GREEN SUPPLY CHAIN IMPLEMENTATION IN MANUFACTURING INDUSTRY: A CASE STUDY

Alina Shamsuddin[1]*, Eta Wahab[2], Nor Hazana Abdullah[2] and Fawad Habib Qazi[2]

[1] Center of Academic Development Universiti Tun Hussein Onn, Malaysia
[2] Faculty of Technology Management and Business, Universiti Tun Hussein Onn, Malaysia

ABSTRACT: This paper is a case study in Malaysia which examines the level of implementation of Green Supply Chain Management (GSCM) practices in Malaysia. The findings serve as an indicator to the future prospects of GSCM in Malaysia. The study was carried out in the manufacturing industry as the manufacturing industry produces more emissions compared to other industries. A quantitative method was adopted. Questionnaires were sent to the employees of the manufacturing companies and the data was analyzed using the Statistical Package for Social Science (SPSS) program. The levels of implementation of the manufacturing companies were determined using a descriptive analysis. The results indicate that the company had a medium implementation level of GSCM practices. From the results, it can be concluded that the manufacturing companies are aware of green practices but are not able to implement it out in each of the supply chain key processes.

1. INTRODUCTION

Manufacturing companies produce more emissions compared to other industries during the manufacturing processes of their products to meet their customer needs and demands. Hence, the manufacturing companies need to be more concerned about the environment and how their processes are influencing the environment. Because of this massive ignorance of the majority of manufacturing companies, manufacturing companies are now accused for the cause of global warming in the form of waste generation, ecosystem disruption, and depletion of natural resources [1]. Nevertheless, manufacturing companies have now begun to be more aware of their processes and how it affects the environment.

Over the years, green supply chain management (GSCM) has gained popularity among Malaysian manufacturing companies although not as popular when compared to developed countries [2]. However, there are still a lot of manufacturing companies which are not adopting green supply chain practices in their manufacturing processes. According to [2], green supply chain management can be considered as closing the loop. The reason for this is because the product's "life" does not end when the consumer is done with it, but instead, it is brought back to the first stages where it can be used as raw materials or be reused, remanufactured, or recycled. This research addresses the level of implementation of GSCM in manufacturing companies that are attained the ISO 14001 certificate. This certification is to certify that a company's processes are green but it does not certify that the whole supply chain is green. According to [4], the ISO 14001 principle provides a framework, which guides firms to implement Environmental Management System (EMS) to improve environment performance only within a firm's operation boundaries instead of throughout the whole supply chain management of the manufacturing company.

In Malaysia, environmental issues have become a priority for the government and the public [2]. The depletion of natural resources has caused a shortage in some raw materials as the population of the world increases while resources start to decrease. Companies are starting to realize that the supply chain must be redesigned [5]. Researchers have now come to the conclusion and claim that the future of supply chain management is sustainability [5,6]. Concept of GSM is gaining more attention among the public as it enables companies to minimize the negative impact of the industries while enhancing their competitiveness [7]. Fully owned Malaysian companies have the lowest level of participation in green supply chain initiatives as compared to foreign based companies [2]. Various reasons have been identified such as difficulties and barriers to adopt green supply chain initiatives low involvement in green initiatives as compared to multinational companies (MNC) [8,2]. This supports the fact that there are definitely barriers and obstacles that are hindering

the local manufacturing companies from converting and start practicing GSCM. Greening supply chain not only allow firms to achieve substantial cost saving, it would also enhance sales, market share, exploit new market opportunities, which lead to greater profit margins [9].

2. PUTTING GSCM INTO CONTEXT

The traditional supply chain is an integrated manufacturing process wherein raw materials are manufactured into final products, then delivered to customers via distribution, retail, or both [10]. The focus of the definition of supply chain has shifted over the years; early definition took into consideration the integration of a firm's internal functional groups such as purchasing, manufacturing, and distribution but the current definition pays attention to the interdependence in a broader sense, a global perspective. Definitions of GSCM have ranged from green purchasing to integrated supply chains flowing from supplier, to manufacturer, to customer and reverse logistics, which is closing the loop [10]. GSCM improves environmental performances as measured by reductions in air emissions, effluent waste, solid waste, and the consumption of toxic materials. In a nutshell, unlike traditional environmental management, green supply chain assumes full responsibility of a firm towards its products from the extraction or acquisition of raw materials up to final use and disposal of products.

