International Journal of
Supply Chain Management
(IJSCM)

THE EFFECT OF GREEN PRODUCT DESIGN AND INSTITUTIONAL PRESSURES ON MANUFACTURING FIRMS PERFORMANCES IN MALAYSIA : IMPLEMENTATION OF REVERSE LOGISTICS PRODUCTS

Kashveenjit Kaur

IPRJB
INTERNATIONAL PEER REVIEWED JOURNAL AND BOOK PUBLISHING

THE EFFECT OF GREEN PRODUCT DESIGN AND INSTITUTIONAL PRESSURES ON MANUFACTURING FIRMS PERFORMANCES IN MALAYSIA : IMPLEMENTATION OF REVERSE LOGISTICS PRODUCTS

[1] Kashveenjit Kaur,

Graduate Student: School of Business

Universiti Kebangsaan Malaysia, Bangi, 43600 Selangor, Malaysia

Corresponding Author's E-mail: Kashveenjit Kaur @ Knesh9@gmail.com

Abstract

Purpose: This study is to explore the empirical analysis of green product design and institutional pressures on firm's performances by employing from ISO14001 certified electrical and electronic manufacturing firms in Malaysia.

Methodology: The study has collected the data from the Electrical and Electronics (E&E) manufacturing firms in Malaysia certified with ISO 14001 through online survey questionnaire from the FMM-MATRADE Industry Directory for Electrical and Electronics 2019/2020, the sampling frame is 177 companies and a sample size of 122 with 89 return response using convenient sampling.

Findings: The results indicated that design for disassembly is necessary to produce valuable inventories from every product except of disposal whereas design for environment has slight influence on repair and disposal activities. As the evidence show that green product design, institutional pressure and reverse logistics product are inter-related, firms ought to undertake environmentally proactive approaches to generate benefits for the firm's overall performances.

Unique contribution to theory, practice and policy: Since manager's decisions and interactions take place within a social network that is affected by stakeholders, a theoretical perspective that accounts for the impact of the social climate, rather than simply the economic, rational perspective alone, is more encompassing and may better explain organizations' behaviors.

Keywords: *Green Product Design*,, *Reverse Logistics, Institutional Pressure, Organization Performance*

International Journal of Supply Chain Management
ISSN 2518-4709 (Online)
Vol.6, Issue 2, No.2, pp 12-30, 2021

1.0 INTRODUCTION

The ultimate progress and undergoing radical transformation in industrialization and economic development in the last two hundred years has accelerated the global interchange of people, goods, and information to such an extent that the natural environmental has been placed under a tremendous burden, exceeding its capacity for self-recovery. In recent years, the global warming issue has received a great deal of attention from both public and private organizations. Increasing global demand and industrialization causes land, water, and air pollution, and degrades natural resources (Huong, 1999). Firms are finding that they must deal with a high level of uncertainty, which is not only technical in nature. Accordingly, manufacturing firms face pressures from stakeholders, including end customers who prefer to buy eco-friendly products, along with a growing number of legal regulations that establish environmental standards for products, such as the Waste Electrical and Electronic Equipment Directive and the Restriction of Hazardous Substance Directive (Hu and Hsu, 2010; Shukla et al., 2009). The 2009 Copenhagen Climate Change Summit highlights the importance of energy-saving, emissions reduction, and low-carbon economy in global economic development. Generally, global business environment induces the adoption of green and sustainable products and processes through source reduction strategy. More than ever, consumers, business enterprises, and governments are paying increasing attention to sustainable development. Sustainable development is regarded as a vitally important business goal with a profound impact on firm competitiveness (Hart, 2005; Pfeffer, 2010). Sustainability is an emerging megatrend that has caused enterprises to rethink their strategies (Lee and Lam, 2012; Lubin and Esty, 2010) and has driven green innovation (Nidumolu et al., 2009). In response to sustainable development concerns about the integration of economics, environment and society (Carter and Rogers, 2008), reverse logistics (RL) is seen by many as a promising organizing concept that considers environmental elements in the management of returned goods (Álvarez et al., 2007; de Brito et al., 2002).

2.0 LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

In this section, the study reviews the extant literature and develops hypotheses with a view to achieving the research objectives outlined above. Fig. 1 graphically illustrates our proposed theoretical model, which captures green product design, institutional pressures, reverse logistics and firm's performance.

