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Review of green supply chain management in manufacturing: A case study

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Abstrak. Supply Chain Management (SCM) is a series of activities related to the flow of goods, information, and finance from suppliers, manufacturers, warehouses, distributors, and retailers to end customers (users). Whereas Green Supply Chain (GSCM) is an environmental innovation that integrates environmental issues and SCM to improve the organization's sustainable performance. Some literature uses qualitative, quantitative, and a combination of the two methods in analyzing the positive impact of GSCM. Literature study was conducted to determine the impact felt by the company if implementing GSCM in its organization. So that it can be a reference for the manager in deciding the application of GSCM processes in the organization. There are four green processes in GSCM, namely: green design, green manufacturing, green logistics, reconditioning and core disposal. Some positive impacts that can be felt by the company, such as increasing organizational productivity (financially and efficiency), improving environmental performance, and to identify trends in organizational development. This practice can be implemented well if it is supported by pressures from various interests and pressures of the organization (management). Thus forcing companies to perfect the organization's business model.

1. Introduction

Supply Chain Management (SCM) includes a set of approaches in industry from suppliers, manufacturers, warehouses, distributors, and retailer to customers (final customers) [1]. Activities within the scope of SCM are all activities related to the flow of material, information, and money along the supply chain [2]. In manufacturing companies, the activities included in the SCM classification are: (1) Activities of designing new products (product development); (2) Activities to obtain raw materials (product, purchasing, or supply); (3) Planning and production planning (planning & control); (4) Production activities; (5) Activities of sending / distributing (distribution); and (6) Product return management activities.

Green Supply Chain Management (GSCM) is an environmental innovation that integrates environmental issues into supply chain management [3]. This issue has been widely discussed by previous researchers by bringing up case studies in manufacturing companies. Some researchers use qualitative methods [4–8], quantitative [9–11], as well as a combination of the two methods [12] in determining the relationship between supply chain management practices and environment practices.



2. Literature Review

2.1. Green Supply Chain Management (GSCM)

Environmental management is a key strategic issue for improving supply chain [7,11–14]. Whereas GSCM is defined as the integration of environmental problems in supply chain management during the product life cycle [15]. The GSCM model is highly correlated with the implementation of the principles of sustainable development in business practices with regard to environmental aspects. GSCM covers environmentally friendly design and production as well as the function of technology in recycling.

Islam et al. [15] categorizes green supply chain practices and initiatives into several aspects, such as: reverse logistics, industrial symbiosis, green information technology and systems (GITS), green design, carbon management, supplier environment collaboration, customer environment collaboration, ISO 14001 certification, internal management support, green purchasing, green manufacturing, green packaging, green logistics, green outsourcing, and green warehousing. Kumar et al. [16] divides green processes into four, that is green design, green manufacturing, green logistics, core reconditioning and disposal. Table 1 shows the keywords that can be used to group processes in the supply chain into green processes.

Table 1. Keywords generate in each green processes

Green Processes	Keywords
Green design	Green design; and Eco-design.
Green manufacturing	Green manufacturing; and Green operations.
Green logistics	Green logistics; Green transportation; Green packaging; and Green warehousing.
Core reconditioning and disposal	Disassembly; Remanufacturing; and Green disposal.

2.2. Green Design

Green design is concerned with designing products that are ecologically sustainable and produce less emissions in the manufacturing process and when used. So that it can reduce the environmental impact [16]. Green design is also considered to be able to encourage organizations to innovate, improve brand position, and better business communication [17]. In the green design process, it uses less energy and emits less emissions.

2.3. Green Manufacturing

Green manufacturing is the process of transforming products from raw materials to finished products. In the green manufacturing process, the resulting waste can be minimized both in the form of emissions and product residues (such as: metal grinding in the machining process) [16]. The purpose of green manufacturing is to reduce the bad effects of the manufacturing process. So that the green manufacturing process produces quality products to avoid a lot of returns and damage, and there is no waste/pollution which can ultimately reduce the cost of raw materials [11].

2.4. Green Logistics

Logistics is the flow of resources from upstream to downstream to meet the needs of the company or customer [16]. Activities in the distribution logistics process such as: procurement logistics, production logistics, distribution logistics, disposal logistics, and reverse logistics. While activities in green distribution logistics include green packaging and green transportation. Green logistics aims to minimize the environmental impacts that occur in the logistics process, such as by optimizing routes, maximizing transportation volume, reducing fuel consumption, and reducing fuel emissions.

