

# Making Supply Chain Green!

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## **ABSTRACT**

*Now everybody talk about global warming and its increasing problems such as toxic substance usage, and decreasing in non-replenish resources. Several organizations are taking some concrete steps towards reducing the ill-effects of global warming by applying green principles to their company, such as using environmental friendly raw material, reducing the usage of petroleum power, and using the recycle papers for packaging. These green principles are being applied in nearly every department of organization, including supply chain. From last couple of years the concept of Green supply chain management (GSCM) was emerging. This green principle covers each and every stage in manufacturing right from the first stage of product design to the last stage of product recycle life cycle. GSCM can also be used to other business sectors as well including government, education and services other than manufacturing sectors.*

*The purpose of this paper is to illustrate the impact of green strategy on the supply chain management. Since GSCM can be applied to various areas within the company, this paper also discussed the implementation of GSCM to numerous areas. Some examples of GSCM application also discussed to support the concept.*

**Keywords:** Global Warming, Product life cycle, and Green supply chain management.

## **INTRODUCTION**

One definition of green supply chain management (GSCM) is from (Srivastara, 2007). His study collected and classified previous literatures relating to green supply chain management. He defined GSCM as integrating environment thinking into supply chain management, including product design, material sourcing and selection, manufacturing processes, delivery of the final product to the consumers, and end-of-life management of the product after its useful life.

According to this definition, GSCM relates to a wide-range of production from product design to recycle or destroy, or from cradle to grave. This principal is similar to lifecycle of product. Product lifecycle is an idea that products pass through a cycle of life, similar to human, birth, maturity, death. The product lifecycle provides a degree of structure to the life of products and thereby provides direction for the diverse functional efforts required to

produce and deliver product/service offerings (Birou, Fawcett, & Magnon, 1998). Many studies addressed product lifecycle along with supply chain or GSCM, for example, (Stonebraker & Liao, 2006) discussed that the stage of lifecycle variables is associated with the various dimensions of supply chain integration.

Since GSCM normally involved the inverse of the product flow, reverse logistics are automatically included in the study. There were numerous researches about this. (Sheu, Chou, & Hu, 2005) proposed a linear multi-objective programming model optimizing the operations of both integrated logistics and used product reverse logistics in green supply chain. Results from their study showed that the proposed model improved net profits by 21.1%. In terms of both government and non-government organizations in the U.S., they were aware of the environmental changes, especially from gas price. In (Trunick, 2006) article, he discussed why the logistics companies should be more concerned on the GSCM. He described some regulations released by either federal or local organizations such as U.S. Department of Transportation (DOT) or California Air Resources Board (CARB), that affects to the logistics and how they

According to (Boks & Stevels, 2007), they categorized “green” into 3 types depended on the different perceptions of the environment among different stakeholders involved: scientific green, government green, and customer green. In scientific green, life cycle assessment (LCA) was used to determine the environmental impact of products, processes, and systems. However, it concerned only the emissions, not other aspects. In government green, several factors were involved such as population density, geographical position, and the availability of energy sources. These factors affected the government agenda to maintain or improve quality of life. For customer green, the perceptions of green were strongly linked to emotions that were directly impacted to people, especially health and safety, than resources or emissions.

Although GSCM was introduced not too long ago, there have been a number of studies about it. These studies were differently in detail. There are a few papers that collect studies, categorize them and conclude the trend of research. An example of a paper related to previous GSCM studies is (Kleindorfer, Singhal, & Van Wassenhove, 2005). They collected research from the first 50 issues published in The Production and Operations Management Society (POMS) and found that there were substantial number of research related to sustainability, including integrating environmental, environmental management, green-product design, and closed-loop supply chains. Another example is (Srivastara, 2007), he gathered numerous article and study related to the green and sustainability supply chain, and classified based on problems context into 3 types: importance of GSCM, green design, and green operation. He also classified based on methodology into 3 types: empirical studies and mathematical modeling.

### **BENEFITS OF GSCM**

Speaking of greening the supply chain, one might think only banning toxic chemical substance usages or reducing emission or waste to the environment. However, it is much more than just a mere reducing usage and pollution. Consequently, the benefits are not limited only less toxic consuming or less waste. The GSCM principle can be applied to all

departments in the organization. The effects of GSCM expand to all area, both tangibly and intangibly.

