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The Influence of Green Supply Chain Management (GSCM) on Environmental Performance: Case Study of Automotive Industry in Malaysia

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Abstract

The use of the green concept in the automotive industry and its practice in Supply Chain Management (SCM) as an energy-efficient transport innovation, and to improve environmental performance context has the potential to alleviate environmental issues. Green Supply Chain Management (GSCM) can be defined as bringing together environmental thinking into SCM. The need for GSCM especially in the automotive industry is due to the increasing environmental constraints due to global warming as well as pollution from the transportation and industry activities as the major contribution. Numerous companies have recently recognised the term GSCM, also known as 'supply chain environmental management'. However, little research has been done on the relationship between environmental performances. Thus, this study aims to bridge the gap by modelling the green innovation drivers on the Malaysian automotive industry and their impact on environmental performance. This study also provided empirical evidence that will allow companies to implement green supply chain management in order to improve environmental efficiency. The information gathered through a questionnaire survey from Malaysia's automotive industry sectors. The data analysed using structural equation modelling. Findings could help the automotive industry to build a systematic blueprint in controlling their green innovation practices towards increasing their productivity.

Keywords: Green Innovation, Automotive Industry, Environmental, Performance, Green Supply Chain Management

Introduction

Green supply chain management (GSCM) can be defined as bringing together environmental thinking into supply chain management (SCM). GSCM which considers environmental issues is the extension of the traditional SCM. Slack et al (2009) defined SCM as the linked operations to the source and the provision of goods and services to the end-users. Meanwhile, the GSCM concept is defined as the achievement of economic, environmental, and social goals in the systemic coordination of key inter-organizational business processes to boost the performance in the long term for the organization and its partners in the supply chain (Ageron, et al., 2012). GSCM proves to be a concerted effort across the enterprise and it is more than simply carrying out some ecological practices, but rather a coherent approach to improve both the environmental and organizational performance of all management levels (Zhu, et al., 2007). Srivastava (2007) defined GSCM as integrating environmental considerations into SCM and these considerations include product and service design, procurement, manufacturing processes, distribution, and end-of-life management of the product to attain sustainable competitive advantage.

The need for GSCM especially in the industry is due to the increasing environmental constraints due to global warming as well as pollution from industrial activities. GSCM is also beneficial for organizations and corporate social responsibility. Furthermore, GSCM boosts eco-friendly elements and increases the stakeholders' environmental awareness. The core of GSCM lies in the principle of reducing waste by increasing efficiencies. Effective resource and supplier management can lower production costs, promote recycling and not to mention reuse the raw materials (Carter & Rogers, 2008). GSCM is a progressively widely diffused practice among companies that are seeking to improve their environmental performance. Businesses have adopted the concept of GSCM to improve their competitive advantage and to respond to the increasing global awareness. At the same time, GSCM is able to protect the environment and it is a progressively widely diffused practice among companies. This green alternative could help the industry to become more competitive, but how far GSCM will influence the condition of Malaysian manufacturers when the condition did not achieve some standards of quality, is still yet to be known. The GSCM truthfully helps the industry to become competitive with other developing countries.

Green growth has become one of the main requirements by the governments and communities that companies need to fulfil to sustain and succeed in the market. However, transforming to be a green company comes with challenges that need to be handled. In this regard, green innovation has been documented to be the companies' driver towards attaining a sustainable green economy. In Malaysia, there is a serious effort to boost up the level of green innovation performance among the industry players. Implementing GSCM in a developing country like Malaysia is still seen as a major problem due to several barriers. The automotive industry is the main industry in Malaysia with a support chain. More than 10% of the total workforce is employed within this industry. Stakeholders and regulatory agencies are putting pressure on automotive industries to ensure sustainability due to increased concern about environmental pollution. Consequently, Malaysia is emphasizing economic development and at the same time, it is trying to emphasize environmental and social protection. These forces created a balance on the economic, environmental and social performance of companies. For this reason, green initiatives and policies should be developed for any company to overcome these challenges and ensure sustainability.

This study will help determine whether or not adopting these environmental measures towards automotive related suppliers is worth the effort of these automotive-related suppliers in terms of environmental performance. In addition, the relationship between GSCM practices in environmental performances may be moderated by other organizational practices. The fact that enthusiasm for green manufacturing is expanding tremendously within research and industrial communities shall be emphasised. This research could be considered as part of the initiatives and guidelines for other ASEAN countries and that could pave the way to identify appropriate policies to enhance the quality of green city urban systems within the Malaysian context.