Fully owned Malaysian firms have the lowest participation of green supply chain initiatives compared to foreign based companies or MNCs (Multinational Companies) [2]. The reason for this is that the concept of green purchasing is still new in Malaysia. In addition firm size plays an important role too in influencing GSCM, the bigger the firm size, the more willing to participate in green supply chain initiatives [2]. Nine influencing factors of GSCM, they are Information Technology (IT) implementation, Technology Advancement and Organization Adoption, Quality of Human Resources, Government Support systems, Innovative Green Practices, Top Management Commitment, International Environment Agreements, and Supplier Motivation [11]. IT implementation refers to efficient information technological system is necessary for effective communication and supporting the GSCM. Technology advancement

and organization adoption is advancements in machinery and equipment to improve the products and services to increase the environmental performance to achieve GSCM. Organization Encouragement is to motivate the employees to achieve efficient GSCM. Quality of human resources means well qualified and professionals to implement effective green practices. Government support systems are industry friendly policies to promote GSCM. Innovative Green Practices involves hazardous solid waste disposal, energy conservation, reusing and recycling materials. Top management commitment is a dedication to empower people to change, the progress to ensure core manufacturing strategies and business strategies. An international environment agreement means green practices should be promoted at international platforms. Supplier motivation involves involving the suppliers in design process and technology affects overall performance of whole chain. All these factors were identified by the researcher using existing literature review and expert opinion.

In a summary, GSCM is best described as the firms full responsibility towards a product from the beginning of the supply chain process (acquisition of raw materials), until the end of the product life cycle (disposal of product). The level of implementation is influenced by IT implementation, Technology Advancement and Organization Adoption, Quality of Human Resources, Government Support systems, Innovative Green Practices, Top Management Commitment, International Environment Agreements, and Supplier Motivation, new concept, and firm size. By realizing the factors and level of implementation of GSCM practices in manufacturing companies, this study is able to not only get an idea of GSCM in Malaysia, but also to propose an action plan for future companies to follow

3. METHODOLOGY

This study adopts a quantitative approach in gathering and analyzing the data. Quantitative research methods attempt to maximize objectivity, the ability to replicate it, and the generalization of findings, which are normally interested in prediction. In this study, purposive sampling is applied. The population of this study is the employees in a manufacturing company with the

ISO 14001 certification. The sample of this study is taken from different levels of employees within a company with the ISO 14001 certification. The primary method for collecting data for this study is through questionnaires. The questions are adopted from a journal entitled "The Implementation of Green Supply Chain Management Practices in Electronics Industry" by [13]. The data collected was analyzed using a descriptive analysis in the Statistical Package for Social Science (SPSS) program.

4. DATA ANALYSIS AND DISCUSSION

This study analyses the data collected via questionnaires distributed and uses the aid of Statistical Package Social Science (SPSS) to analyze and determine the level of GSCM in this Malaysian manufacturing company. The reliability analysis, demographic analysis, was conducted in order to give a clearer picture and better understanding of the data collected using the questionnaire. The population size of the company was 600 and the required a sample size of 234 [14]. However, 250 questionnaires were distributed and only 200 were returned.

To ensure that the questions contained in the questionnaire are valid and reliable, pilot test was carried out before distributing the questionnaire for the masses. The respondents chosen for the pilot test were supervisors and executives who in general know more about GSCM. The number of questionnaires used in the pilot test was 20. The coefficient of Cronbach's Alpha should be higher than 0.6 to be considered as an acceptable, good and valid question [15]. If the question scores lower than 0.6, then the question may contain a few problems like vagueness or appropriateness. The table below shows a summary of the results of the pilot test.

Table 1.1: Pilot Test (Reliability)

Item	Cronbach's Alpha
Internal environment assessment	0.748
Green purchasing	0.748
Eco design	0.895
Cooperation with customers	0.881
Investment recovery	0.603
Total	0.910

The results of the test clearly show that the questionnaire is valid and can be used for the research and is ready to be distributed. In addition to the validity of the questionnaire, previous researchers have used these questions in their research such as [13]. After collecting the data from the respondents, the data was analyzed again for its reliability. The table below shows the results of the analysis.

