

# Green Supply Chain Management Practice and Performance of Manufacturing Companies in Batu Pahat, Johor

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**Abstract** - Environmental issues such as air and water pollutions are increasing because of the speedy growth of industrial modernization especially in the manufacturing industry. The industry is considered as one of the main sources of environmental problems. Green supply chain management (GSCM) practices can help companies in the industry improve firm sustainability performance through reduction of environmental risk, at the same time, provide economic and environmental benefit. In Malaysia, researchers were more focused on internal environmental management practices such as the implementation ISO 14001 and the number of research on GSCM practices is still low. This research aims to explore GSCM practices and sustainability performance through a survey among manufacturing companies in Batu Pahat, Johor. It also compares the practices and performance of two case companies using data gathered from interviews. The findings reveal that the manufacturing companies in Batu Pahat had a moderate level of GSCM implementation and sustainability performance. The GSCM practices that companies should focus more are internal environmental management and reverse logistics.

**Keywords** - Green supply chain management, firm performance, manufacturing industry

## 1. Introduction

Nowadays, governments, societies, and businesses are giving more attention to environmental issues. The environmental problems such as global warming, waste and environmental pollutions had increased because of the growth of the industrial activities especially in the manufacturing sector. Manufacturing companies were considered as the source of most of the environmental problems [1]. The manufacturing process turns raw materials into products or goods. However, raw materials leftover or substances produced may be harmful to the environment and can cause pollutions. In order to solve the environmental issues, the Malaysian manufacturing sector spends around RM1.73 billion on environmental protection expenditure or 66.9% of overall contribution across sectors [Department of Statistics 2].

With the intensification of the competition in the 1990s, awareness of the green supply chain management (GSCM) practices has increased and prompted firm to manage their supply chains in ethically and socially responsible way [3]. GSCM is a useful tool to improve firm sustainability performance through reduction of environmental risk that can provide economic and environmental benefits [4]. According to Van Hoek [5], GSCM was developed as a crucial organizational principles to help companies achieve profit and market share objectives by decreasing the negative environmental risks and impacts, while increasing the ecological benefit of the companies and their partners.

Current GSCM studies were mostly conducted in developed countries like the United States and Europe. The results from those researches might not portray the implementation of GSCM practices in the Malaysian manufacturing industry. In addition, researches in Malaysia were more focused on internal environmental management practices, specifically the implementation of environmental management systems such as ISO 14000. Therefore, this study aims to address the research gap on GSCM studies in the Malaysian industry context. It explores the implementation of GSCM practices and identifies the level of sustainability performance of manufacturing companies in Batu Pahat, Johor through a survey. In addition, the study uses interview to gather data from two case companies that allows for identification of similarities and differences of GSCM practices among companies that operate within the same industry. The findings can contribute towards increasing our knowledge regarding the GSCM practices and performance, which can be used as a guideline for future improvement and decision making by manufacturing companies.

## 2. Literature review

### 2.1 Green supply chain management practices

Nowadays, awareness of environmental issues and global warming are increasing among the consumers, which create pressure on companies to improve the sustainability of their activities. The companies can use GSCM as a tool to green manufacturing process and supply chain, measure their carbon footprint and improve recycling practices. GSCM is a useful management tool for greening initiative among leading manufacturing companies [6]. Supply chain elements such as supplier, factory, warehouse, distribution center, consumer, and store need to work together to provide goods or services to the market with minimal or no negative impact to the environment.

GSCM practices ranged from green purchasing to integrated supply chains flowing from the supplier to the customer, and reverse logistics [7]. Table 1 summarizes GSCM practices that had been examined in previous studies.

Table 1. GSCM practices

Practices	Source
Internal environmental management (IEM)	Murray (2000); Evans et al., (2006); Zhu & Sarkis (2007) and Zhu et al., (2008)
Cooperation with customer (CC)	Vachon & Klassen (2006); Zhu et al., (2008); Green et al. (2013); Vijayvargy et al., (2013); Kannan et al., (2014); Jabbour et al., (2015) and Geng et al., (2017)
Eco-Design (Eco)	Eltayeb et al., (2011); Zhu et al., (2005); Zhu et al., (2008); Green et al., (2013); Vijayvargy et al., (2013); Zhu et al., (2013b); Kannan et al., (2014); Abdullah (2016) and Geng et al., (2017)
Reverse logistic (RL)	Hervani et al., (2005); Azevedo et al., (2011); Eltayeb et al., (2011); Geng et al., (2017); Luthra et al., (2016); Abdullah (2016) and Tan et al., (2016)

The integration of GSCM practices into the overall plan of the enterprise is imperative to ensure successful implementation of the practices [8]. IEM is used to manage the environment like workplace within the organization. Zhu, et al. [6] suggest that IEM practices include top management commitment to GSCM, cross functional cooperation for environmental improvement, total quality environment management, environmental compliance, auditing program, and implementation of environmental management system. According to Matuszak-Flejszman [9] IEM can improve

efficiency of operation performance and lower operational cost, reduce resource use, waste and emission, improve regulatory compliance, employee involvement, and enhance relations with customer or supplier. Besides, according to Alberti, et al. [10], IEM can contribute also contribute towards improvement in production system availability, as well as reduce logistics cost, liability and risk.