Green Product Design

Green product design is a knowledge-based resource (Mills et al., 2003) because intangible property such as talents, creativity or skills are developed and applied to fulfill demands of the current market and these sets of knowledge subsequently build competitive edge. According to Kuo et al. (2001), the goals of green product design are minimize use of non-renewable resources, effective management of renewable resources and reduce the volume of toxic emissions. Although these goals were adapted as measures of eco-design by Zhu and Sarkis (2007) and Eltayeb et al. (2010), design that reduces complexities associated with value recovery must be taken into account. Additionally, Green et al. (2012) argued that the design modification is commendable so long as there is no negative trade-off with other product design criteria, particularly cost and function ability. Products must be redesigned to reduce the impact of waste pollution and enhance assets recovery (Ayres et al., 1997; Van Hoek, 1999). Design team should collaborate with asset recovery division including collection centers or third party recyclers to counter reprocessing issues that deter recovery of invested material and energy. For this study, green product design is defined as 'corporate proactive approach for integrating product design and environmental considerations without compromising product's function and quality, including innovations for recovering product value throughout its life cycle prior to disposal.' This definition encompasses all elements highlighted by previous authors and emphasizes on the need to adopt environmentally proactive approach to attain business benefits from reverse logistics management. Literatures suggest that green product design (design for disassembly, design for environment and design for recycling) and resource commitment are associated with reverse logistics product disposition options (repair, recondition, remanufacture, recycle and disposal). Thierry et al.(1995) are pioneer authors who integrate design aspects related to disassemble ability and recyclability into products. On the other hand, Dowie (1994), Mathieux et al. (2008) and Bogue (2007) proposed that adjustments on choice of material, joints and product structure be taken into consideration to improve recoverability of products. For product repair and recondition, products are disassembled to access non-conforming subassemblies whereas product remanufacture requires most of their parts and components to be sorted, tested and graded to preserve product's quality. Apart from that, green product design focuses on environmentally friendly conducts such as avoid and or minimize use of heavy or toxic materials (Ninlawan et al., 2010; Zhu et al., 2007). Given the importance of design issues when recovering product returns of various conditions including those that have reached end of life or end of use stages, green product design ought to share a strong and positive relationship with reverse logistics. Therefore, this study hypothesizes that:

Hypothesis 1: Green product design is positively related to reverse logistics

Institutional Pressures

General management strategy and organizational behavior literature have been examining institutional pressures for a considerable time already, but applications in reverse logistics and supply chain management have been scarce (Koulikoff-Souviron and Harrison, 2008; Martınez-Costa et al., 2008; Miemczyk, 2008; Huang et al., 2010; Liu et al., 2010). Despite the acceptance of institutional environment as a critical factor to our field's development, the impact of institutional pressures on chain members' behavior remains largely unexplored (Cai et al., 2010). Certain sub areas are adopting institutional theory more than others. Specifically, it is becoming a major research direction to explain environmental related practices in supply chain management (Sarkis et al.,2011) and has been adopted to study implementation of quality programs and technology applications (Barratt and Choi, 2007; Nair and Prajogo, 2009; Liu et al.,2010; Heras-Saizarbitoria et al., 2011). Institutional theory is based on the premise that individuals and organizational structures become institutionalized through the formation of established, orderly, stable, and socially integrating patterns that add value, or constraints, to the firm's structure or activities (Scott, 2003). Since manager's decisions and interactions take place within a social network that is affected by stakeholders, a theoretical perspective that accounts for the impact of the social climate, rather than simply the economic, rational perspective alone, is more encompassing and may better explain organizations' behaviors (Scott, 1995). Regulations are generally considered to be the greatest source of external influence on a firm's reverse logistics activities (Stock, 1992; Carter and Ellram, 1998; Lewis and Harvey, 2001; Daugherty et al., 2002; Lai and Wong, 2012; Das and Chowdhury, 2012). Government officials in many parts of the world are paying close attention to environmental protection and sustainable development. Many governmental agencies have implemented standards and regulations that encourage resource reuse, which can be enhanced through reverse logistics (Kumar and Putnam, 2008). These laws and regulations exert institutional pressures on manufacturers to implement reverse logistics, and may have a profound impact on the attitudes and behaviors of top management (Murphy et al., 1995). Therefore, this study hypothesized that:

Hypothesis 2: Institutional pressures have positive influences on reverse logistics

Reverse Logistics

Though the conception of Reverse Logistics (RL) dates from long time ago, the denomination of the term is difficult to trace with precision. Terms like Reverse Channels or Reverse Flow already appear in the scientific literature of the seventies, but consistently related with recycling (Guiltinan and Nwokoye, 1974; Ginter and Starling, 1978). The Council of Logistics Management (CLM) published the first known definition of Reverse Logistics in the early nineties (Stock, 1992):

"…the term often used to refer to the role of logistics in recycling, waste disposal, and management of hazardous materials; a broader perspective includes all relating to logistics activities carried out in source reduction, recycling, substitution, reuse of materials. The previous definition is quite general, as it is evident from the following excerpts "the role of logistics in "and" all relating activities. In the same year Pohlen and Farris (1992) define Reverse Logistics, guided by marketing principles, as being: "… the movement of goods from a consumer towards a producer in a channel of distribution." Kopicky (1993) defines Reverse Logistics analogously to Stock (1992) but keeps, as previously introduced by Pohlen and Farris (1992), the sense of direction opposed to traditional distribution flows "Reverse Logistics is a broad term referring to the logistics management and disposing of hazardous or non-hazardous waste from packaging and products. It includes reverse distribution which causes goods and information to flow in the opposite direction of normal logistics activities."

In the end Rogers and Tibben-Lembke (1999) describe Reverse Logistics including the goal and the processes of the logistics and defined Reverse logistics as '… the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal' (Khor and Udin, 2013 ; Rogers and Tibben-Lembke, 1999). Horvath et al. (2005) indicates that RL refer to a set of programs or competencies aimed at moving products in the reverse direction in the supply chain. RL involves planning, implementing, and controlling an efficient, cost effective flow of raw materials, in-process inventory, finished goods, and pertinent information from consumption to retrieval or proper disposal of the product (Rogers and Tibben- Lembke, 1998). Other author refers to reverse logistics as activities that closes the supply chain loop (Talbot et al., 2007) or as activities that reuse, recycling and reclamation of materials from products and packaging (Eltayeb et al., 2010).