2.5. *Disassembly*

Disassembly can reduce the environmental impact by means of product recovery [16]. The purpose of disassembly is to take part at the end of the age of the product that can be reused, recycled, and then reproduced. Thus disassembly can minimize the total amount of waste that arrives at the landfill.

2.6. *Remanufacturing*

Remanufacturing is the process of utilizing used components that come from the final demolition of the final product to make a new product. Some remanufacturing processes are final product life span, product separation, disassembly, cleaning, repair and reassembly [16]. The aim of remanufacturing is to improve the environmental performance of the industry by reducing the amount of material wasted. So as to reduce the need for new components, production that causes emissions and energy consumption.

2.7. *Advantages of GSCM*

GSCM is a corporate approach to being environmentally friendly [5]. GSCM is carried out by companies to obtain financial and environmental benefits. GSCM is carried out by companies to get financial, environmental [12] and social benefits [8]. Table 2 shows some benefits for each aspect.

Table 2. Advantages of GSCM implementation

Aspect	Advantages
Financial	<ul style="list-style-type: none"> • Increase revenue for increasing customer confidence. • Reduce waste treatment costs. • Increase asset utilization.
Environment	<ul style="list-style-type: none"> • Reducing the amount of waste produced. • Increase the efficiency of energy use. • Reducing air emissions. • Reducing water emissions. • Reducing fuel consumption that is not environmentally friendly.
Social	<ul style="list-style-type: none"> • Reducing the danger of waste and gas emissions resulting from overall supply chain activities on public health.

Vanalle et al. [12] compares the positive impact on GSCM internal practices (internal environmental management; eco-design) and external GSCM practices (green supply chain; customer cooperation with environmental concerns; and investment recovery) on corporate performance (operational performance, and economic performance). It was found that internal practices were higher than external practices.

The companies believe that by adopting green supply chain practices, they can be more competitive in the market [18]. Internal and external green supply chain practices contribute to improving environmental performance because for all companies that is a positive relationship between green practices and environmental performance in term of energy, water consumption, waste and air emissions reduction. Internal environmental practices such as: internal environmental management, green design, green purchasing, and green production. External environmental such as: environmental collaboration with customers and suppliers green packaging, and reverse logistics.

GSCM practices are carried out due to pressure from various interests and organizational pressure [5,8,10,19]. Institutional pressure influences decisions taken in organizations. Resulting in forcing companies to apply GSCM practices to perfect the organization's business model. This practice is able to have a positive impact on an organization to be wiser in using its resources and able to maintain its organization in being competitive [10,20].

3. A Case Study

Zhu et al. [5] using questionnaire data from managers in China manufacturing and processing companies that have an impact on the environment. The results obtained that from a scale of 5.0, the company's mission is running GSCM became one of the drivers that the highest points with an average of 4.45. Whereas related costs have the lowest average of 4.03 which shows that managers may not see environmental programs as providing a large economic benefit for the company. Based on literature studies and the results of the distribution of questionnaires to 314 industry experts, companies in China have implemented strong GSCM practices. This is supported by the company's awareness of the environment due to pressure and regulatory encouragement.

Wu et al. [10] conducted an empirical study of textile and apparel manufacturers in Taiwan. They investigate the relationship between GSCM drivers (organizational support, social capital, and government involvement) and GSCM practices (green procurement, collaboration with customers, eco-design and investment recovery). Using a hierarchically moderated regression analysis method, the research shows that: all three GSCM practices except investment recovery are positively influenced by GSCM drivers; investment recovery is only positively influenced by organizational support; market pressure does not have a moderating effect on the relationship between drivers and GSCM practices; regulatory pressure has a positive moderation effect on the relationship between drivers and GSCM practices; and competitive pressures have a negative moderating effect on the relationship between drivers and GSCM practices.