Zhu, et al. [6] define cooperation with customers (CC) as a practice that requires producing firm working with customer to design cleaner production processes that produce environmentally sustainable products. [11] suggest that CC involves strategic information sharing and collaboration with customers to increase the visibility and enable joint planning for the environment. This practices also requires customers' willingness to learn about operational factors such as companies' environmental goal [12].

Eco-design (ECO) is introduced to integrate ecological attributes and stakeholder demands in product as well as process design and development. At the designing stage, activities like product design, process and service is finalized. Therefore, the optimal decisions can be made such as selecting raw materials, suppliers and process chemicals at the beginning [13]. ECO in supply chain includes product design strategy that can reduce consumption of material or energy, design of product for reuse, recycle, and recovery as well as avoid or reduce the use of hazardous product and/or their manufacturing process [6, 13-15]. Plouffe, et al. [16] discover that eco-design practices can influence product cost, revenues and profitability.

Hervani, et al. [17] define reverse logistic (RL) as an action taken by organization to collect waste products and materials from their customers for the purpose of reuse or recycling. Some research had shown that the efficiency of reverse logistic networks can provide economic advantage and improve organization competitiveness [18]. Lau and Wang [19] stated that most developing countries are still at the beginning stage of the development of reverse logistic although their contribution in manufacturing is large. Research on RL focused on product returns and remanufacturing, recycling, recovery, reuse and redistribution [20-22]. The benefits of RL implementation include cost reduction, competitive advantage and differentiation in the corporate image [23]. Reverse logistics can minimize environmental impacts along products life cycle, provide earnings that can stimulate new initiatives in logistics activities, and improve brand value of product or service through cooperation with supply chain partners and customers [23].

## 2.2 Firm sustainability performance

Many researches had shown the importance of GSCM practices towards firm sustainability performance [20-22, 24, 25]. GSCM practices can reduce cost (i.e. save resource, decrease use of energy and water) and environmental liability as well as improve organization reputation [12, 26]. In addition, GSCM practices can also provide other benefit to the firm such as increase efficiency, improve quality of the service, maximize the sales and improve organization reputation [27].

According to Wisner, et al. [28], poor environmental performance has a direct relationship with company stock prices. Therefore, a company must take environmental issue seriously because it affects investor's interest. Generally, environmental performance relates to saving resource or energy and reducing waste, pollution, and emissions. For the manufacturing sectors, environmental performance included reducing air and water emissions, waste and hazardous materials (Zhu et al., 2005). Measurement of supply chain environmental performance can include companies' ability to reduce air emission, waste water, solid wastes, decrease the consumption of hazardous material and frequency for environmental accidents [6].

Economic performance, on the other hand, is measured using financial indicators to assess organization's efficiency and effectiveness. According to Geng, et al. [20], the goal of improving economic performance should be a reason why a company needs to implement GSCM practices. Zhu et al., (2008) used the following indicators to measure supply chain economic performance: cost for materials purchasing, cost for energy consumption, fee for waste treatment, fee for waste discharge and fines for environmental accidents.

## 3. Methodology

This study used a mixed-method approach to understand GSCM practices and sustainability performance of manufacturing companies in Batu Pahat, Johor. According to Federation of Malaysian Manufacturers [29], there were 71 manufacturing companies in Batu Pahat area. The sample size was, therefore, 59 companies [30]. Data for this study were gathered using an online survey among the companies, where the samples were selected using simple random sampling. In addition, interviews were conducted at two of the sample companies, i.e. one is a local furniture company and the other is a multinational that produce electrical and electronic products. The two cases were chosen in order to identify similarities of GSCM practices across the manufacturing industry. Any differences, on the other hand, can be attributed to, for example, the

characteristics of the companies operations, products, target markets and other external factors related to their business environments.