Hence, this study will adopt reverse logistics product return as the term that represents product recovery strategies which are industry and product-specific, where decision-making highly depends on conservable value in used products. At normal circumstances, product recovery is common because products flow backwards for several purposes and they include manufacturing-related, distribution-related and customer-related returns (Flapper, 2003; Rogers and Tibben-Lembke, 1999) which contain substantial residual value for resale at primary or secondary marketplace. In the Kocabasoglu et al. (2007) study, institutional pressure from top management towards involvement with the reverse supply chain was related to the reconditioning process, an aspect of product recovery. Therefore, this study hypothesizes that:

Hypothesis 3: Reverse Logistics have a mediating relationship between green product design and institutional pressures towards firm's performances**Performances**

Previous studies have shown that a well-managed reverse logistics reduces costs, increases revenue and improves customer service and satisfaction levels (Stock et al., 2002; Rogers and Tibben-Lembke, 1999). In addition, by implementing reverse logistics a firm gains intangible benefits associated with an improved corporate image, corporate social legitimacy and competitive advantages (Stock et al., 2002; Toffel, 2003;Wong et al., 2012). This study will examine two forms of performance: economic and environmental. Economic performance is associated with the financial impact of the firm's reverse logistics process (Klassen and McLaughlin, 1996). Environmental performance measures reflect the social and environmental benefits of a reverse logistics such as reduced environmental pollution, legislative compliance and the development of a corporate image as a socially responsible enterprise (Daugherty et al., 2001). Some researchers believe that reverse logistics process is a necessary evil since it forces manufacturers to spend additional costs, including production, logistics and depreciation costs (Padmanabhan and Png, 1995; Petersen and Kumar, 2009). Moreover, implementing and maintaining a product return system requires strategic planning and the investment of additional resources in facilities, training and operating activities; it can be viewed as a costly sideshow (Stock et al., 2002).

Although product return increase costs associated with additional processes and reverse logistics, it can also be beneficial since it may reduce customers' purchase risk and increase their repurchase behaviors (Petersen and Kumar, 2009). Hence, some researchers argue that a well-managed product return system generates revenue in excess of the costs incurred (Stock, 1998), by establishing flexible return policies, manufacturers can increase sales by encouraging retailers to order more products and mitigate retailers' risk simultaneously and increase customer service. Better customer service will lead to higher levels of customer satisfaction and customer loyalty, which will in turn result in enhanced future purchase intentions (Chen et al., 2009) and increased revenues. In addition, since ''each product has its own life cycle, and each return may require different treatment, depending on whether the product is defective, damaged, recyclable or repackageable'' (Meyer, 1999, p. 28), manufacturers are most knowledgeable about how to recycle parts and reduce environmental pollution through the return of used and defective products. Therefore, this study hypothesized that:

Hypothesis 4: Reverse Logistics have direct positive relationship economic and environmental performances.

International Journal of Supply Chain Management
ISSN 2518-4709 (Online)
Vol.6, Issue 2, No.2, pp 12-30, 2021