Literature Review

Previous studies highlighted that a positive relationship between GSCM and competitive advantage and environmental performance was discovered (Wahab et al., 2018). This study attempts to see whether or not GSCM will influence the automotive industry in Malaysia to become more competitive or vice versa. In terms of the new construct, this study extends the GSCM framework by including “environmental performance” to the new GSCM framework. According to Azavedo et al (2010), the green supply chain would influence three important elements including economics (competitive advantage), environmental and operational. It shows that the environmental performance is significantly influenced by the supply chain framework. In addition, Wang et al (2015) included “operational performance” in the supply chain framework to see whether or not green innovation will influence not only the economic and environmental performance but also the operational performance of the companies.

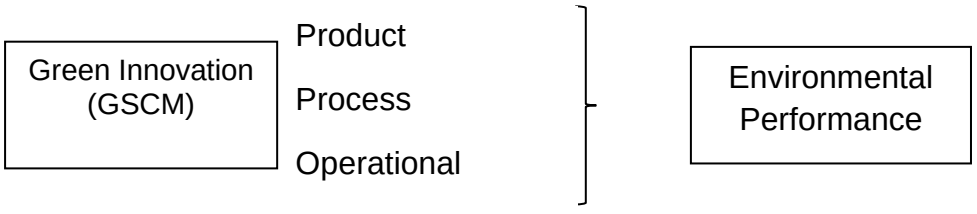
However, the contribution made by an optional approach focusing on GSCM has been overlooked in the operational context. Whether or not there is an association (directly or indirectly) between GSCM and operational has yet to be discovered. Can GSCM possibly make positive contributions towards the operation? Answering this critical question would pave the way for some significant implications for the literature due to a widely spread concern that firms that operate in rapidly changing contexts prefer a flexible working approach rather than the efficiency-focused lean approach (Fisher, 1997; Christopher and Towill, 2000). For instance, if a firm with strong volume flexibility may enjoy more revenue by rapidly offering the necessary quantity of green products to the market. We would like to posit that GSCM as a key organizational capability will also support effective operational strategies. However, existing literature has scarce insights into this GSCM–operational relationship. For example, an early attempt was made by Klassen and Angell (1998) to examine the relationship between manufacturing flexibility and environmental management, but as it was, flexibility was treated as an amalgamated construct. In much the same way, Liu et al (2016) probed into the association between GSCM and operational in the automotive sector but also treated GSCM as a single integrated construct. The different dimensions of GSCM may mean that they play dissimilar roles in the adoption of specific environmental performance. Hence, we still need to know in what way GSCM will contribute to the environment, especially concerning the multidimensional nature of GSCM. In this study, we would try to look into these knowledge gaps through investigations guided by the primary research question: what is the role played by the GSCM in the environmental performances of successful adoption?

According to Routroy (2009), the impact of green GSCM antecedents may be diverse operationally with different manufacturing processes, raw materials, conversion processes, product characteristics and reverse logistics activities. Sarkis (2003) refers to the following production process characteristics that determine the greening of the supply chain: (i) the process's capacity to make use of certain materials; (ii) the possibility of putting together reusable or remanufactured components into the system; and (iii) the design for waste minimization (energy, water, raw materials and non-product output). Therefore, the effect of green practices on environmental performance must be assessed in order to have information about the competitive priorities related to a company's operations. Moreover, the economic performance must be reviewed because, according to Zhu and Sarkis (2004), it is the most important driver for enterprises looking forward to implementing environmental management practices. Bearing this in mind, it is crucial to have sufficient details about costs, efficiency, environmental costs and revenues.

Methodology

Several elements were employed to conduct the survey for the automotive industry including online interviews, face to face interviews, telephone interviews and mail questionnaires. The interviews would enable the researcher to establish rapport with potential participants and therefore get them to collaborate. It also produced the highest response rates in survey research and enabled the researcher to explain ambiguous answers when appropriate and get follow-up or elaborated information. The interview was conducted through appointments, walk-in to the companies and also networking with friends and family. At the same time, manufacturer's power could also be used to get the response of surveys from their clients (suppliers). In other ways, telephone interviews and mail interviews are also used when there is a difficulty to arrange for face-to-face interviews due to the current Covid-19 situation and locations (distance) of the companies. This would save time and money as well as data processing time. The target automotive companies were the supplier factories that are located in Klang Valley based on the Malaysian Automotive Institute (MAI) and Malaysian Automotive Association (MAA) website accessed. A total of 640 automobile manufacturers are listed.

