

Chapter 2

Environmental Management Practices with Supply Chain Efforts

Abstract This chapter aims to provide a comprehensive understanding of the sustainability impacts of supply chain and studies the commonly-used environmental management practices of achieving supply chain sustainability including product and process stewardship, green services, and green logistics management. From the life cycle perspective, all of products, processes, and services, involve multiple stages which incur energy consumption, wastes, and pollutant emissions. Product stewardship is concerned with the environmental impact of products relating to their packaging design, production, delivery, usage, and development. Process stewardship is concerned with reducing adverse environmental impact in the processes ranging from production, distribution, to end-of-life product management. Green services are the services that are designed to have a lesser effect on environment and human health. Moreover, green logistics management which can be driven by economic pressure, customer pressure, and environmental regulation, helps mitigate the environmental footprints of forward and reverse flows of products, information, and services between origin and consumption. Last but not least, extended producer responsibility is a type of product stewardship that requires at a minimum the producer to be responsible for their product throughout the life cycle, which includes various approaches such as take-back programs, advanced recycling fee, and voluntary industry practices. Extended producer responsibility could improve market performance of businesses by materials recycle, waste reduction, and customer integration.

2.1 Product Stewardship

With an increasing demand for organizations to be environmentally responsible, the scope of environmental management spans from product development to management of the entire product life cycle, including eco-design, clean production, recycling, and reuse with a focus on minimizing the expenses associated with manufacturing, distribution, use, and disposal of products [1].

2.1.1 Definition of Product Stewardship

The product-oriented environmental management practice can be referred to as product stewardship. Product stewardship is concerned with reducing environmental burden with less use of hazardous and nonrenewable materials in products development, considering the environmental impact in product design, packaging, and material used [2]. The product should be made of non-hazardous materials, is packed in minimal or reusable packaging and consumes less energy when in use. The product is also designed for easy disassembly to facilitate reuse and recycling of parts and components with the aim to reducing environmental impact upon disposal [3]. Aimed to reducing the environmental damage arising from all product-related parts and components, product stewardship promotes recycling and reuse of product components with eco-design, and using recyclable parts and packaging [4]. An exemplar of implementing product stewardship is Samsung Electronics Co., Ltd. a South Korean multinational electronics company. Samsung has established the Eco-partner Certification in 2004 to address the European Restriction of Hazardous Substances Directive (RoHS). This certification encourages active participation and cooperation of suppliers to remove hazardous substance from products at the raw materials acquisition stage. In regards to treating end-of-life products, Samsung has an extensive mobile phone recycling program, with operations in 32 countries across Asia, Europe and the Americas. In the U.S., Samsung has recycled 1.7 million pounds of e-waste through Samsung Recycling Direct. This mobile phone recycling program allows electronic products recycling in all 50 states of the U.S. [5].

Product stewardship is often mentioned alongside with extended producer responsibility. Both practices concern management of end-of-life products, however product stewardship refers to the responsibility of every party involved in the product lifecycle, not only the producer. According to the Product Stewardship Institute, extended producer responsibility is a type of product stewardship that includes at a minimum that the producer is responsible for their product and that responsibility extends to post-consumer management of that product and its packaging [6]. Extended Producer Responsibility (EPR) in some countries, such as the European Union and South Korea, is mandatory in such context as WEEE and ELV Directives, requiring producers to be responsible from production to post-consumer management of product and its packaging. This shifts the financial and management responsibility of end-of-life products upstream to producers and not on users. EPR also encourages producers to consider environmental impacts of their products and packaging during the design stage to facilitate recovery of useful residuals for new product development. In product stewardship contrarily, constitutes that the producer is the first step and has the greatest influence over adverse environmental impacts throughout a product life-cycle. However, other stakeholders such as suppliers, retailers, and consumers are assumed to be responsible.

For example, upstream suppliers would cooperate to provide raw materials that are more environmentally friendly, whereas consumers would participate in recycling of end-of-life products.