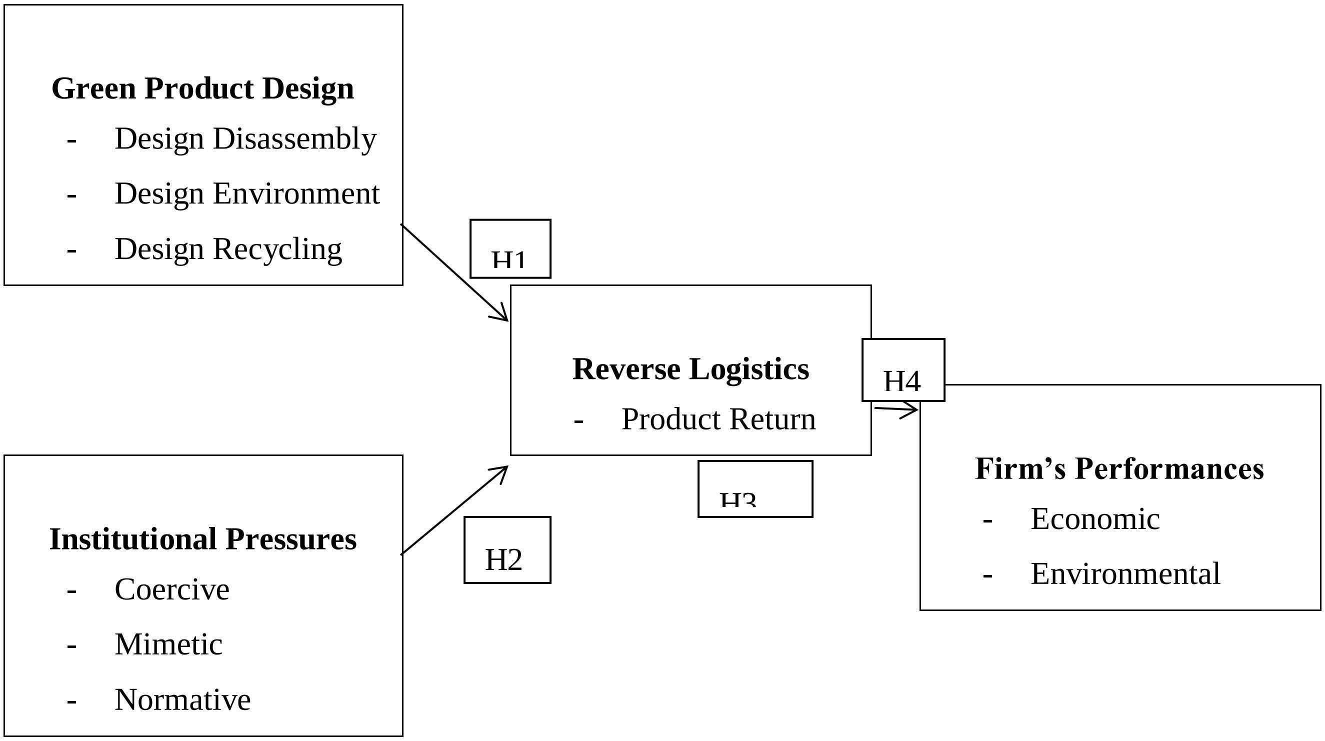

Figure 1: Conceptual Framework

3.0 RESEARCH METHODOLOGY

The survey targeted ISO 14001 certified E&E manufacturing firms operating in Malaysia because these firms are more conscious of the environmental impact exerted by its processes and products. Manufacturing organization is the unit of analysis and the representatives of this study are managers of Environmental, Health and Safety Department or environmental management representatives who are responsible to ensure IS0 14001 compliant environment management system. With reference to FMM-MATRADE Industry Directory for Electrical and Electronics 2019/2020, the sampling frame is 177 companies and a sample size of 122. Due to possibility of low response rate, the survey was done through online questionnaire to each population element to elevate the generalizability of findings. Some level of personalization such as over-the-phone conversations took place to address, brief and induce the interest of respondents. Softcopy of the survey questionnaire were mailed out to provide convenience to respondents and a series of periodic reminders derived a final sample of 89 organizations. Consequently, responses that return with unclear answers are followed up to reduce non-response error due to uncertainty or misinterpretation. Ten characteristics of firms and respondents were analyzed to identify significant differences between responses such as ownership status, length of business, number of employees, reverse logistics (products), reverse logistics (packaging), total current assets, average annual revenue of firms and designation, department and length of service of respondents. The questionnaire used for this study included four sections: institutional pressures, green product design, reverse logistics implementation and performance.

Forty-four items were used to measure the eight constructs. Based on institutional theory categorizations, seven items were used to measure three kinds of institutional pressures (A´ lvarez-Gil et al., 2007; Lewis and Harvey, 2001; Henriques and Sadorsky, 1999; Zhu et al., 2005) two for government pressure, two for customer pressure and three for competitor pressure. In total Nineteen items captured green product design towards reverse logistics implementation (Chatterjee et al., 2002; Daugherty et al., 2005; A´ lvarez-Gil et al., 2007). Reverse logistics constructs, product return were measured on the basis of three items according to logistics terms and prior literature (A´ lvarez-Gil et al., 2007; Skinner et al., 2008). The economic and environmental performance constructs were captured by 12 items (Daugherty et al., 2005; Zhu et al., 2005). An exploratory factor analysis (EFA) was employed to determine the main constructs measured by the items. Factors were extracted using principal components analysis and varimax rotation. Kaiser normalization was used to clarify the factors.

4.0 FINDINGS

The results of the EFA for each construct are shown in Tables 1–4. An analysis of the factor loadings for institutional pressures indicates that the first factor captures the respondents' general perceptions of government pressure, which includes government regulations on environmental protection along with subsidy and tax policies. The second factor gauges the respondents' perceptions of customer pressure and the third represents competitor pressure. These three factors explain 75.32% of the inherent variation in institutional pressures. The third factor analysis for green product design explained 71.63% of the variation. As for reverse logistics product return, were identified for reverse logistics implementation and explain 65.67% of the variation in reverse logistics implementation. The two performance factors, economic performance and environmental performance, explained 67.78% of the variation. As shown by the results in Tables 1–4, the reliability of these factors is supported. All Cronbach's alpha values are above the lower limit of 0.60 to ensure the internal consistency and validity of a construct (Nunnally and Bernstein, 1994). A confirmation factor analysis (CFA) model using the AMOS 7.0 was estimated to assess convergent and discriminant validity as in Table 5. In the model, each item is linked to its corresponding construct with freely estimated covariance. The model fit indices are Chi-square =571.73 with df=349, CFI=0.931, NNFI=0.932, IFI=0.932, RMSEA=0.055, and RMR=0.041, which suggest that the model is acceptable (Hu et al., 1992).