This study utilized the given equation in deciding the sample estimate and the result for a sample size of 248 of the population. According to Krejcie and Morgan (1970), the population is 650 - 700, resulting in 242 target samples to be surveyed. However, if it is difficult to achieve that target sample, then about 10% of the total population should be enough to conduct the research (Fowler, 2002). In this study, SmartPLS was used to perform the SEM. A five-point Likert scale (1 = Strongly Disagree and 5 = Strongly Agree) is used. It is important as the reaction design for every indicator variable. The questionnaire design was adapted from the established instrument previously developed by other researchers (Chiou et al., 2011). The survey was divided into three important sections. The questions on the construct ''Greening the suppliers'' in Part 1 are adapted from Rao (2002) and Rao and Holt (2005). The respondents were asked whether the environmental initiatives had been made when choosing and working with the suppliers. Next, the questions on the construct ''Environmental Performance'' were adapted from Rao (2002) and Rao and Holt (2005). The other questions for the construct ''Green Innovation'' were adapted from Chen et al., (2006) and Chen (2008).



Result and Discussion

A survey had been conducted among automotive related suppliers to find out their effort in greening their production towards improvement in environmental performance and enhancement in competitive advantages. About 240 companies were interviewed as in table 1:

Company Profile	Frequency	Percentage (%)
Establishment Period		
Under 10 years	15	6.3
Between 10-20 years	82	34.2
Between 21-30 years	83	34.6
Between 31-40 years	31	12.9
Over 40 years	29	12.1
Number of employees		
100 - 300	6	2.5
Between 301 and 500	81	33.8
Between 501-800	71	29.6
Between 801-1000	53	22.1
1000 and above	29	12.1
ISO Certification		
Yes	234	97.5
No	6	2.5
Local Input		
Low quality	9	3.8
High price of local material when available	79	32.9
Non-availability of local materials	122	50.8
Insufficient of local materials	14	5.8
Disappointment in delivery-time	16	6.7
Others	0	0

Based on this table, it showed that most of the companies were between 10-30 years of establishment period with the number of employees between 300-800 people. At the same time, about 97.5% had ISO certification and from several backgrounds of local input. Furthermore, the structural model is examined by using collinearity, r square blindfolding and path coefficient. The Cronbach's Alpha of each item is more than 0.9 and less than 1.0 (0.9 < Cronbach Alpha < 1.0), which means that the questionnaire has high reliability and consistency. In terms of composite reliability, the values for all constructs are greater than the recommended value of 0.7. That means the measures of the constructs are highly reliable in terms of their internal consistency. In addition, the AVE values for the variables are all greater than the recommended value of, which means that those (indicator) variables in the questionnaire have been understood.

Table 2:

No.	Managerial Innovation	MEAN	SD
MI1	Selecting suppliers based on environmental criteria	3.85	1.024
MI2	Requiring suppliers to obtain a third-party certification of environmental management system (EMS) such as ISO14000	3.50	1.329
MI3	Providing environmental awareness seminars and training sessions for suppliers	3.35	1.003
MI4	Providing environmental technical advice to suppliers to help them meet the required environmental criteria	3.30	1.109
MI5	Inviting suppliers to join in the early product design and development particularly related to environmental aspects	3.65	1.279
MI6	Sending in-house auditors to appraise the environmental performance of suppliers	3.65	1.084
MI7	Providing standard of procedures (SOP) related to environmental criteria to be obeyed among suppliers	3.57	0.889
	TOTAL:	3.55	0.817

Given the importance of the automotive industry, innovation is vital to maintain profitability and market share. Mean ratings of the managerial innovation attribute (see Table 2) were computed by using the SPSS software. The data collected from the Likert response scale can be assumed to be on an interval scale, and therefore means can be compared to determine the relative perceived managerial innovation attribute. Generally, as the mean value increases, the rating of the managerial innovation attributes increases. After comparing the mean ratings, the most important attribute with a mean rating of 3.85 was MI1; 'Selecting suppliers based on environmental criteria'. This means that a company who is having some concern for the environment and its brand image would have a stronger preference to get suppliers who can provide them with a green product. The least important factor with a mean rating of 3.30 was MI4 ('Providing environmental technical advice to suppliers to help them meet the required environmental criteria'). The low mean shows that companies do not give consultations to suppliers in this area.

Ironically, another important managerial innovation that the companies have taken action with their main suppliers is on factors MI5 and MI6 which shares the same mean scores of 3.65; 'Inviting suppliers to join in the early product design and development particularly related to environmental aspects' and 'Sending in-house auditors to appraise the environmental performance of suppliers respectively'. This means that the companies do intend to bring the suppliers on board with them. 'Providing environmental awareness seminars and training sessions for suppliers' with a mean value of 3.35, is the second least important influence of greening the production. However, the companies participating in this survey strongly believed in the importance of ISO 14000 (mean value = 3.50), thus strongly encouraging their suppliers to obtain a third-party certification of environmental management system (EMS) to gain recognition of their green products.

