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Research paper

The Driving Factors of GrSCM Adoption for Indonesian Electronic Industry

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Abstract

The application of Green Supply Chain Management (GrSCM) appears because of the increased awareness of the environmental impact of industrial development. GrSCM progress as an innovation environment that integrate environmental factors into supply chain management. Thus the company began to shift from traditional supply chain to green supply chain management. This study is focused on the development of GSCM in term of determining the driving factors affecting the adoption of GrSCM. Factor analysis is used to find the key factors considered in GrSCM implementation in Indonesian electronic industry. Results of this study can be identified that there are seven factors affecting the adoption of green supply chain management for electronic industry in Indonesia such as green procurement, waste management; green distribution, green marketing; green manufacturing, green design, and green environment.

Keywords: *Green supply chain, driving factors, adoption, electronic industry*

1. Introduction

Green Supply Chain Management (GrSCM) has known as an environmental supply chain innovation which integrates environment in supply chain management. Most organization currently considers GrSCM in their businesses as responsibility to sustainability of environment. They realize that the benefit by adopting green system in technology of their businesses will impact significantly to their supply chain, from supplier to end-customers. GrSCM has been accredited by the leading organization and become a new systematic approach in supply chain management. Research in GrSCM is categorized into 2 different topics, which are GrSCM framework and performance measurement (Ninlawan, Seksan, Tossapol, & Pilada, 2010).

While the positive impacts of adopting GrSCM on manufacturing activities which were stated clearly by most prior research in GrSCM, the discussion and the application of GrSCM particularly in Indonesian electronic manufacturers are not given much attention. Meanwhile, the growth of electronic industry in Indonesia has been increasing significantly. In term of manufacturing processes, electronics industry has also results some hazardous wastes which are very dangerous for human and environment. Moreover, the after-used products of electronic industry have bad impacts on environment due to chemistry hazardous and most of them are not recyclable. Therefore, it is essential to explore and determine the factors affecting GrSCM in Indonesian Electronic Industry.

The objective of this article is to determine the critical factors affecting the application of green supply chain management for the Indonesian manufacturers. This article focuses on the development of GrSCM in Indonesian electronics industry which is currently progressing significantly in the numbers of manufacturers and demand, imported components and the level of environmental impact.

2. Literture Review

Green supply chain management

Green Supply Chain Management (GrSCM) is a sustainable development for enterprise which has emerged as a new important innovative SCM approach for organization to achieve simultaneously financial benefit and environmental benefit in order to reduce the negative impact (Van Hoek, 1999). Chin et al. (2015) defined GrSCM as a concept to integrate SCM with environment thinking which has the aims to reduce wastes, emissions, energy and wastes. Prior research proves that there is a relationship between the application of green manufacturing and green logistics; which are part of GrSCM components, and financial performance of the firm (K. Y. Tippayawong, Tiwaratreewit, & Sopadang, 2015). It is also supported by the research by Yee Phuah (2015) which indicated that reaching the balance of financial and environmental performance of SC is the point of GrSCM adoption.

2.1. Green Procurement

GP is the starting point of SCM channel that has been discussing intensively in term of the drivers of the implementation of GP, barrier of GP practices, and the implication of GP implementation. In this study, GP is focused on the drivers which motivate firm to adopt GP. Previous researches discussing green procurement are numerous, for instance, Zhu & Geng (2013). This study has measured 3 kind of drivers developed by DiMaggio and Powell (1983), which are coercive, normative and mimetic, has motivated or not for extended supply chain in energy saving and cost reduction. Moreover, 5 drivers of GrSCM have been identified as GrSCM capabilities, the purchasing strategy, the commitment to environment, the assessment of green supplier, and the level of green supplier's collaboration (Large & Gimenez Thomsen, 2011).

2.2. Green manufacturing

Green manufacturing has became as a heated topic discussed intensively in the recently decades in term of its contribution to GrSCM. The main goal of the activities in green manufacturing is reducing the negative impact of manufacturing processes in which in the same time, minimizing the use of resources. Dornfeld et al. (2013) believed that the environmentally consideration in the manufacturing processes involve remanufacture, reduce and reuse/remake. Moreover, the indication of minimizing resource uses of adopting green manufacturing activities could be indentified as minimizing the use of fuel while machining, reducing the use of power and energy, selective material handling equipment selection (Saputro, Masudin, & Daneshvar Rouyendegh, 2015) and considering rework-raw material in production processes.