International Journal of Supply Chain Management
ISSN 2518-4709 (Online)
Vol.6, Issue 2, No.2, pp 12-30, 2021

Table 1: Factor analysis result for institutional pressures

Measurement	Government pressure	Customer pressure	Competitor pressures	Cronbach's alpha
Organization perspective	0.873	0.066	0.140	0.601
Tax and policy	0.788	0.235	0.208	
Rules and regulation	0.199	0.863	0.132	0.622
EMS	0.087	0.730	0.380	
Customer satisfaction	0.187	0.182	0.821	0.830
Market competitiveness	0.225	0.408	0.691	
Awareness of green	0.129	0.160	0.893	
Eigenvalue	1.53	1.56	2.18	
Total variance explained	75.32%			

International Journal of Supply Chain Management
ISSN 2518-4709 (Online)
Vol.6, Issue 2, No.2, pp 12-30, 2021

www.iprjb.org

Table 2: Factor analysis result for Green product design

Measurement	Design Disassembly	Design Environment	Design Recycling	Cronbach's alpha
Supplier relationship	0.875	0.457	0.600	0.666
Customer relationship	0.456	0.667	0.432	
Eco material	0.600	0.432	0.555	
Eco labelling	0.294	0.341	0.874	0.873
Supplier information	0.704	0.432	0.401	
Alternative material	0.559	0.754	0.342	
Packaging	0.552	0.403	0.453	0.664
Eco strategy	0.530	0.530	0.654	
Environmental products	0.313	0.432	0.333	
Waste management products	0.558	0.543	0.432	
Product classification	0.556	0.587	0.876	
Eigenvalue	2.18	1.56	2.78	
Total variance explained	71.63%			

International Journal of Supply Chain Management
ISSN 2518-4709 (Online)
Vol.6, Issue 2, No.2, pp 12-30, 2021

Table 3: Factor analysis result for Reverse Logistics

Measurement	Factor Loading	Cronbach's Alpha
Reuse product	0.8664	0.867
Recycle products	0.857	
Repair product	0.734	
Return product	0.148	0.661
Waste materials	0.133	
Reassemble products	0.171	
Eigenvalue	2.09	
Total variance explained	65.67%	

International Journal of Supply Chain Management
ISSN 2518-4709 (Online)
Vol.6, Issue 2, No.2, pp 12-30, 2021

Table 4: Factor analysis result for Performances

Measurement	Economic Performances	Environmental Performances	Cronbach's alpha
Reduce accident	0.653	0.270	0.923
Reduce toxic	0.703	0.286	
Reduce emission	0.816	0.118	
Reduce waste	0.724	0.345	
Reduce solid	0.739	0.337	
Improve sales	0.719	0.461	
Waste treatment	0.329	0.737	0.877
Waste discharge	0.212	0.755	
Improve social	0.251	0.888	
Improve share	0.334	0.788	
Transport	0.379	0.788	
Warehouse	0.306	0.801	
Eigenvalue	4.40	3.74	
Total variance explained	67.78%		

Variables	M	SD	1	2	3	4	5	6	7	8	9
Government Pressures	4.03	0.84	0.73								
Customer Pressures	3.78	0.78	0.38**	0.69							
Competitors Pressures	3.76	0.79	0.43**	0.57**	0.79						
Design Disassembly	3.12	1.01	1	0.457**	0.600	0.294**					
Design Environment	4.04	0.82	0.457**	1	0.432**	0.341**	0.428**				
Design Recycling	3.21	1.18	0.600	0.432**	1	0.231**	0.443**	0.364			
Product Return	2.45	0.77	0.08	0.10	0.08	0.10	0.20	0.07	0.75		
Economic Performances	3.79	0.71	0.22**	0.40**	0.43**	0.60**	0.046	0.14	0.75	0.77	
Environment Performances	3.96	0.70	0.30**	0.41	0.51	0.59	0.07	0.17	0.68	0.83	0.77

5.0 DISCUSSION

Hypothesis 1 stated that green product design is positively related to reverse logistics product (repair, recondition, remanufacture, recycle and disposal). In each of the three institutional pressures, government, customer and competitor has a statistically significant and positive relationship with reverse logistics implementation ($p<0.10$), hypotheses 2 are supported at the 10% significance level. In this study, the significant relationships between product return and both economic and environmental performance is ($p<0.01$), therefore, hypothesis 4 is acceptable. In the path of coefficient relating product return and economic performance is significant ($p<0.01$). In addition, product return is significantly related to environmental performance ($p<0.10$). Thus, the results of empirical analyses showed that environmentally sensitive designs, also known as green product design, are crucial product characteristics that elevate recoverability of electrical and electronic equipment. Instead of designing products that accommodate use of recycled material, design for disassembly must be taken into consideration for value recovery purposes whereas design for environment should be adopted for minimizing threat of e-waste to the natural environment.

Design for disassembly facilitates accessibility and reparability of modules, parts and materials with secondary market value (Guide et al., 2000; Krikke et al., 1998). This design aspect is a significant determinant to the effectiveness of product disposition options. Consistent with multiple recovery loop approach for minimizing volume of e-waste, usable constituents are inspected to reuse in new and/or used product assembly. If the types of joints, fasteners and connectors administered during product assembly were complex and difficult to separate, firms have to engage skilled labour to gather benefits from backward flowing products. Some assembly materials can only be separated by application of heat and force, such as welding, adhesives and mechanical joints (i.e. irreversible snap fits).

These joints challenged extraction of valuables as either both conjoined parts are susceptible to damages during disassembly or only part with more value is reused by preserving its aesthetic value at the expense of the other part. Disassemblability of products influences both time-sensitive recovery (repair, recondition, remanufacture) and cost-efficient recovery (recycle). However, this design factor is insignificant to disposal activities as returns with limited recoverable value are best shredded and crushed for recovery of precious materials. This study presents evidence on the importance of designing for the environment and influences of stakeholders initiatives towards enhancing their performances.