The questionnaire for the survey was developed based on the research of Zhu, et al. [6]. The questionnaire used 5-point likert scale (i.e. from very low to very high) and consists of 3 sections: demography, GSCM practices and firm performance. The interviews conducted were semi-structured that aimed to obtain more in-depth information about the companies' GSCM practices and sustainability performance. The questions include, among others, the companies' opinion about GSCM, their strategies, actions implemented to improve performance and the problems faced in the implementation of green practices. Data gathered from the survey and interviews were analyzed using descriptive analysis and pattern matching.

## 4. Results and Discussion

This section discusses the analysis results of data gathered through the survey and interviews. Overall, questionnaires were emailed to 59 companies, where 15 valid questionnaires were returned. Therefore, the response rate was 25.42%. The profiles of the companies are as summarized in Table 2. It can be seen that most of the companies involved in the survey were SMEs with less than RM25 million annual revenues.

**Table 2.** Profile of companies and respondents

	Frequency	Percent	Cumulative Percent
Number of employees			
Less than 250	11	73.3	73.3
250 - 500	3	20.0	93.3
More than 1000	1	6.7	100.0
Annual revenue (RM)			
Less than 25 million	12	80	80
25.1 million – 50 million	3	20	100
Respondents' working experience (years)			
Less than 5	8	53.3	53.3
6 -10	3	20.0	73.3
16 - 20	1	6.7	80.0
More than 20	3	20.0	100.0

Table 3 shows the results of descriptive analysis of the companies' GSCM practices. Based on Table 3, both CC and ECO scored the highest mean at 3.42 compared to other GSCM practices. Overall, the mean score of all practices were average, indicating that much can be done to improve the current implementation of GSCM.

**Table 3.** Results of descriptive analysis of GSCM practices

Items	Mean	Standard Deviation
Internal environmental management (IEM)		
Commitment of senior managers to GSCM practices	3.27	0.59
Support for GSCM from mid-level managers	3.20	0.56
Cross functional cooperation for environmental improvements	3.33	0.62
Environmental compliance and auditing programs	3.27	0.70
Use of ISO 14001 certification	2.80	1.37
Use of environmental management systems	3.00	0.85
<b>Average score</b>	<b>3.14</b>	<b>0.58</b>
Cooperation with customers (CC)		
Eco-design	3.13	0.64
Cleaner production	3.67	0.49
Green packaging	3.47	0.52
<b>Average score</b>	<b>3.42</b>	<b>0.34</b>
Eco-design (ECO)		
Design of products for reduced consumption of material/energy	3.60	0.63
Design of product for reuse, recycle, recovery of material, component parts	3.47	0.99
Design of products to avoid or reduce use of hazardous materials	3.20	0.78
<b>Average score</b>	<b>3.42</b>	<b>0.70</b>
Reverse logistics (RL)		
Use environmental friendly transportation	3.40	0.63
Reuse/recycle materials or components or products	3.53	0.64
Remanufacture components or products	3.20	0.76
Reuse/recycle packaging container/materials	3.20	0.76
<b>Average score</b>	<b>3.33</b>	<b>0.62</b>

Further analyses of the factors used to measure the practices revealed a clearer picture of the extent to which each practice were implemented by the companies. Specifically, in terms of IEM, cross-functional cooperation for environmental improvements has the highest mean at 3.33, while the use of ISO 14001 certification has the lowest mean score at 2.80. Analysis of the companies' profile indicate that 60% of the companies were not ISO 14001 certified. Cooperation with customers in cleaner production has score at 3.67 compared to the other areas studied. For eco-design practices, the companies are mostly involved in designing products that use less materials and energy. Meanwhile, in terms of reverse logistics, the practice that scored the highest mean was the resue/recycle of materials, components or products, which was at 3.53.

The level of firm sustainability performance was also analysed using descriptive analysis. The results are summarized in Table 4.

**Table 4.** Results of firm sustainability performance analysis

	Mean	Standard deviation
<b>Environmental performance</b>		
Reduce air emission	3.40	0.51
Reduce energy consumption	3.67	0.62
Reduce waste water	3.47	0.52
Reduce solid wastes	3.40	0.51
Reduces consumption of hazardous/harmful materials	3.67	0.49
Reduce frequency of environmental accidents	3.47	0.52
<b>Average score</b>	<b>3.51</b>	<b>0.53</b>
<b>Economic performance</b>		
Reduce materials purchasing cost	3.40	0.83
Reduce energy consumption cost	3.40	0.74
Reduce waste treatment fee	3.40	0.63
Reduce waste discharge fee	3.40	0.51
Reduce fine for environmental accidents	3.40	0.63
<b>Average score</b>	<b>3.40</b>	<b>0.56</b>

Overall, the results show that the sustainability performance of the companies was average. Specifically, environmental performance had a slightly higher mean score at 3.51 compared to economic performance. The companies indicate that in the last three years they were able to improve most in reducing energy consumption as well as the use of hazardous and harmful materials in their products and processes.