The adoption of green manufacturing has a significant influence in supply chain management. Previous studies discussed factors affecting the implementation of green manufacturing in the different perspective such as methods, approaches, type of firms and framework models. Govindan et. al (2015) found that there are 12 factors should be considered as adopting green manufacturing such as regulation, stakeholders, customers, eco-design, competitor and investor pressure.

2.3. Green Distribution and Out-Bound Logistics

Kam et al. (2006) believed that type of transport, fuel source and consumption, operational and organizational practices of distribution activities are the required parameters need to be considered in order to deal with green transportation. Other study by Demir et al. (2014) who found that that emission and fuel consumption are contributed by different level of planning for road freight transportation. The identification of the possible destination of the returned products is the basic concept of reverse logistics, where the activities involved in reverse logistics can be named as repair, reutilization, reprocessing, recycling and reuse (Thierry, Salomon, van Nunen, & van Wassenhove, 1995). There 2 parties which are involved in reverse logistics activities as the products are started to be moved back from supply chain, they are the returner party and the receiver party (de Brito & Dekker, 2004).

2.4. The Implementation of Green Supply Chain in Electronic Industry

Electronic industry in most countries plays a significant role in national economic income. In the developing and developed countries, in spite of its contribution to national economic growth, electronic industry also has potential environmental issues along the supply chain channels. Thus, the discussion of the concept and driving factor of GrSCM practices in electronic industry has been progressing recently. Rahman and Subramaniam (2012) modeled a framework for end-of-life of computer operations and investigated the driving factors in implementing recycling operation of supply chain in Australian electronic industry. Chen and Liang (2012) studied the implication of adopting green supply chain in Taiwanese computer industry and found that by implementing GrSCM, most computer industry in Taiwan has influenced internal cost function and cost benefit of firms. A study by Ninlawan et. al (2010) deals with evaluation of GrSCM in term of green procurement, green manufacturing, green distribution and reverse logistics activities in Thailand's computer industry. Tippayawong et al. (2015) used 5 main areas of supply chain such as procurement, manufacturing, transportation and distribution, reverse logistics and greening processes based on the score model.

3. Methodology

This article is an exploratory study, which explore the relation between variables and test the defined hypothesis (Singarimbun, 1999). In this quantitative research, the proposed variables are collected based on the questionnaire where respondents are required to answer questions regarding supply chain activities in their companies. In this study, the population is the whole electronic in Indonesia while the number of electronic industry in Eastern Java can be represented as the sample of population. The number of electronic manufacturer in Eastern Java reaches 24, which is the biggest number of electronic manufacturer in Indonesia. However, of the 24 electronic industries in Eastern Java, there are 5 biggest electronic manufacturers which play significant role in this area.

Table 1 Five biggest electronic manufacturers in Indonesia

No	Name	Industry
1	Panasonic Lighting Indonesia, Ltd.	Electronic
2	Yamaha Musical Products Indonesia, Ltd.	Electronic
3	PT Yamaha Electronics Manufacturing Indonesia , Ltd.	Electronic
4	Jatim Autocomp Indonesia, Ltd	Electronic
5	Maspion, Ltd.	Electronic

The respondents who filled in the questionnaires are chosen from those five biggest companies who worked in logistics and supply chain activities. The proposed number of respondents in this research are 50 managers or supervisors their specifics areas.

3.1. Conceptual Framework and Empiric Indicators of GrSCM

Theoretically , prior research involve five main variables affecting the application of GrSCM as GP (Prahalad and Hamel, 1990; Vonderembse & Tracey, 1999; Hsu et al. 2006), green manufacturing (Srivastava 2007; Ninlawan et al 2010 and Li and Wang, 2008) , green marketing (Peattie, 1992; Walter, 1993; Beattie, 2009 and He, 2006), green distribution (Liu, 2008; Todd, 2009) and waste management (Lippmann 1999; Evans and Johnson 2005; Handfield et al 2005; Hu et al 2010). Based on the theory of GrSCM discussed by previous research, it can be described clearly in Figure 1.