2.1.2 Components of Product Stewardship [7]

There are 10 aspects to consider when implementing product stewardship:

1. Shared responsibility:

All stakeholders, namely suppliers, manufacturers, retailers and customers, involved in a product lifecycle are responsible when it comes to product stewardship. Specifically, manufacturers have the responsibility and need the ability to reduce the environmental footprint of their products. By reducing use of toxic substances and designing components for reuse and recyclability, manufacturers can reduce costs, improve profitability, and foster customers' values with less environmental footprints. Besides, retailers play a salient role in influencing suppliers to behave more environmentally friendly, educating consumers on choosing environmentally safe and efficient products, and enabling consumer return of products for recycling. Real change, however, cannot be achieved without the participation of consumers. It is ultimately the consumers who make the purchase decision, use and dispose the products responsibly. Responsibility to ensure products are managed safely, in regards to supply, distribution, use, dispose and recycle is shared amongst stakeholders.

2. Lifecycle thinking:

Firms should work towards thinking of the product lifecycle as a whole to prevent or reduce environmental risks, and to improve sustainability. For example, Samsung continues to improve eco-features of its products. In 2006, Samsung started to implement an Eco-Design Process to evaluate the eco-friendliness of its new products at the development stage [8]. Under this rating system, it classifies a premium eco-product as complying with regulation standards, qualifying for environmental marks, and is innovative in reducing environmental impacts. When evaluating the environmental impact, firms need to consider raw material extraction, material processing, transportation, distribution, consumption, reuse/recycling, and disposal. Taking a holistic assessment of the environmental impact of a product life-cycle is important as a product is likely to have different environmental impacts at different stages of its cycle. Taking aluminum as an example, the extraction and processing of aluminum have an adverse environmental impact, but the use and recycling of aluminum are relatively benign.

3. Knowledge:

Firms need to understand the potential environmental, health, and safety risks in a product manufacturing stage as well as the environmental impact in its life-cycle may cause. This allows contingency plans to be developed early to

reduce environmental risks. The responsibility for developing knowledge of a product's hazards lay on the manufacturers who are responsible for designing their products. For example, DuPont develops a comprehensive toxicology database on its products, raw materials, and degradation products, which lays a foundation for knowledge on product safety for workers, consumers, and the ambient environment [8].

4. Supply chain communication:

It is important to share information with upstream and downstream partners in a supply chain to allow partners to fully understand potential hazards. For example, Samsung works closely with suppliers for carrying out a series of site audits on its major suppliers in China to assess their practices in human rights, working conditions, and environmental protection in 2012. In case of any violation, Samsung would suspend transactions immediately having adopted a zero-tolerance policy [8]. Information related to product specification and environmental requirements, delivery information, and exposure to hazards, are shared between supply chain partners to facilitate environmental management in their segment of supply chain [9].

5. Stakeholders:

Firms need to understand the needs and concerns of stakeholders, such as employees, stockholders, suppliers, neighbors, governments, peers and public interest groups, in order to incorporate their opinions to develop solutions to reduce environmental impact. For example, Samsung collects information from key stakeholders through different communication channels, including:

- Reaching out to *customers* through customer relationship management programme, eco-friendly awareness campaign, conducting survey, and green marketing.
- Working with *suppliers* on energy saving partnership, support for greenhouse gas inventory, and training in climate change response.
- Training *employees* through meetings with the CEO, communication through Samsung media, internal blogs, and eco-friendly campaign.
- Participation in *government* policy, the Environment Mark, and carbon labeling system.
- Supporting *NGOs* through answering environmental inquiries, responding to green ranking, and producing sustainability report and information postings on its websites.
- Communicating with *local communities* through eco-friendly campaigns with the participation of local residents, establishing a “one company, one village” sisterhood relationship, supporting children's environmental schools, and hosting CSR forums for college students.