Table 5 shows the results of interviews with two manufacturing companies. As mentioned earlier, Company A is a local furniture company that supplies to international markets, while Company B is a multinational that produces electric and electronic products for local and international markets. The table compares the GSCM practices of the companies as well as their sustainability performance.

**Table 5.** Comparison of interview results

GSCM issue/factors discussed	Company A	Company B
Company opinion about GSCM	- Very costly system - Increase cost of production and operations	- Reduce the cost of the production and operations - Reminds of the importance of taking good care of the environment - Focus on ensuring that products cause less environmental impact
Quality vs. sustainability	- Focus more on quality management than	- Use ISO 9001 & ISO 14001 - Implement IEM, ECO, CC and RL, waste

Internal environmental management (IEM)	<ul style="list-style-type: none"> <li>- environmental management</li> <li>- Use ISO 9001</li> <li>- Changed all light bulb to LED light bulb</li> <li>- Does not encourage working over time</li> <li>- Give a short briefing before starting work</li> <li>- Close the power supplies before leaving office</li> <li>- Five working days only</li> <li>- A paperless policy</li> <li>- All employees know the policy of company (quality)</li> </ul>	<ul style="list-style-type: none"> <li>management, lean management and just in time (JIT)</li> <li>- Changed all light bulb to LED light bulb</li> <li>- Give a short briefing before starting work</li> <li>- Close the power supplies before leaving office</li> <li>- Five working days only</li> <li>- A paperless policy</li> <li>- All employees know the company policy (environmental and quality)</li> <li>- Conduct environmental compliance and auditing program every week</li> <li>- Build a water tank to manage water consumption</li> <li>- Use of sensors to manage energy use</li> <li>- Send operational routine report to headquarters</li> </ul>	Reverse logistic practice	<ul style="list-style-type: none"> <li>- No action on this practice because the raw material of the product cannot be remanufactured, recycle or reuse again</li> <li>- Does not remanufacture components or products because of the cost</li> <li>- Does not conduct take-back program (all products are for export)</li> </ul>	<ul style="list-style-type: none"> <li>- Design and test packaging for reuse</li> <li>- Drop tests conducted to make sure the packaging is durable and can protect the product</li> <li>- Implement take-back program by giving discount or voucher</li> <li>- Prepare recycle bin</li> <li>- Multiple tests conducted to make sure product have minimal environment impact</li> <li>- Remanufacture and reuse packaging</li> <li>- Reuse/recycle materials or components or products</li> <li>- Remanufacture components or products</li> <li>- Reuse/recycle packaging container/materials</li> </ul>
Cooperation with customer (CC)	<ul style="list-style-type: none"> <li>- Choose supplier who is offering the cheapest price</li> <li>- Choosing supplier based on whether they had meet the requirements of company, e.g. ISO9001, ISO14001 and others</li> <li>- Follow the requirement and design from customer</li> <li>- Green packaging</li> </ul>	<ul style="list-style-type: none"> <li>- Green packaging</li> <li>- Design packaging and conduct protection test on packaging</li> <li>- Choosing supplier based on whether they meet the requirements of company, e.g. ISO9001, ISO14001 and others</li> </ul>	Environmental performance	<ul style="list-style-type: none"> <li>- Changed all light bulb to LED light bulb</li> <li>- Does not encourage working over time</li> <li>- Close the power supplier before leaving the office</li> <li>- A paperless policy</li> <li>- Reduce use of harmful material like plastic</li> <li>- Reduce use of cloth material in productions and find substitute materials</li> </ul>	<ul style="list-style-type: none"> <li>- Use of liquid petroleum gas system had been changed to the electric system</li> <li>- Build a water tank for water management</li> <li>- Had change manual switch to the sensor of automatic switch</li> <li>- Changed all light bulbs to LED</li> <li>- Close power supplies before leaving the office</li> <li>- A paperless policy</li> <li>- Reduce use of harmful material like plastic, lean material and others</li> <li>- Prepare recycle bin</li> <li>- Use green or recycled raw material</li> <li>- Reuse and remanufacture packaging</li> <li>- Conduct take-back programs</li> </ul>
Eco-design practice (ECO)	<ul style="list-style-type: none"> <li>- Follow the requirement and design form customer</li> <li>- Design of products for reduced consumption of material/energy</li> <li>- Design of products to avoid or reduce use of hazardous materials</li> </ul>	<ul style="list-style-type: none"> <li>- Design of products for reduced consumption of material/energy</li> <li>- Design of products to avoid or reduce use of hazardous materials</li> <li>- Design of product for reuse, recycle, recovery of material, component parts</li> <li>- Conduct a lot of tests to ensure that the products will cause less environmental impact</li> </ul>	Economic performance	<ul style="list-style-type: none"> <li>- Use the cheapest and quality raw material</li> <li>- Reduce the operational cost</li> </ul>	<ul style="list-style-type: none"> <li>- Reduce materials purchasing cost</li> <li>- Reduce energy consumption cost</li> <li>- Reduce waste treatment fee</li> </ul>