In regards to choice of materials used in EEEs, the avoidance and/or substitution of heavy metals or hazardous substances with environmentally compliant raw materials facilitate reduction of toxic emissions. Repair activities are made easier when design for environment is given attention because risks of exposures exerted by hazardous materials are minimized thus mitigating the complexity of handling environment and/or requirements. The desired parts and/or subassemblies can be conveniently separated and safely handled during asset recovery processes. As global environment have acknowledged the need to preserve environmental and human health, this design aspect plays a vital role in managing exposures related to disposable end-of-use or end-of-life EEEs. Unlike design for environment, design for recycling did not contribute significant influence on reverse logistics product options. Other than adjusting firm's preference in types of raw materials, product designers are advised to cluster compatible materials to ease identification of valuable, recyclable and recycled materials.

However, the absence of relationships between design for recycling and product disposition options may have resulted from manufacturer's disinterest towards product take-back except for manufacturing-related and distribution-related returns. This view is supported by Eltayeb and Zailani (2010), who revealed that manufacturers seldom accept products beyond sales except for commercial returns and are more inclined to execute minor reuse activity such as recycling of packaging. At the point of writing, design for recycling is not as well received as product safety and quality issues create daunting challenges to the use of recycled material. The findings of this study also observed that product repair activities gain cost-effectiveness with higher firm's performances.

Conclusion

This study investigates the antecedents and outcomes of reverse logistics implementation through a large-scale study. This study explores the antecedents of reverse logistics implementation from the perspective of institutional theory. Specifically, propose that reverse logistics is the mediator of the relationship between green product design and institutional pressures, government, customer and competitor – and performances. In addition, this study examines the relationship of reverse logistics implementation and the firm's economic and environmental performance. The empirical results suggest that the green product design, government, customers and competitors have statistically significant positive influences on reverse logistics towards firms' performances. We find that product return has a significant positive impact on both economic and environmental performance. Results of this study cannot be generalized to other industries because the nature of products manufactured by E&E industry sub-sector is different as compared to those of food and beverage, furniture, plastic, automotive, construction and service industry. Future study should consider the inclusion of non-ISO14001 certified E&E manufacturing companies to expand the sampling frame to obtain greater generalizability of findings. Additionally, future studies ought to investigate the effect of other predictors such as liberalized return policy (Autry, 2005), customer cooperation and green purchasing (Zhu et al., 2007), perceived environmental pressure and managerial environmental awareness (González-Benito, 2006) towards implementation of reverse logistics. The application of longitudinal study would be practical for tracking the progression of green product designing in facilitating reverse logistics practices. The development of green product design and reverse logistics capabilities are green supply chain practices that are parallel with the objectives of sustainable development via extended producer responsibility. It is recommended that future studies examine the influence other predictors such as liberalised return policy (Autry, 2005), reverse logistics program formalisation (Richey et al., 2005), technical and financial capability (Chan and Fang, 2007), organisational learning and management support (Zhu et al., 2008) in developing reverse logistics capabilities.

REFERENCES

Álvarez-Gil, M.J., Berrone, P., Husillos, F.J. and Lado, N. (2007), "Reverse logistics, stakeholders' influence, organizational slack, and managers' posture", Journal of Business Research, Vol. 60 No. 5, pp. 463-473.

Autry, C.W., Daugherty, P.J., Richey, R.G., 2001. The challenge of reverse logistics in catalog retailing. International Journal of Physical Distribution and Logistics Management 31 (1), 26–37.

Ayres R, Ferrer G, Van Leynseele T. (1997). Eco-efficiency, asset recovery and remanufacturing. European Management Journal.15(5):557–74.

Barratt, M. and Choi, T. (2007), "Mandated RFID and institutional responses: cases of decentralized business units", Production and Operations Management, Vol. 16 No. 5, pp. 569-585

Bogue R. Design for disassembly.(2007). A critical twenty-first century discipline. Assembly Autom ;27(4):285–9.

Cai, S., Jun, M. and Yang, Z. (2010), "Implementing supply chain information integration in China: the role of institutional forces and trust", Journal of Operations Management, Vol. 28 No. 3, pp. 257-268.

Carter C.R. & L.M. Ellram (1998), Reverse logistics: a review of the literature and framework for future investigation, Journal of Business Logistics, 19(1):85-102.

Carter, C.R. and Rogers, D.S. (2008), "A framework of sustainable supply chain management: moving toward new theory", International Journal of Physical Distribution & Logistics Management, Vol. 38 No. 5, pp. 360-387.

Chan S-C, Fang W.(2007).Antecedents and performance outcomes of environmental man- agement levels. In: Paper presented at the International Conference on Business and Information;

Chatterjee, D., Grewal, R., Sambamurthy, V., 2002. Shaping up for e-commerce: institutional enablers of the organizational assimilation of web technologies. MIS Quarterly 26 (2), 65–89

Chen, Y., Ganesan, S., Liu, Y., 2009. Does a firm's product recall strategy affect its financial value? An examination of strategic alternatives during product-harm crises. Journal of Marketing 73 (6), 214–226.

Daugherty, P.J., Autry, C.W., Ellinger, A.E., 2001. Reverse logistics: the relationship between resource commitment and program performance. Journal of Business Logistics 22 (1), 107–123

de Brito, M.P., Flapper, S.D.P. and Dekker, R. (2002), Reverse Logistics: A Review of Case Studies, Econometric Institute Report EI2002-21, Erasmus University Rotterdam.