6. Teamwork:

Teamwork component of product stewardship is concerned with developing tightly knitted working relationships between experts, who have expertise on different aspects of the product's lifecycle. For example, while Samsung's

research and development teams search for eco-friendly materials and design products with lower environmental impacts, the manufacturing team needs to know about all the materials information and product specifications in order to carry out and monitor environmental impact of the production process without fault. Marketing team also needs to know about the product features and eco-friendly characteristics for highlight in marketing programmes. While the legal team needs to establish environmental standards that comply with national and international regulations, it also needs to ensure that all internal as well as external parties are aware of and comply with the standards.

7. Awareness:

Organizational awareness of product stewardship is referred to as a situation where firms stay on top of industry news regarding new product changes and risk. This will allow firms to develop quick response to changes which can impact product safety such as resources, processes, science, technologies, uses, users/customers and societal and regulatory expectations.

8. Innovation:

Innovation improves products to reduce environmental impact as well as to meet customer and societal needs. Firms are advised to actively conduct research and development for improving environmental performance in order to achieve sustainability. Through eco-innovation, Samsung introduces a wide range of products using green technologies, which decrease use of hazardous materials while saving resources and energy in production and product in-use. For example, LED televisions that are high in energy efficiency with EU energy efficiency rated A+, washing machine with the lowest energy usage in the U.S. that consumes only 90 kWh/year, hazardous materials free smartphones, and so on [8].

9. Management:

Management of product stewardship is concerned with implementation of practices that continue product stewardship management within the firm and find new ways to improve continuously.

10. Integration:

Lastly, integration of product stewardship is referred to action that integrate each and every function and department of the organization when practicing product stewardship. This includes every function making up the lifecycle impacts of a product. Individual consumers are also product stewards whenever they buy, use, and discard any product.

No product is entirely environmentally safe, such that it does not require resources and consume energy to produce or to use. Yet, in order to minimize negative environmental impacts and maximize eco-friendly features of the products, product stewardship is required. The above ten components are crucial to guide firms in implementing product stewardship. In order to reduce the environmental impacts of products, involvement from the supplier, manufacturer, retailer and consumer is required.

2.1.3 Product Stewardship Example

Seiko Epson Corporation, more commonly known as Epson, a Japanese electronics company has environmental conservation as one of their social responsibilities. It implements a six-step product stewardship practice [10]:

- *Think*: Epson understands that the environmental effects of a product during use as well as throughout the product life cycle are mostly determined at the planning and design stages. Epson designs and plans with three foci: energy-saving design, resource saving, and elimination of harmful substances. Epson designs products with an aim to reduce energy consumed during use by setting an energy-conservation goal for each product. To save resources, Epson sets targets for recyclable rate of products as well as reduce consumption of resources through compact product design in terms of size and weight. Epson also develops and makes use of a database that collects all the information on banned substances by different standards.
- *Choose*: Epson strives to procure green production materials with less environmental impact. Epson has established the SEG Green Purchasing Standard for Production Material in 2003, which maps out the organization's policies to green procurement of production materials and provide standards and procedures for implementation. Epson has also developed the supplier part approval and production material approval systems to ensure all products are in compliance with product content restrictions and do not contain banned substances set by Epson's standards.
- *Create*: During the manufacturing process of its products, Epson focuses on global warming prevention, zero emissions, chemical substance management, and factory environmental risk management. The prime example is the "Epson Method", a patented technology to calculate PFC emissions, which is one of the most difficult non-CO₂ greenhouse gases to measure. This method has radically reduced Epson's level of PFC emissions. The Epson "zero emissions" program is an initiative that promotes effective use of resources, waste reduction, and extension of product lives to avoid disposal. All subsidiaries of the group worldwide are to meet material recycling targets at production sites. In addition to recycling, Epson is recently moving towards resource conservation practices [10], for example cutting energy use in basic facilities and buildings at plants, reduce energy use through production equipment, and process innovations and introducing new types of energy.
- *Deliver*: Epson has initiatives in Japan and other countries to lower CO₂ output in logistics. Epson monitors its shipping volumes, energy usage, and CO₂ emissions to reduce environmental impact of its distribution activities with a goal of reducing emissions by 1 % versus the previous year per unit of sales. To do so, for example, Epson Europe B.V. (Netherlands) introduced double-decker trucks in Europe to replace conventional trucks. These double-decker trucks increase loading efficiency, subsequently reduce the number of trucks required for the same volume of delivery.

