coolant releases, and solid and liquid wastes from terminal operations. To mitigate the negative environmental impacts of intermodal logistics activities, Rondinelli & Berry (2000) suggested an environmental management and information system for transportation. The article has reinforced the importance of environmental innovation as well as provided a possible solution for improving environmental performance for logistics service providers. However, the topic about antecedents and consequences of environmental innovation for logistics service providers is a lack of that article.

Rodrigue et al. (2001) provides an argument that environmental considerations do not conflict with profitability for the logistics industry based on an argument about the six green paradoxes (costs, time/speed, network, reliability, warehousing, and e-commerce) of logistics in transportation systems. They suggest that further government intervention promoting greater environmental regulation is important in developing green logistics. Environmental management systems, such as ISO 14000, may offer opportunities to green the logistics industry. That article only highlights descriptively the importance and practicability of green logistics; it did not give any empirical evidence on the influences of adopting environmental practices in the logistics industry. Wong & Fryxell (2004) analyzed the influences of stakeholder pressures on the adoption of environmental management practices for vehicle fleet companies (e.g. bus/taxi companies, movers and storage services, containerized freight services, air cargo services, freight forwarding contractors, furniture companies, and fuel supply companies) in Hong Kong. The stakeholder pressures come from government and environmental sources, media sources, community sources, competitive sources, and network sources. The environmental management practices include establishment of environmental policy, creation of a suitable organizational structure for attending to environmental issues, allocation of adequate resources to attain environmental objectives and targets, and management review. The results reveal that stakeholder pressures may partly affect significantly the implementation of environmental management practices. However, the research only investigated the influences of stakeholder pressures may on the adoption environmental practices for logistics service providers. The determinants of environmental innovation are diversified. In addition to stakeholder pressures, a further study on the influences of other possible determinant factors on the adoption of various types of environmental logistics practices is still required.

Lin & Ho (2011) analyzed the influences of technological, organizational and environmental factors on the adoption of green practices in Chinese logistics industry. The results reveal that these factors have positive influences on the willingness to adopt green practices. Moreover, explicitness and accumulation of environmental practices, organizational encouragement, quality of human resources, and governmental support exhibit significant influences on the willingness to adopt green practices for logistics service providers. Based on the research results, it is found that higher explicitness of green practices can help the transfer of technological knowledge within the organization and, consequently, can raise the willingness to adopt green practices. Logistics companies can also increase their adoption of green practices by encouraging or supporting their employees to environmental activities and by training and educating their employees to become environment-friendly workers. The government should provide financial incentives, pilot projects, and tax breaks to stimulate the adoption of green practices for logistics industry. In summary, the research to date is fairly sparse compared to the manufacturing industries. Only a limited number of research articles focused on environmental issues in the logistics industry in the literature while there has been an increase in the number of articles related to environmental management appearing in an amount of academic journals. This suggests that much remains to be learned about environmental issues in the logistics industry.

3. Discussion and Conclusion

This review examines research related to environmental issues in the logistics industry. All of the related research has taken place over the past two decades. Since there is not a large body of research on environmental issues in the logistics industry, the review is inclusive rather than selective. The research reported above includes a variety of investigations and several important findings. Some of these studies merely argued the importance of environmental issues for the logistics industry (Rodrigue et al., 2001; Rondinelli & Berry, 2000); some explored the environmental practices adopted by the logistics industry (Murphy & Poist, 2000, 2003; Wu & Dunn, 1995); and some introduced some possible factors that may

influence the adoption of environmental practices for the logistics companies (Lin & Ho, 2011; Murphy et al., 1994; 1995; 1996; Szymankiewicz, 1993; Wong & Fryxell, 2004).

As the above analysis illustrates, researchers are currently focusing on a limited range of issues and ignoring important areas. This review highlights the need for researchers to endeavor to raise the quality of research in environmental issues in the logistics industry. Although there is empirical research in the field, too much of this research is descriptive. Future logistics research would benefit from other methodologies such as field experiments to show causality, and relying on actual behavior rather than intended behavior. There is a gap between a sample of respondents filling out a form saying they intend to implement and what logistics companies actually implement. In addition, reviewing the published articles also highlights that research in this field needs more originality in both topics addressed and the research methods used. Having considered the majority of the peer-reviewed articles published on the topic these years, most research focus is currently much too narrow and that a broader research agenda would make the work more relevant to industry practitioners. Researchers should address a broader research agenda.