Some studies mentioned benefits of adopting GSCM, such as (Stevens, 2002). He demonstrated the benefits of GSCM to different roles of supply chain including environment and society in terms of different categories: material, immaterial, and emotion. For material, GSCM helps lower environmental load for environment, lower cost prices for supplier, lower cost for producer, lower cost of ownership for customer, and less consumption of resources for society. In terms of immaterial, GSCM helps overcoming prejudice and cynicism for environment, less rejects for supplier, easier to manufacture for producer, convenience and fun for customer, and better compliance for society. For emotion, GSCM helps motivation of stakeholder for environment, better image for supplier and producer, feel good and quality of life for customer, and make industry on the right track for society. He also provided examples of company that were successfully adopted GSCM.

In (Duber-Smith, 2005), he identified ten reasons that the company should adopt the green: target marketing, sustainability of resources, lowered costs/increased efficiency, product differentiation and competitive advantage, competitive and supply chain pressures, adapting to regulation and reducing risk, brand reputation, return on investment, employee morale, and the ethical imperative.

## **WHAT DRIVE COMPANY TO ADOPT GSCM**

### **Government**

In the United States, there are a large number of government agencies controlling guide line, regulation and law. Some agencies are federal by the government while some manage only in the local area. These agencies and organizations are responsible for either similar or different issues such as pollution, product material, and chemical waste. Different industries may be controlled by different regulation depended on the industry characteristics and resources needed. One example of the government agency is Environmental Protection Agency. Environmental Protection Agency (EPA) is a government organization established to protect human health and the environment. One of their responsibilities is to develop and enforce regulations that implement environmental laws enacted by Congress (U.S. Environmental Protection Agency, 2007). EPA was a main agency referred in most study related to environment.

An example of environmental guide line is ISO 1400 series. ISO 14000 was formally adopted in 1996 by the International Organization for Standardization (ISO). It represents a new standard and approach to improved environmental performance (Montabon, Melnyk, Sroufe, & Calantone, 2000). Results from their study showed that the ISO 14000 series can positively impact both performance of the environmental management system and overall corporate performance. It ensures that the company is well organized in the environmental field. However, ISO 14000 certification is no guarantee that such improvements are really delivered (Stevens, 2002)

For companies dealing with company in Europe, they got a huge impact from a new regulation released last year. The Restriction of Hazardous Substances (RoHS) limits the amount of lead and five other substances that may be contained in products sold to Europe

after July 1, 2006 (Jorgensen, 2005). Not only manufacturers who produce products, but suppliers, distributors or even customers do get great impact from this new regulation. One example of changes was that suppliers need to assign new part numbers to all lead free components.

### **Market and Competitor**

In today's business world, the competitive among company is very high. To make customer impress, the company needs to make themselves standing out from others. Being environmental friendly is one way to differentiate them from the competitors. Furthermore, when competitors already adopted GSCM, the company gets a pressure instead. Therefore, it is a good idea to implement GSCM no matter the competitors have adopted it or not. Not only competitors, but do customers affect to the company's decision to adopt the GSCM. In many cases, customers were the one who require special treatment or special products. Therefore, the company needs to make changes to make them satisfy and stay with them. Some papers studied about the relationship between applying GSCM with customer's requirement such as (Simpson, Power, & Samson, 2007). In this study, they explored the moderating impact of relationship between a customer and its suppliers and effectiveness of customer's environmental performance requirements.

### **Company**

Two drivers mentioned earlier are from external factor. Sometimes a driver is from the company itself. Numerous studies support that adopting GSCM can reduce the cost (Duber-Smith, 2005), (Stevens, 2002), and (Gunther, 2006). There also are other reasons such as increase efficiency, eliminate waste and pollution, and generate brand reputation. In terms of human resources, in (Duber-Smith, 2005), he mentioned that more sustainability enhances employee morale from some green programs such as wellness programs, ergonomic work environment.

There are several studies about the factors or benefits that make the company apply GSCM. In Chinese industry, (Zhu & Sarkis, The Moderating Effects of Institutional Pressures on Emergent Green Supply Chain Practices and Performance, 2007) developed a survey to 341 Chinese manufacturers to examine the relationships between GSCM practice, environmental and economic performance, incorporating 3 moderating factors market, regulatory, and competitive institutional pressures. Results showed that they experienced increasing environmental pressure to implement GSCM practices. Market and government pressures through regulation influenced them to improve environmental performance. Another study of this kind of study is (Hu & Hsu, 2006). They develop a set of critical factors of GSCM practices that could be used by managers. They surveyed in the electrical and electronics industries in Taiwan. Results showed that there were four critical factors: supplier management, product recycling, organization and involvement and life cycle management.

Factors and drivers to adopt GSCM in different industries were differently. In a study of (Zhu, Sarkis, & Lai, Green Supply Chain Management Implications for "Closing The Loop", 2008), they developed a survey to 4 industries in Chinese to evaluate their perceived GSCM practices and relate them to closing the supply chain loop. Results showed that automobile industry lagged behind the other industries, power generating, chemical/petroleum and

electrical and electronic. They assumed that the reason may result from a high level of complexity in the adoption of GSCM practices.