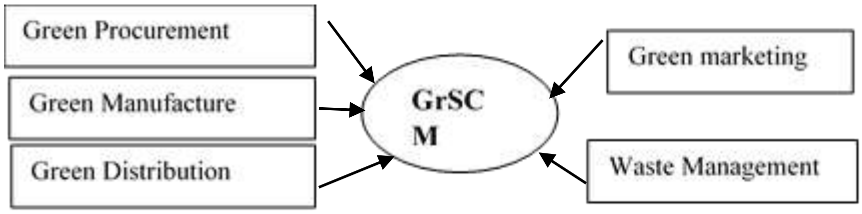

Fig 1: Conceptual Framework of GrSCM

From the conceptual framework and the discussion of previous research, this research attempts to answer the following research statements as 1). The independent variables as green procurement, green manufacture, green distribution, green marketing and waste management are the GrSCM components. 2). Those five independent variables are the most affecting in application of GrSCM in Indonesian Electronic industry. In this study, statistical data analysis is using SPSS to determine the descriptive values of statistics, non response bias, reliability and adequate of data test are also done before the analysed by factor analysis, which has the objective to find the relationship among the independent variables and form into smaller clusters.

4. Results and Discussion

A total of 40 responses from respondents are received for data analysis. The data attribute of total score from Indonesian electronic manufacturers which are represented by their managers who response 57 assessments are shown in Table 2.

Table 2: Data attributes of total score from Indonesian electronic manufacturers

Item	Value
Demography of respondents	
Mean	176.1750
Standard deviation	29.27052
Variance	856.763
Lighting	50%
Computer	12.5%
Kitchen appliance	12.5%
Music instrument	25%

The first test of validity uses coefficient correlation of pearson indicates that 11 assessment have value < 0.139 which are not valid. Tabel 3 shows the re-validity testing by reducing invalid assessment.

Table 3: Test of validity results

No	Indicator	Person correlation	Status
X.1	Environmental standard in supplier selection	.778**	Valid
X.2	Regulation-based audit for supplier environmental components	.756**	Valid
X.3	Considering ISO 14000, OHSAS for supplier selection	.574**	Valid
X.4	Selecting supplier based on the firm's standard	.664**	Valid
X.5	Selecting supplier which have eco-green certificate	.666**	Valid
X.6	Adopting just in time in term of supplier cooperation	.705**	Valid
X.7	Cooperation with supplier for environmental purposes	.595**	Valid
X.8	Green packaging	.562**	Valid
X.9	Paperless order	.520**	Valid
X.10	Cooperation with supplier to reduce packaging	.402*	Valid
X.11	Substitute components such as silver with other eco-material	.467*	Valid
X.12	Substitute components as mercury with other eco-material	.533**	Valid
X.13	Substitute components such as gold with other eco-material	.542**	Valid
X.14	Substitute components such as zinc with other eco-material	.488*	Valid
X.15	Water treatment for chemist products cleaning	.719**	Valid
X.16	Water quality control before using	.461*	Valid
X.17	Environmental consideration trough 3Rs	.444*	Valid
X.18	Reduce unnecessary material	.626**	Valid
X.19	Eco-product design considering low hazardous material	.426*	Valid
X.20	Eco-design product by reducing wastes and costs	.669**	Valid
X.21	Minimizing wastes during production processes	.434*	Valid
X.22	Reducing setup time	.404*	Valid
X.23	Omitting secondary processes	.499*	Valid
X.24	Saving package	.548	Valid
X.25	Using green package	.477*	Valid
X.26	Minimizing loading and unloading time	.410*	Valid

X.27	Enhancing to use recycle package	.469*	Valid
X.28	Promoting recycle package	.414*	Valid
X.29	Direct delivery to customers	.552	Valid
X.30	Using alternative fuel of vehicle	.494*	Valid
X.31	Efficient in production time	.443*	Valid
X.32	Re-inspection before delivery	.435*	Valid
X.33	Transparent in green promotion	.519*	Valid
X.34	Promoting to customers that green is important	.445*	Valid
X.35	Helping customers to improve environment productivity	.464*	Valid
X.36	Helping customers in term of environmental demand	.496*	Valid
X.37	Information to new staff about environmental issues	.633	Valid
X.38	Interaction among departments in environmental productivity	.528	Valid
X.39	The use of eco-information system in product marketing	.419	Valid
X.40	Cooperation with customers for green package	.433*	Valid
X.41	Preventive program for pollution	.583**	Valid
X.42	Evaluation system on internal environment productivity	.535	Valid
X.43	Producing environmental internal report	.461	Valid
X.44	Compensation of environmental productivity for management	.474*	Valid
X.45	Compensation in term of environmental productivity for staff	.474	Valid
X.46	Support for GSCM application for managers in the low level	.600**	Valid

The reliability of the construct in this study is tested using Cronbach's alpha test (see table 4). A total of 46 assessments are provided to respondents are tested and found that the constructs provided to respondents are reliable.