Table 1.2 Actual Test (Reliability)

Item	Cronbach's Alpha
Internal environment assessment	0.648
Green purchasing	0.707
Eco design	0.837
Cooperation with customers	0.656
Investment recovery	0.774
Total	0.906

The total of the Cronbach's Alpha for the actual test is 0.906 which indicates that the questions are valid and are appropriate for the research.

5. DESCRIPTIVE ANALYSIS

Descriptive analysis can be used to generalize the sample to the population. This research uses descriptive analysis on each section to analyze the data collected. The discussions continues with the personal information of the respondents such as their gender, age, position held, and department their attached to. Frequency and percentage will be used to explain the data collected. Out of the 200 samples analyzed, there were 102 males and 98 females or 51% and 49% respectively that took part in this study. This showed that there is almost a balanced number of respondents between males and females in this research. The results are shown in table 1.3.

Table 1.3 Gender Analaysis

Item	Frequency	Percentage
Male	102	51%
Female	98	49%
Total	200	100%

In this study, age was divided into four categories. Below 30, between 31 to 40, between 41 to 50, and above 50. The ages between 31 to 40 has 96 respondents which is the highest followed by ages 41 to 50 with 71 respondents and then the below 30 category with 26 respondents and finally those above the age 50 with 7 respondents. Table 1.4 below shows the tabulation and the percentage of each category.

Table 1.4 Age Analaysis

Item	Frequency	Percentage
<30	26	13%
31-40	96	48%
41-50	71	35.5%
>50	7	3.5%
Total	200	100%

The positions held by the respondents were divided into four categories namely Executives, Supervisors, Managers, and Operational or Staff. Being a manufacturing company, the labor force dominates the number of respondents with 159 or 79.5% of the respondents. This is followed by supervisors with 17 people or 8.5%, executives with 13 people or 6.5% and lastly by managers with 11 people or 5.5%. Table 4.5 shows the distribution of the positions held with their frequency and percentage.

Table 1.5 Position Analaysis

Item	Frequency	Percentage
Manager	11	5.5%
Executive	13	6.6%
Supervisor	17	8.5%
Operational or Staff	159	79.5%
Total	200	100%

The data collected revealed that there are nine departments that took part in the survey. They are Human Resource, Information Technology, Marketing, Customer Service, General Administration, Finance and Accounting, Production, Engineering, and Quality Control. In keeping in line with the number of positions held, the production department yields the most amount of responders, while at the opposite side of the scale, Engineering, and Finance and Accounting departments yielded the least amount of responders with 10 people each. Table 1.6 below shows the results collected.   In order to figure out the level of implementation, the mean of each question and each section is taken into account and based on [16], the level of implementation can be determined by using the calculated mean. Table 1.7 shows the central tendency level and the mean range.

Table 1.6 Department Analysis

Item	Frequency	Percentage
Human Resource	14	7%
Information Technology	15	7.5%
Marketing	12	6.0%
Customer Service	13	6.5%
General Administration	13	6.5%
Finance And Accounting	10	5.0%
Production	100	50%
Engineering	10	5.0%
Quality Control	13	6.5%
Total	200	100%

Table 1.7 Agreement Level of Mean Measurement

Central tendency level	Mean range
3.68 – 5.00	High
2.34 – 3.67	Medium
1.00 – 2.33	Low

5.1 Internal Environment

Question one to question nine in the questionnaire are indicators for internal environment assessment. Based on the mean results of these nine questions, the level is only medium. It is clear that there are plans to carry out (or even is being carried out) ISO 14001 activities, as the mean is the highest with 4.245. The lowest mean would be plans for eco labeling of products, with a mean of only 3.290. Despite this, the overall level is medium as the overall mean is 3.619. Table 1.8 shows the mean breakdown of each question.