Environmental management provides a potentially important framework for understanding environmental change and is an important means of solving a country's ecological problems. Because environmental issues can be both technical and social (Etzion, 2007), it may be difficult to address a clear and uncontested definition of environmental management. Environmental management is a complex, dynamic and interactive process with many paradoxes, and is a multidisciplinary phenomenon and should be viewed from a technical, managerial and social perspective. It also involves international differences and synergies (Husted, 2005), as well as varying perspectives from governments, industry, society and a wide range of more specific stakeholders (Hellstrom, 2007). Substance of environmental management has been addressed by a number of researchers. In practice, environmental management has been defined in a variety of ways based on its implementation objectives. Murphy & Poist (2000; 2003) have suggested twelve environmental strategies for the logistics industry. Besides these environmental practices, there seems to be no other environmental management practices proposed for the logistics industry in the literature. A vast space is left for the research on investigating the substance of environmental management practices for the logistics industry.

As adopting environmental management practices can be regarded as an important means of solving firms' environmental problems, it is particularly important to learn more about the driving forces of environmental management. Murphy et al. (1995, 1996) have suggested some drivers and obstacles to establishing environmental policies for the logistics industry; but they did not argue the influences of these factors on the adoption of green management practices. Wong & Fryxell (2004) studied the influences of stakeholder pressures on the adoption of environmental management practices for vehicle fleet companies. Lin & Ho (2011) analyzed the influences of technological, organizational and environmental factors on the adoption of environmental practices in Chinese logistics industry. However, there is an amount of explanations as to why manufacturing firms should engage in environmental activities, including stakeholder pressure, environmental regulation, industrial sector, company size, mangers' characteristics, human resources, internationalization, organizational structure, corporate operation activity, environmental technology characteristics, position in the value chain, strategic attitude, and geographical location (Etzion, 2005; Gonzalez-Benito & Gonzalez-Benito, 2006; Pun, 2006). As all industrial sectors are not exposed to the same types of pressure or to the same extent, there is a clear research need to explore more potential factors that will influence the adoption of environmental management practices for the logistics industry.

It is generally perceived that environmental practices help to enhance environmental performance, minimize waste and achieve cost savings, and consequently promote efficiency and synergy among business partners and their lead corporations. Although a standardized green performance measurement model is useful for comparing the environmental performance of companies in different industrial sectors, it is also necessary to develop an industry-specific environmental performance measurement model on the basis of the industrial characteristics (Ramos & De Melo, 2006). There is still room for developing an environmental performance measurement model for the logistics industry. In addition, while environmental issues have been highlighted over the last decades, the link between being environmentally and being an economically successful company has also been a core topic of the corporate environmental management literature in the corresponding period of time. However, the link between environmental and economic performance is widely debated in the literature. One view is that improved environmental performance mainly causes extra costs for the firm and thus reduces profitability, whereas the opposite has been argued for that improved

environmental performance would induce cost savings and increase sales and thus improve economic performance. Theoretical and empirical research has provided arguments for both positions and has not been conclusive so far (Schaltegger & Synnestvedt, 2002). Although a number of studies explore the relations between environmental performance and economic performance, none of them examine the link between environmental performance and logistics service performance for the logistics industry. Therefore, a considerable space is left for the research on exploring the relationship between environmental performance and logistics service performance for the logistics industry.

3. Recommendations

According to reviewing research on environmental issues in the logistics industry, the analysis suggests three broad research areas: the substance of environmental management practices for the logistics industry, the determinants of environmental management practice adoption, and the consequences of implementing environmental management practices. Future research can put more efforts to clarify the substance of environmental management practices for the logistics industry, to verify the determinant factors influencing the adoption of environmental management practices for logistics companies, to develop an environmental performance measurement model for the logistics industry, and to explore the relationships among environmental management practices, environmental performance, and logistics service performance for logistics companies.

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References

Bacallan, J. J. (2000). Greening the supply chain. *Business and Environment*, 6(5), 11-12.

Beamon, B. M. (1999). Designing the green supply chain. *Logistics Information Management*, 12(4), 332-342.

Etzion, D. (2007). Research on organizations and the natural environment, 1992-present: A review. *Journal of Management,* 33(4), 637-664.

Gonzalez-Benito, J., & Gonzalez-Benito, O. (2006). A review of determinant factors of environmental pro-activity. *Business Strategy and the Environment*, 15(2), 87-102.

Gunasekaran, A., & Cheng, T. C. E. (2008). Special issue on logistics: New perspectives and challenges. *Omega: The International Journal of Management Science,* 36(4), 505-508.

Hellstrom, T. (2007). Dimensions of environmentally sustainable innovation: The structure of eco-innovation concepts. *Sustainable Development*, 15(3), 148-159.

Henriques, I., & Sadorsky, P. (1996). The determinants of an environmentally responsive firm: An empirical approach. *Journal of Environmental Economics and Management,* 30(3), 381-395.