Dowie T. Green design. World Class Des Manuf 1994;1(4):32–8.

Eltayeb TK, Zailani S.(2010). Green business among certified companies in Malaysia towards environmental sustainability: benchmarking on the drivers, initiatives and out- comes. International Journal of Environment Technology Management.12(1):95–125

Flapper SDP. Product recovery strategies. (2003). In: Guide VDR Jr, Van Wassenhove LN, editors. Business aspects of closed-loop supply chains. Pittsburgh, Pennsylvania: Carnegie Bosch Institute; p. 71–92.

Ginter P.M. and J.M. Starling (1978), Reverse distribution channels for recycling, California Management Review, 20(3):72-81.

Gonza´lez-Torre, P., Adenso-Dı´az, Artiba, H., 2004. Environmental and reverse logistics policies in European bottling and packaging firms. International Journal of Production Economics 88 (1), 95–104.

Green KW Jr, Zelbst PJ, Meacham J, Bhadauria VS. (2012). Green supply chain management practices: impact on performance. Supply Chain Management International Journal ;17(3):290–305

Guide, V.D.R., Jayaraman, V., Srivastava, R., Benton, W.C., 2000. Supply-chain management for recoverable manufacturing systems. Interfaces 30 (3), 125–142.

Guiltinan J. and N. Nwokoye (1974), "Reverse channels for recycling: an analysis for alternatives and public policy implications" in R. G. Curhan (ed.), New marketing for social and economic progress, Combined Proceedings, American Marketing Association.

Hart, S. (2005), "Innovation, creative destruction and sustainability", Research Technology Management, Vol. 48 No. 5, pp. 21-27.

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

Heras-Saizarbitoria, I., Landı´n, G. and Molina-Azorı´n, J. (2011), "Do drivers matter for the benefits of ISO 14001?", International Journal of Operations & Production Management, Vol. 31 No. 2, pp. 192-216.

Hsu, Y.-L., C.-H. Lee and V. B. Kreng (2010). "The application of Fuzzy Delphi Method and Fuzzy AHP in lubricant regenerative technology selection." Expert Systems with Applications 37(1): 419-425

Hu, A. H., & Hsu, C. W. (2010). Critical factors for implementing green supply chain management practice: an empirical study of electrical and electronics industries in Taiwan. Management Research Review, 33(6), 586-608.

Huang, X., Gattiker, T.F. and Schroeder, R.G. (2010), "Do competitive priorities drive adoption of electronic commerce applications? Testing the contingency and institutional views", Journal of Supply Chain Management, Vol. 46 No. 3, pp. 57-69.

Javier Gonzalez-Benito. The effect of manufacturing proactivity on environmental management: an exploratory analysis. International Journal of Production Research, Taylor & Francis, 2008, 46 (24), pp.7017-7038.

Khor KS, Zulkifli MU. (2012). Impact of reverse logistics product disposition towards business performance in Malaysian E&E companies. Journal of Supply Chain Customer Relationship Management ;19.

Klassen, R.D., McLaughlin, C.P., 1996. The impact of environmental management on firm performance. Management Science 42 (8), 1199–1214.

Kocabasoglu, C., Prahinski, C., & Klassen, R. D. (2007). Linking forward and reverse supply chain investments: The role of business uncertainty. Journal of Operations Management, 25(6), 1141–1160.

Kopicky R.J., M.J. Berg, L. Legg, V. Dasappa and C. Maggioni (1993), Reuse and Recycling: Reverse Logistics Opportunities, Council of Logistics Management, Oak Brook, IL

Koulikoff-Souviron, M. and Harrison, A. (2008), "Interdependent supply relationships as institutions: the role of HR practices", International Journal of Operations & Production Management, Vol. 28 No. 5, pp. 412-432.

Krikke, H. R., KOOI, E. J., and SCHUUR, P. C., 1998. Network Design in Reverse Logistics: A Quantitative Model.

KRIKKE, H. R., KOOI, E. J., and SCHUUR, P. C., 1999b. Network Design in Reverse Logistics: A

KRIKKE, H. R., KOOI, E. J., and SCHUUR, P. C., 1999b. Network Design in Reverse Logistics:

Kriwet A, Zussman E, Seliger G. (1995). Systematic integration of design-for-recycling into product design. Int J Prod Econ ;38:15–22.

Kumar, S., Putnam, V., 2008. Cradle to cradle: reverse logistics strategies and opportunities across three industry sectors. International Journal of Produc- tion Economics 115 (2), 305–315.

Kuo T-C, Huang SH, Zhang H-C. (2001). Design for manufacture and design for ‘X’: concepts, application and perspectives. Comput Ind Eng ;41:241–60.

Lee, C.K.M. and Lam, J.S.L. (2012), “Managing reverse logistics to enhance sustainability of industrial marketing”, Industrial Marketing Management, Vol. 41 No. 4, pp. 589-598.

Lewis, G.J., Harvey, B., 2001. Perceived environmental uncertainty: the extension of Miller’s scale to the natural environment. Journal of Management Studies 38 (2), 201–233.