Table 1.8 Internal Environment Assessments

No	Item	Mean	Level
1.	Question 1	3.75	High
2.	Question 2	3.66	Medium
3.	Question 3	3.38	Medium
4.	Question 4	3.63	Medium
5.	Question 5	3.71	High
6.	Question 6	4.25	High
7.	Question 7	3.58	Medium
8.	Question 8	3.29	Medium
9.	Question 9	3.34	Medium
	Total Average	3.62	Medium

5.2 Green Purchasing

Questions 10 to question 13 discuss on green purchasing. Overall, the level of green purchasing is medium with cooperation with suppliers for environmental regulations receiving the lowest mean with 3.250, and the highest mean of 3.275 goes to certifying suppliers with ISO 14000. This shows that there is indeed intention of applying GSCM. Table 1.9 below shows each question's mean and level.

Table 1.9 Green Purchasing

No	Item	Mean	Level
1.	Question 10	3.25	Medium
2.	Question 11	3.26	Medium
3.	Question 12	3.28	Medium
4.	Question 13	3.27	Medium
	Total Average	3.26	Medium

5.3 Eco Design

The next section starting from question 14 to question 20 indicates the level of eco design. Plans to design products that minimize capacity, time, area stored, and energy between transport has the highest mean with 3.385, while plans to design products for easy set up for users with minimal effort receives the lowest mean which is 3.200. Table 1.10 below shows the mean and level of the questions involved.

Table 1.10 Eco Design

No	Item	Mean	Level
1.	Question 14	3.32	Medium
2.	Question 15	3.35	Medium
3.	Question 16	3.30	Medium
4.	Question 17	3.27	Medium
5.	Question 18	3.39	Medium
6.	Question 19	3.20	Medium
7.	Question 20	3.38	Medium
	Total Average	3.31	Medium

5.4 Cooperation with Customers

The next three questions show the level of cooperation with customers that the company has. The overall level of cooperation with customers is medium with a mean of 3.223. The lowest mean is shared between plans to cooperate with customers for eco-design, and plans to cooperate with customers for green packaging, with a mean of 3.225. The highest of the three is plans to cooperate with customers for cleaner production with a mean of 3.230. Table 1.11 below shows the data.

Table 1.11 Cooperation with Customers

No	Item	Mean	Level
1.	Question 21	3.23	Medium
2.	Question 22	3.23	Medium
3.	Question 23	3.23	Medium
	Total Average	3.22	Medium

5.5 Investment Recovery

The last three questions of the questionnaire deal with investment recovery and has an overall mean level of 3.291. The lowest mean which is 3.200 belongs to plans for sale of excess inventories or materials; whereas plans to sell excess capital equipment have the highest mean of 3.370. Table 1.12 below illustrates the collected data.

Table 1.12 Investment Recoveries

No	Item	Mean	Level
1.	Question 24	3.20	Medium
2.	Question 25	3.31	Medium
3.	Question 26	3.37	Medium
	Total Average	3.29	Medium

5.6 Summary of GSCM Practices

A summary of all the GSCM practice with their respective means and levels are shown in table 1.13 below. As seen from the table below, it is clear that the company implies a medium level of GSCM across the board and as a result, the overall implementation can be considered as medium level as the total mean average is less than 3.68.

Table 1.13 Summary of GSCM Practices

GSCM Practices	Mean	Level
Internal Environmental Management	3.62	Medium
Green Purchasing	3.26	Medium
Eco Design	3.31	Medium
Cooperation with Customers	3.22	Medium
Investment Recovery	3.29	Medium
Total Mean Average	3.34	Medium

6. DISCUSSIONS

The level of GSCM practices implemented by the company had to be measured. The questions that were adopted from Ninlawan et al. (2010) are based on a scale of one to five thus allowing the measurement of the level of implementation. The mean results from the research have revealed that the company has been implementing some of the GSCM practices and according to the agreement level of mean measurement, it can be concluded that as an overall, the company has achieved an implementing level of medium for GSCM practices, which is a mean of 3.34 out of 5.00. To achieve a high level, the mean must be at least 3.68. Despite only achieving a medium level, a closer look at the results show that the company's mean is only 0.34 shy from achieving a high implementation level of GSCM practices. The questions in the questionnaire were analyzed in five categories which were internal environmental management, green purchasing, eco design, cooperation with customers, and investment recovery. Each category was measured with the same agreement level of mean measurement, and all the categories had a medium level of GSCM implementation with 3.62, 3.26, 3.31, 3.22, and 3.29 respectively.