Table 3:

No.	Product Innovation	MEAN	SD
PT1	Using less or non-polluting / toxic materials (i.e. using environmentally friendly material)	3.06	1.051
PT2	Designing or improving environmentally friendly in daily activities for existing and new products	2.94	1.736
PT3	Recovering company's end-of-life products and Recycling	2.82	1.413
PT4	Using standard of procedure (SOP) that emphasis towards environmentally products	2.80	1.032
PT5	Emphasizing green / environmentally aspects in every aspect of production process	2.85	1.655
PT6	Using limited resources efficiently	2.94	1.289
PT7	Using eco-labelling	3.25	1.382
	TOTAL:	2.95	1.037

The interest in producing motorized vehicles has always been strong among the suppliers. However, the effort in creating an environmentally friendly environment needs more effort from the automotive companies. Table 3 shows the mean ratings for product innovation. The question of whether companies have taken any of the following actions before designing their product indicated a total mean score of 2.95 and SD at 1.037. The lowest mean score for this question is 2.80, which is the use of Standard of Procedure (SOP) before designing their environmental product while the highest mean score is 3.25 using eco-labelling. Several companies have a large number of eco-labelled products (refer to Table 3-PTI7). Eco-label is

a voluntary scheme of environmental performance certification and labelling which identifies products proven environmentally preferable overall among specific products. Countries such as Malaysia and the Philippines also publish a Directory of green goods or manufacturers whose purpose is to augment published lists of eco-labelled products and services. Eco-labelling can assist companies to develop harmonized criteria.

The mean analysis indicates the companies' efforts to promote product innovation. We could observe a spectrum of ratings of the companies on their greening effort from the graph. Recovering the company's end-of-life products and recycling them also show a low mean value (2.81±1.413). Overall, the results of the Likert-type scale survey, are seen to possess an average importance. The companies' opinion on product innovation is not as encouraging as the managerial innovation.

Table 4:

No.	Process Innovation	MEAN	SD
PS1	Lower consumption of e.g. water, electricity, gas and petrol during production use/ disposal	3.66	1.461
PS2	Recycle, reuse and remanufacture materials or parts	3.67	1.230
PS3	Use of cleaner or renewable technology to make savings (such as energy, water, waste)	3.84	1.179
PS4	Redesign of production and operation processes to improve environmental efficiency	3.76	1.047
PS5	Redesigning and improving products or services to meet new environmental criteria or directives (such as WEEE/ RoHs/ REACH/ Eup directives)	3.75	1.582
PS6	Rules of green production among workers in terms of ethics and attitude to work more efficient	3,65	1.180
PS7	Improvement in terms of machineries and equipment towards ability of green production and meet new environmental criteria	4.20	1.120
	TOTAL:	3.79	0.736

From Table 4, it can be deduced that the respondents are generally consistent in their responses to the importance of various greening efforts during the production process. The

mean values for all the attributes are above 3.60 which indicated that respondents perceive them as influential determinants. The highest mean score is 4.20 out of a possible 5, which is PSI7 (see Table 4). Human touch seems to receive the lowest rating in this attribute. Companies seem to take this issue lightly. Rules of green production among the workers in terms of ethics and attitude to work were not explained clearly to them (3.65±1.180). This is actually a violation of law as the rights of the workers were not spelt out during the process innovation period.

Being environmentally friendly will definitely be beneficial to the companies (4.15±1.242) as there will be a reduction of hazardous waste and emission. It will prevent pollution caused by reducing the need to harvest new raw materials and save energy. Compliance to environmental regulations is actually adhering closely to the ISO 14000 certification.

Table 5: Path coefficient and hypotheses

FACTOR	OS	SM	SD	T.VALUES	P.VALUES
ENV->CAV	0.36	0.37	0.09	4.21	0.00
GREEN->MANAGE	0.54	0.54	0.05	10.03	0.00
GREEN->PRODUCT	0.79	0.79	0.04	20.07	0.00
GREEN->PROCESS	0.72	0.73	0.04	18.01	0.00

The result showed that green innovation in terms of managerial, product and process had significant influence on operational and environmental performance. All of the variables showed the significant values as well as positive relationship among constructs as expected.

Conclusion

The findings would help companies to become more productive in terms of the green innovation on automotive industry performance in Malaysia. GSCM also could become the guideline to industry so they could improve the air quality. For safeguarding the environment, the government should implement a revised version of the environmental law and regulation by having more frequent inspections, organise more programs and campaigns, lay out more defined guidelines and standards etc. As a conclusion, this study echoes well the 11th Malaysia Plan (2018-2020) which is a green growth initiative to achieve by protecting the environment, reducing the amount of greenhouse gases and spearheading a low carbon and resource-efficient economy. The valuations observed in the study can be a strong sign to the local authorities to prioritise green services and facilities. The highlighted attributes in GSCM will benefit those involved, such as the environmental department, policy makers and consumers. As for economic and policy instruments, it might be employed to create incentives for green GSCM as well as to encourage people to take part in environmental preservation activities.

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