### IMPLEMENTATION OF GREEN

From product lifecycle concept, the cycle starts at the designing of product. According to (Srivastara, 2007), literatures related to green design emphasize both environmentally conscious design and life cycle assessment/analysis. In designing a product, the designing team can change the raw materials or substances used during the manufacturing to be less toxic, more environmental friendly. Some terminologies are related to design for green such as design for environment or EcoDesign. An example of green product is hybrid car. Due to the increasing demand and decreasing amount of petroleum, automobile manufacturers needed to redesign the engine that consumes no or less gas. Hybrid car has been developing from day to day. One article about automobile design is (McAuley, 2003), he discussed the green design of automobile, which tend to change to advanced lightweight materials and fewer materials in vehicle design. In designing a product, the manufacturing company needs a high level of cooperation with their suppliers. An example for the research on supplier-manufacturer cooperation in EcoDesign is (Stevens, 2002). He also presented two examples of successful green supply agenda between manufacturer and suppliers.

In manufacturing process, the company can apply green by several methods to reduce the energy and resource consumption. This is where reuse and recycling are referred. Several papers provided green practices such as (Duber-Smith, 2005). He suggested some practices including reducing energy consumption, recycle and reuse, using biodegradable and non-toxic materials, minimize harmful emissions, and minimize or eliminate waste. In a Chinese sugar manufacturer, Guitang Group can reduce the wastes and improve their financial performance by using waste from the upstream as raw materials for downstream production (Zhu & Cote, Integrating Green Supply Chain into An Embryonic Eco-Industril Development: A Case Study of the Guitang Group, 2004).

Further than design and manufacturing, other departments in an organization are involved with the green. Purchasing could become an important agent for change regarding environmental initiatives in the supply chain (Preuss, 2001). In (Walton, 1998) article, he conducted a qualitative study to explore the primary areas for change to increase purchasing's impact on environment.

As mentioned earlier, not only manufacturer, other supply chain roles got impact from GSCM also. For a largest retailer in the U.S., Wal-Mart has an interesting story of adopting GSCM to their organization. In October 2005, Wal-Mart CEO committed the company to 3 goals: to be supplied 100% by renewable energy; to create zero waste; and to sell products that sustain Wal-Mart's resources and the environment, and Wal-Mart was launching a business sustainability strategy to dramatically reduce the company's impact on the global environment and become "the most competitive and innovative company in the world (Plambeck, 2007). In this study, she provided 8 practices engaged with 14 network partners.

### BARRIERS OF APPLYING GSCM

In (Zhu & Cote, Integrating Green Supply Chain into An Embryonic Eco-Industril Development: A Case Study of the Guitang Group, 2004), they studied the integration of green supply in sugar industry. They mentioned three barriers: maintaining close

relationships with their main suppliers, obtaining a larger market share through competition with other market share through competition with other domestic sugar refineries by improving product quality and reducing costs, and ensuring the sustainability of their operations including reducing the environmental impacts. At the same times, there are some research studied barriers of applying GSCM from supplier's perspective. An example of supplier's barrier is (Wycherley, 1999), he conducted a qualitative study on the suppliers' barriers of GSCM implementation for an environmental-friendly image products like the Body Shop.

### **SUCCESSFUL STORIES**

Several studies were exploratory study about a company succeed in applying GSCM, various in different industry such as electronics, automobile, furniture, and packaging. An example of Electronics Company is Advanced Micro Devices. Advanced Micro Devices (AMD) wanted to be recognized as a sustainable organization. They wanted to better mage the risk of a potential supply chain and work together with suppliers to identify alternative materials an equipment to minimize environmental impacts. Moreover, they were drove by their customers, investors, and non-governmental organization groups externally (Trowbridge, 2001). In packaging Industry, results from survey showed that green supply chain practices were positively linked to operational performance. Also, the green supply chain practices were affecting the allocation of resources among 3 types of environmental technologies: pollution prevention, pollution control, and management systems (Vachon, 2003).

### **STATEMENT OF PROBLEM**

This study is aimed to find the GSCM adopting in the U.S. manufacturer in some aspects. The focus of the study is that the driver and factor that make the company in different industry choose to adopt GSCM in their organization. The survey will be sent to manufacturers across the country to different industries such as automobile, electronics, furniture, healthcare, plumbing, and textile. Survey questions will be asked to see the perspective of the manufacturers in GSCM and what make them apply it, as well as the future trend. Other aspects will be asked such as the collaboration with their suppliers and customers, technology used, and how they choose the supplier.

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