- *Use*: Energy consumption and ease of product disassembly for recyclable components are parts of Epson's focus when designing a new product. Epson uses a variety of environmental labels to communicate to customers about their environmental performance. A "Product Information Sheet" is supplied to customers to ensure end-users can safely and properly use Epson products and know about chemical content of products.
- *Recycle and Reuse*: To treat end-of-life products, Epson established a worldwide network of collection and recycling system. Customers can recycle Epson products with ease as product recycling and reusing issues are already incorporated in the design stage.

2.1.4 Performance Impacts of Product Stewardship

A research study on the role of environmental management and the influence of environmental management capability of suppliers on firm performance and pollution reduction found that product stewardship does not directly generate desirable financial and environmental performance. Yet, product stewardship is a useful enabler for process stewardship and subsequently bringing desirable performance [11]. Selecting and evaluating alternative materials and components in product and packaging development is part of product stewardship. These practices emphasize the use of renewable, nonhazardous, and recyclable materials in product manufacturing [12]. Product stewardship prevents the use of hazardous materials in products, and subsequently reduces hazardous waste and reduces environmentally threatening risks, such as water contamination. Environmentally friendly production techniques as well as resource and energy conservation are also important for production and usage of eco-design products [13]. Product stewardship requires cross-functional participation to determine the environmental consequences of products. Specifically, it requires involvement from procurement and production through to distribution and marketing [14]. The resource-based view (RBV) of a firm advocates that organizational resources and capabilities are valuable, rare, and inimitable determine the competitiveness of firms [15]. Adapted from the resource-based view, the Natural Resource Based View (NRBV) suggested that businesses are constrained by and dependent on the conditions and resources of their natural environment to prosper and flourish [16]. A firm can make use of three interconnected strategies—pollution prevention, product stewardship, and sustainable development to achieve superior performance. According to the NRBV, manufacturers would be more capable in reducing pollution and risk of accidental polluting or hazardous substance releases.

Research studies have also found that through product and packaging eco-design, use of low-impact materials and components, and an energy efficient product distribution method, the environmental consequences of products in production and distribution can be controlled [13]. In addition, firms can benefit

through promotion of their news and feature stories. The improved environmental reputation can attract and retain environmentally conscious customers [17]. For example, Hewlett-Packard and Dell Inc. are known for their global recycling programmes, and return and recycling service. These environmentally responsible initiatives have earned positive publicity and customers' compliments. Hewlett Packard and Dell Inc. h avoidance of legal penalty and bad public image in the case of environmental regulation violation [18], and cost savings from eco-design and recycling of more than 30 % of their products [19], financial performance can be improved.

However, a research study on the environmental management of Taiwanese electronics manufacturers has revealed that in some cases product stewardship brings a negative impact on the environmental and financial performance of the organizations [11]. This indicates that product stewardship is desirable but insufficient to lessen environmental damage, reduce costs in product development, and improve financial performance. In the early implementation stage of product stewardship, firms would incur costs and irrecoverable financial investments through new product design, use of recyclable containers for transportation, redesign of packaging and sourcing of ecological materials. Therefore, firms would not be able to secure the benefits of scale economy and waste reduction [20]. Similarly for pollution reduction, it is inevitable that the development of environmentally friendly product and packaging would generate waste and pollution. Therefore in the beginning of implementation, it would be difficult for firms to achieve pollution reduction.