Kebenei et al. [6] made a descriptive survey research design at the Department of Textile Industry in Eldoret, Kenya. The questionnaire was used as an instrument for data collection. Then analyzed using descriptive statistics. The results showed that the three independent variables (green procurement, green manufacturing, operations and reverse logistics) showed a very strong relationship with the dependent variable (organizational productivity). So the textile industry must consider the environmental impact when making purchasing decisions. In addition, it has begun to adopt production with relatively low and efficient environmental impacts resulting in little or no waste/pollution. And logistics practices that comply with environmental regulations include the flow of products, information, and services from origin to consumption. It is hoped that further research will be carried out in other sectors.

Puryono et al. [11] applied the green supply chain at the Pabrik Gula Trangkil, Indonesia to improve the company's financial performance. They use the AHP method to measure supply chain performance. Then compare the real weight gain obtained from the SCOR model. The Du Pont Ratio Analysis method (ROA and EVA models) is used to measure the company's financial performance. The results of this study are a decision-making information system that can describe the relationship between the green supply chain and the company's financial performance. The analysis shows that when companies implement green procurement, green manufacturing, and green distribution can increase company's financial by 87.3% and efficiency by 12.7%. This application can be developed to assist managers in making decisions when planning to implement a green supply chain.

Vanalle et al. [12] used partial least squares structural equation modeling (PLS-SEM) that provided by smartPLC software to explore GSCM suppliers of a Brazilian automotive supply chain. The results show that the adoption of GSCM practices positively impacts to the economic and environmental performance. But not be proved in relationship between GSCM and operational performance. This research also identifies institutional pressures that influences GSCM practices.

Villamizar et al. [7] used a semi-structured interview method in 58 different manufacturing companies in Spain. This research shows how companies carry out manufacturing and environmental practices. The results of this study are several considerations for correctly measuring environmental efficiency in companies. These findings can be used to fully exploit the potential of environmental practices, so as to increase manufacturing productivity and environmental performance, as well as to identify trends in organizational development.

Dermawan et al. [8] devised a supply chain model to minimize resource consumption and adverse effects on the environment in the pharmaceutical industry. The method used in this research is

reviewed from an industrial and management perspective that focuses on methods, measurement tools, and solutions that can be applied to the GSCM model. The results obtained from this study indicate that the value of regulatory pressure is 3.28 (not thinking) compared to 3.01 for supply chain pressure at a total point of 5.00 each. This is in line with data obtained from the Global Intelligence Alliance which states that the strictness of regulations on the environment in Indonesia is still very low with points 2.8 / 7.0. Therefore, it is necessary to increase compliance with regulations established by the government in accordance with Presidential Regulation of the Republic of Indonesia No. 61 of 2011 concerning the national action plan for reducing greenhouse gas emissions. The GSCM model framework is very important to be applied in Indonesia, especially in the pre-production, production, and post-production stages that are comprehensive and consistent in the pharmaceutical industry.

Younis et al. [13] conducted a study to investigate the relationship between Green Supply Chain Management (GSCM) and Corporate Performance (CP) practices. They designed Mixed Method (quantitative and qualitative). A quantitative survey was conducted with 140 respondents in the UAE to test a series of hypotheses. In a qualitative study found several main reasons why GSCM practices fail to affect many dimensions of company performance. This study found that quantitative research alone is not enough to describe the relationship between GSCM practices and company performance. The results of this study are a series of managerial recommendations for companies interested in improving their performance while implementing green supply chain practices.

Santos et al. [9] developed a questionnaire that would sharing to 117 respondents on GSCM practices Brazilian manufacturer. There are three hypotheses formulate in this research: (H1) the adoption of GSCM practices with suppliers or (H2) customers separately and (H3) the balanced adoption of GSCM practices with both of the (suppliers and customers) has operational benefit for organizations. The result show that the operational performance has positive effect between suppliers and/or customer in GSCM. This research offered empirical support for managers to promote environmental practices that aim to operational performance and sustainable growth.

4. Conclusions and Future Work

The implementation of Green Supply Chain Management (GSCM) is able to have a positive impact on several manufacturing companies, such as increasing organizational productivity (financially and efficiency), environmental performance, and to identify trends in organizational development. In the success of GSCM, full support from management is needed which can be in the form of strict regulations to encourage the concern of the parties involved.

For future research, it discusses the impact of implementing GSCM activities to improve company performance. So that researchers can discuss in detail the relationship of each activity in improving company performance. Furthermore, it can be used by management in making appropriate GSCM decisions to be applied to the organization.

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