Companies that would want to implement GSCM could start off by fulfilling the conditions of acquiring the ISO 14000 certification. Although this does not make them a fully green supply chain [4], it is a start. From there, companies slowly work their way to a green supply chain by tackling the elements of green supply chain like Internal Environmental Management, Green Purchasing, Eco Design, Cooperation with Customers, and Investment Recovery [13]. It all starts with the companies, after acquiring the ISO certification, they can start by selecting suppliers that not only deliver on quality and affordable prices, but also adhere to environmental standards. They can also design their products to reduce the need for environmentally hazardous materials. It also needs to be designed for reuse, repairs, reduced energy consumption (APO, 2004), and recycling. They could also introduce reverse logistics which deals with reuse, remanufacturing, and recycling of their products after consumers are done with them.

This study was to examine the implementation level of GSCM practices. To examine the implementation level of GSCM practices, a descriptive analysis was performed on the data collected through purposive sampling. The results from the analyzed data showed that the implementation level of GSCM was a medium level which was based on the mean and it fell in the medium range as described by the agreement level of mean measurement. Overall, the literature supported the results that manufacturing companies in Malaysia were not so keen in GSCM yet. Future research on the topic can be improved dramatically by increasing the sample size of the companies sampled to include manufacturing companies from all over Malaysia. But as far as results go, it is encouraging to see that at least the company sampled was applying some methods of GSCM in:

- Internal Environmental Management
- Green Purchasing
- Eco Design
- Cooperation with Customers
- Investment Recovery

7. ACKNOWLEDGEMENT

4. REFERENCES

[1] Fiksel, J. (1996). Design for environment: Creating eco-efficient products and processes. New York, NY and London: McGraw-Hill.

[2] Eltayeb, T. K.; Zailani, S.;. (2009). Going green through green supply chain initiatives towards environmental sustainability. Operations & Supply Chain Management Vol. 2 No, 2, 93-110.

[3] Zhu, Q.H.; Sarkis, J.; Geng, Y.;. (2004). Green supply chain management in China: pressures, practices and performance. Green supply chain management, 449-465.

[4] Handfield, R. B.; Sroufe, R.; Walton, S. V.;. (2005). Intergrating environmental management and supply chain strategies . Busines Strategy and the Environment Vol. 14(1), 1-19.

[5] Carter, C.R., Jennings, M.M. (2004). The role of purchasing in corporate social responsibility: A structural equation analysis . Journal of Business Logistics, Vol.25 (1), 145-186.

[6] Murphy, P.R. and Poist, R.F. (2002). (2002). Socially responsible logistics: an exploratory study. Transportation Journal, Vol. 41 (4), 23-35.

[7] Rao, P. (2006). Greening of suppliers/Inbound logistics-in the South East Asian context. In J. Sarkis (Ed). Greening the Supply Chain London: Springer .

[8] Wycherley, I. (1999). Greening supply chains: the case of The Body Shop International. Business Strategy and the Environment, Vol. 8 (2), 120-127.

[9] Rao, P. & Holt, D. (2005). Do green supply chains lead to competitiveness and economic performance? International Journal of Operations & Production Management, Vol. 25 No. 9, 898-916.

[10] Beamon, B. M. (1999). Designing the Green Supply Chain. Logistics Information Management, 332-342.

[11] Zhu, Q.H; Sarkis, J.;. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. Journal of Operations Management Vol. 22, 265-289.

[12] Luthra, S.; Garg, D.; Kumar, S.; Haleem, A.;. (2012). Implementaion of the green suply chain management in manufacturing industry in India using interpretive structural modeling technique. A Journal of Science, Technology & Management .

[13] Ninlawan, C.; Seksan, P.; Tossapol, K.; Pilada, W.;. (2010). The implementaion of green supply chain management pratices in electronics industry. Proceedings of the International Multiconference of Engineers and Computer ScientistsVol. 3 .

[14] Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educ Psychol Meas.

[15] Sekaran, U. (2003). Research Methods for Business: A Skill Building Approach (4th Edition). Singapore: John Wiley & Sons, Inc.

[16] Chua, Y. (2006). Research Methodology. Malaysia: McGraw-Hill Sdn. Bhd.