Table 4: Reliability analysis (cronbach's alpha test)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.728	.947	46

Table 4 shows the reliability value uses Cronbach's alpha, which indicates that all the value of the questions are acceptable (Alpha > 0.700) or reliable.

Table 5: Data Attributes of KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.744
Bartlett's Test of Sphericity	Approx. Chi-Square	1611.709
	df	630
	Sig.	.000

The final value of KMO shown by Table5. It is shown that KMO value is 0.744 (> 0.50) which indicates that 46 variables are valid to be proceed for the next stage.

4.1. Factor Analysis

This stage is determining the significant loading factors to categorize the variables into suitable group. The value of loading factor is defined as significant with the number of sample at least 50 respondents with α = 0.05 is 0.55. Table 6 shows the value of loading factors for each variable, such as variable X6 has the highest loading factor, reaching 0.854 in the group 1, while in the group 2, X6 has low loading factor value. Therefore, variable X6 is put in the group 1 rather than in group 2.

Table 6: Loading factor values

Factor	*Eigen value*	Variables		*Loading Factor*	
1	7.989	X4	X17	0.529	0.473
		X10	X30	0.654	0.781
		X12	X40	0.714	0.756
		X16		0.589	
2	5.542	X11	X46	0.481	0.597
		X18	X55	0.636	0.700
		X29	X56	0.608	0.498
		X44		0.734	
3	3.103	X1	X6	0.528	0.586
		X2	X8	0.542	0.526
		X3	X14	0.490	0.774
		X5	X15	0.589	0.644
4	4.669	X26	X35	0.665	0.558
		X34	X36	0.745	0.820
5	5.945	X39	X47	.673	.755
		X45	X51	.603	.546
6	3.51	X28	X50	.555	.653
7	1.725	X21	X27	.660	.543
		X23		.694	

The results from the stage of clustering the factors are used to clarify the clusters of variables using Rotated Component Matrix (RCM). The results of RCM show the distribution of each variable can be categorized into 7 clusters (see table 6).

4.2. Re-structuring and Naming Clusters

Based on the clustering process, restructuring the variables into clusters hat fit with the value of loading factors. Naming the clusters that represents the variables involves such as green procurement for cluster 1, waste management (cluster 2), green distribution for cluster 3, green marketing (cluster 4), green manufacturing (cluster 5) and green design and green environment for cluster 6 and 7, respectively.

Table 7: Restructuring and naming clusters

No	*Eigen value*	Var	*Loading factor*	Cluster	No	*Eigen value*	*Var*	*Loading factor*	*Cluster*
1	7.989	X4	.529	*Green Procurement*	4	5.542	X11	.481	*Waste Management*
		X10	.654				X18	.636	
		X12	.714				X29	.608	
		X16	.589				X44	.734	
		X17	.473				X46	.597	
		X30	.781				X55	.700	
		X40	.756				X56	.498	
2	3.103	X1	.528	*Green distribution*	5	5.945	X39	.673	*Green manufacture*
		X2	.542				X45	.603	
		X3	.490				X47	.755	
		X5	.589				X51	.546	
		X6	.586						*Green design*
		X8	.526		6	3.51	X28	.555	
		X14	.774				X50	.653	
		X15	.644						
3	4.669	X26	. 665	*Green Marketing*	7	1.725	X21	.660	*Green environment*
		X34	. 745				X23	.694	
		X35	.558				X27	.543	
		X36	.820						

5. Conclusion

This article analyzes the driving factors affecting the adoption of green supply chain management (GrSCM). Variables in this article are proposed and constructed based on Indonesian electronic industry. It is clear from the results that there 7 keys factors that should be considered as adopting GrSCM such as green procurement, waste management, green distribution, green marketing, green manufacturing, green design and green environment.

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