Henriques, I., & Sadorsky, P. (1999). The relationship between environmental commitment and managerial perceptions of stakeholder importance. *Academy of Management Journal*, 42(1), 87-99.

Husted, B. W. (2005). Culture and ecology: A cross-national study of the determinants of environmental sustainability. *Management International Review,* 45(3), 349-371.

Hutchinson, C. (1996). Integrating environmental policy with business strategy. *Long Range Planning*, 29(1), 1-10.

Lin, C. Y., & Ho, Y. H. (2009). RFID technology adoption and supply chain performance: an empirical study in China's logistics industry. *Supply Chain Management: An International Journal*, 14(5), 369-378

Lin, C. Y., & Ho, Y. H. (2011). Determinants of green practice adoption for logistics companies in China.

Journal of Business Ethics, 98(1), 67-83.

McKinnon, A. (1995). Special issues on environmental aspects of logistics. *International Journal of Physical Distribution and Logistics Management*, 25(2), 3-4.

Murphy, P. R., & Daley, J. M. (2001). Profiling international freight forwarders: An update. *International Journal of Physical Distribution & Logistics Management*, 31(3), 152-168.

Murphy, P. R., & Poist, R. F. (2000). Green logistics strategies: An analysis of usage patterns. *Transportation Journal,* 40(2), 5-16.

Murphy, P. R., & Poist, R. F. (2003). Green perspectives and practices: A "comparative logistics" study. *Supply Chain Management: An International Journal*, 8(2), 122-131.

Murphy, P. R., Poist, R. F., & Braunschweig, C. D. (1994). Management of environmental issues in logistics: Current status and future potential. *Transportation Journal*, 34(1), 48-56.

Murphy, P. R., Poist, R. F., & Braunschweig, C. D. (1995). Role and relevance of logistics to corporate environmentalism: An empirical assessment. *International Journal of Physical and Distribution Management*, 25(2), 5-19.

Murphy, P. R., Poist, R. F., & Braunschweig, C. D. (1996). Green logistics: Comparative views of environmental progressives, moderates, and conservatives. *Journal of Business Logistics*, 17(1), 191-211.

Pun, K. F. (2006). Determinants of environmentally responsible operations: a review. *International Journal of Quality & Reliability Management,* 23(2/3), 279-297.

Ramoa, T. B., & De Melo, J. J. (2006). Developing and implementing an environmental performance index for the Portuguese military. *Business Strategy and the Environment*, 15(2), 71-86.

Ramus, C. A., & Moniel, I. (2005). When are corporate environmental policies a form of green washing? *Business and Society*, 44(4), 377-414.

Rodrigue, J-P. Slack, B., & Comtois, C. (2001). Green logistics (the paradoxes of). In A. M. Brewer, K. J. Button and D. A. Hensher (Eds.), The handbook of logistics and supply-chain management, Handbooks in transport #2. London: Pergamon/Elsevier.

Rondinelli, D., & Berry, M. (2000). Multimodal transportation, logistics, and the environment: Managing interactions in a global economy. *European Management Journal*, 18(4), 398-410.

Sarkis, J., Meade, L. M., & Talluri, S. (2004). E-logistics and the natural environment. *Supply Chain Management: An International Journal*, 9(4), 303-312.

Sauvage, T. (2003). The relationship between technology and logistics third-party providers. *International Journal of Physical Distribution and Logistics Management,* 33(3), 236-253.

Schaltegger, S., & Synnestvedt, T. (2002). The link between 'green' and economic success: environmental management as the crucial trigger between environmental and economic performance. *Journal of Environmental Management,* 65(4), 339-346.

Skjoett-Larsen, T. (2000). European logistics beyond 2000. *International Journal of Physical Distribution and Logistics Management,* 30(5), 377-387.

Srivastava, S. K. (2007). Green supply-chain management: A state-of-the-art literature review. *International*

Journal of Management Reviews, 9(1), 53-80.

Szymankiewicz, J. (1993). Going green: The logistics dilemma. *Logistics Information Management*, 6(3), 36-43.

Vachon, S., & Klassen, R. D. (2006). Extending green practices across the supply chain: The impact of upstream and downstream integration. *International Journal of Operations and Production Management,* 26(7), 795-821.

Wong, L. T., & Fryxell, G. E. (2004). Stakeholder influences on environmental management practices: A study of fleet operations in Honk Kong (SAR), China. *Transportation Journal,* 43(4), 22-35.

Wu, H-J., & Dunn, S. C. (1995). Environmentally responsible logistics systems. *International Journal of Physical Distribution and Logistics Management,* 25(2), 20-38.

Zhu, Q., Sarkis, J., & Lai, K. (2008). Green supply chain management implications for "closing the loop". *Transportation Research Part E*, 44(1), 1-18.