	- Reduce waste treatment fee	- Reduce waste discharge fee
	- Reduce use of cloth material	- Reduce fines for environmental accidents
Challenges in GSCM implementation	- Future plan (implement ISO14001)	- Need a lot of capital to renew ISO certification
	- If implemented ISO14001, prices of the raw material is high compared to others because those material are not common or hard to get from local market	- Weekly environmental compliance and auditing program - Needs resources such as financial, training and technology

Overall, in terms of similarities of GSCM practices, both companies designed their product for reduced consumption of materials, energy, water, and hazardous and harmful materials like plastic. In addition, through the implementation of GSCM practices, both companies were able to reduce purchasing cost, waste treatment fee and discharge fee. The following activities or actions were done by both companies to encourage more environment-friendly behavior and practices in the companies: a paperless policy, switching off light and air condition during lunch hours and when leaving office, use of LED light bulb and recycling bins, briefing before starting work, and implementation of five working days.

The results also revealed that the companies viewed GSCM differently. While Company A believe that GSCM is a costly practice that can increase cost of production and operations, Company B on the other hands contend that GSCM can help manufacturing companies to reduce the costs. The main focus of both companies also differed, where Company A focused more on product quality and Company B focused on both quality and environmental management. The differences were more apparent when specific GSCM practices were investigated, especially in terms of reverse logistics practices. Company A indicated that it did not implement reverse logistics because their products were exported, which prevented the companies from implementing take-back programs as well as remanufacture their products. This was also due to the cost involved in reverse logistics implementation. In addition, on top of having better GSCM practices, Company B implemented waste management, lean management, kaizen and just in time (JIT) practices in their operations.

Generally, both companies revealed that among the challenges that they were facing in GSCM practices is the cost of its implementation. Specifically, the costs of environmental certification, raw materials,

training as well as technology were among the factors that could hinder the implementation. In addition, the frequency and number of environmental initiatives and auditing could also increase the complexity of the implementation and its costs.

### 5. Conclusion and Recommendation

This research was conducted to understand GSCM practices and the level of firm sustainability performance among manufacturing companies in Batu Pahat, Johor. Overall, the analyses of data gathered through a survey and interviews revealed that there are many rooms for improvements in the current implementation of GSCM practices among the companies. The current level of GSCM is average, where more focus should be given on all practices studied especially in terms of internal environmental management and reverse logistics practices. Previous studies show that GSCM can help companies improve their sustainability performance. Due to the data limitation, this study was not able to examine the relationship between GSCM practices and sustainability performance of the companies involved. However, the companies indicate that the implementation of GSCM practices in the last three years were able to moderately help companies to improve their environmental performance, especially in terms of reduction of energy consumption as well as the use of hazardous and harmful materials in products and processes. The results could support the findings of previous research by, for example, Zhu, et al. [31], Laosirihongthong, et al. [21], Paulraj, et al. [32], and Vaz, et al. [23]. The findings of this study also revealed the differences in terms of GSCM are viewed among manufacturing companies. While some companies could view GSCM as a costly practice, others may view it as necessary in helping companies to improve their awareness of how their activities can impact the environment as well as reducing the cost of operations.

Although the current study is able to shed some lights on the implementation of GSCM practices and firm sustainability performance in the manufacturing industry, this study is limited because it focused on specific industrial area which is Batu Pahat, Johor. Due to the area limitation and the lack of data obtained, the results may not be generalizable to the larger manufacturing industry in Malaysia. Future research should, therefore, aims for wider population. In addition, researchers could also focus on other aspects of GSCM practices and firm performance such as green supplier management, product stewardship, eco-process, digital supply chain technologies, operations performance, health and safety performance as well as marketing performance. In order to gain richer

data, case studies that use document analysis and cross-departments interviews could also be conducted. Future research could also look into developing future scenarios of GSCM implementation through the use of foresight tools such as impact-uncertainty analysis and future wheel.

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