Liu, H., Ke, W., Wei, K., Gu, J. and Chen, H. (2010), “The role of institutional pressures and organizational culture in the firm’s intention to adopt internet-enabled supply chain management systems”, Journal of Operations Management, Vol. 28 No. 5, pp. 372-384.

Lubin, D.A. and Esty, D.C. (2010), “The sustainability imperative”, Harvard Business Review, Vol. 88 No. 5, pp. 42-50.

Martı´nez-Costa, M., Martı´nez-Lorente, A. and Choi, T. (2008), “Simultaneous consideration of TQM and ISO 9000 on performance and motivation: an empirical study of Spanish companies”, International Journal of Production Economics, Vol. 113 No. 1, pp. 23-39.

Mathieux F, Froelich D, Moszkowicz P. ReSICLED. (2008). A new recovery-conscious design method for complex products based on a multicriteria assessment of the recov- erability. J Clean Prod ;16:277–98

Meyer, H., 1999. Many happy returns. Journal of Business Strategy 20 (4), 27–31

Miemczyk, J. (2008), “An exploration of institutional constraints on developing end-of-life product recovery capabilities”, International Journal of Production Economics, Vol. 115 No. 2, pp. 272-282

Mills J, Platts K, Bourne M. (2003). Applying resource-based theory: methods, outcomes and utility for managers.International Journal of Operation and Production Management,23(2),pp148-166

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 Distribution & Logistics Management 25 (2), 5–19.

Nair, A. and Prajogo, D. (2009), “Internalisation of ISO 9000 standards: the antecedent role of functionalist and institutionalist drivers and performance implications”, International Journal of Production Research, Vol. 47 No. 16, pp. 4545-4568.

Nidumolu, R., Prahalad, C.K. and Rangaswami, M.R. (2009), “Why sustainability is now the key driver of innovation”, Harvard Business Reivew, pp. 57-64.

Ninlawan C, Seksan P, Tossapol K, Pilada W. (2010). The implementation of green supply chain management practices in electronics industry. In: Paper presented at the International Multiconference of Engineers and Computer Scientists

Padmanabhan, V., Png, I.P.L., 1995. Returns policies: make money by making good. Sloan Management Review 37 (1), 65–72.

Petersen, J.A., Kumar, V., 2009. Are product returns a necessary evil? Antecedents and consequences. Journal of Marketing 73 (3), 35–51.

Pfeffer, J. (2010), "Building sustainable organizations: the human factor", Academy of Management Perspectives, Vol. 24 No. 1, pp. 34-45

Pohlen, T. L. and M. Theodore Farris (1992). "Reverse logistics in plastics recycling." International Journal of Physical Distribution & Logistics Management 22(7): 35-47.

Quantitative Model. Lecture Notes in Economics and Mathematical SYSTEMS, (Berlin:

Richey, R.G., Genchev, S.E., Daugherty, P.J., 2005. The role of resource commitment and innovation in reverse logistics performance. International Journal of Physical Distribution & Logistics Management 35 (4), 233–257.

Rogers, D. S., & Tibben-Lembke, R. S. (1998). Going backwards: Reverse logistics trends and practices. Center for Logistics Management, University of Nevada, Reno, Reverse Logistics Executive Council. 1998.

Sarkis, J., Zhu, Q. and Lai, K. (2011), "An organizational theoretic review of green supply chain management literature", International Journal of Production Economics, Vol. 130 No. 1, pp. 1-15.

Scott, W. (1995), "The adolescence of institutional theory", Administrative Science Quarterly, Vol. 32 No. 4, pp. 493-511.

Shukla, A.C., Deshmukh, S.G. and Kanda, A. (2009), "Environmentally responsive supply chains – learning from the Indian auto sector", Journal of Advances in Management Research, Vol. 6 No. 2, pp. 154-171.

Skinner, L.R., Bryant, P.T., Richey, R.G., 2008. Examining the impact of reverse logistics disposition strategies. International Journal of Physical Distribution & Logistics Management 38 (7), 518–539.

Stock J.R. (1992), Reverse Logistics, Council of Logistics Management, Oak Brook, IL

Stock, J.R., Speh, T., Shear, H., 2002. Many happy (product) returns. Harvard Business Review 80 (7), 16.

Talbot, S., Lefebvre, E., & Lefebvre, L. A. (2007). Closed-loop supply chain activities and derived benefits in manufacturing SMEs. Journal of Manufacturing Technology Management, 18(6), 627–658.

Thierry M, Salomon M, Van Nunen J, Van Wassenhove LN. (1995). Strategic issues in product recovery management. Calif Manage Rev;37(2):114–35.

Toffel, M.W., 2003. The growing strategic importance of end-of-life product management. California Management Review 45 (3), 102–142

Van Hoek RI.(1999). From reversed logistics to green supply chains. Supply chain management ;4(3):129–34.

Wong, C., Lai, K.H., Shang, K.C., Lu, C.S., Leung, T., 2012. Green operations and the moderating role of environmental management capability of suppliers on manu- facturing firm performance. International Journal of Production Economics 140 (1), 283–294.

Zhu Q, Sarkis J. (2007). The moderating effects of institutional pressures on emer- gent green supply chain practices and performance. Int J Prod Res ;45(18–19):4333–55.

Zhu, Q.H., Sarkis, J., Geng, Y., 2005. Green supply chain management in China: pressures, practices and performance. International Journal of Operations & Production Management 25 (5/6), 449–468.