Product stewardship requires involvement of all parties related to a product lifecycle. From the beginning of the lifecycle, the manufacturer source environmentally friendly materials and with design focusing on ease of disassembly and recycling. In the production stage, the processes with the least environmental pollution and risks would be used. Product stewardship aims to minimize waste and improve efficient use of resources through product design, packing, and material. However, prior research found limitations for cost savings and pollution control [21]. In the introduction stage of product stewardship implementation, economies of scale are difficult to achieve. Costs are likely to be incurred when developing environmentally friendly products and returning the reusable packaging to manufacturers [20].

2.1.5 Product Stewardship from the Consumer Perspective

Product stewardship concerns reducing environmental impacts with less use of hazardous and nonrenewable materials in product development. In the fashion industry, companies are similarly investing in this practice as eco-fashion. Eco-fashion consumption is a key aspect of sustainable development of fashion supply chain [22]. Chan and Wong [23] studied the consumption side of sustainable fashion supply chain. The study revealed that store-related attributes of eco-fashion

positively influence consumers' eco-fashion consumption decision. The price premium level of eco-fashion also affects this decision [23]. The research was conducted on consumers in Hong Kong, to examine the relationships between product- and store-related attributes of eco-fashion and fashion consumers' eco-fashion consumption decisions.

The study found that product-related attributes were not related to eco-fashion consumption decision. This suggests that consumers are less likely to purchase eco-fashion due to physical needs for body protection and functionality, emotional needs of expressing their personality, and psychological needs of identity building. However, store-related attributes, namely customer service, store design and environment, store's ethical practices and shop convenience, are found to positively influence eco-fashion consumption and plays an important role in consumers' eco-fashion purchase decision making.

Price premium is also another important factor in regards to eco-fashion consumption decision. A high price premium would discourage eco-fashion consumption decision, as fashion consumers tend to have a tight budget or do not want eco-fashion consumption to cause any sacrifice [23]. The Hong Kong research study establishes that price premium would affect the relationship between store-related attributes and eco-fashion consumption decision [23]. This can be explained by the fact that store-related attributes are largely intangible and consumers would base their perception and purchase decision on the price premium [24]. The research also finds that price premium would negatively affect the relationship between store-related attributes and eco-fashion consumption decision [23]. This shows that consumers may have a negative perception on store-related attributes when there is usually a price premium on eco-fashion. While having the above findings in consideration, fashion companies should also devise marketing plans to promote eco-fashion consumption, subsequently facilitating the development of sustainable fashion supply chain [25].

Global fast fashion giant, H&M Hennes & Mauritz AB (H&M) illustrates the findings of the aforementioned research. H&M is known for their environmental sustainability efforts—H&M Conscious. They have seven green commitments: to provide fashion for conscious customers, choose and reward responsible partners, be ethical, be climate smart, reduce reuse recycle, use natural resources responsibly, and strengthen communities [26].

Whether fashion companies can influence fashion consumers' purchase behavior depends on their ability to fulfill fashion consumer needs [27]. H&M fulfills the need for affordable and latest fashion trends. Their sustainability efforts are widely known because of the successful on-going ethical fashion range "Conscious Collection". The collection drew such generous amount of favorable responses among the public as well as celebrities. The environmentally friendly "Exclusive Glamour" collection was seen dazzling down red-carpet events on several A-list starlets [28] in 2012. The second "Conscious Exclusive" collection of evening launched in March 2013 was also another success.

Additionally, sometimes fashion consumers are unaware of the availability of eco-fashion and are only able to acquire limited information about eco-fashion [29].

H&M satisfies this need with on-going “Conscious” promotion in-store and online. H&M also has e-tailing business in the United States and Europe in addition to their existing physical stores to improve the ease of accessing eco-fashion and the information about eco-fashion [30]. E-tailing allows easy access for potential customers to up-to-date information about eco-fashion, such as the prices and styles. Although H&M e-tailing is not available in some countries, its website still provides all the local product information and prices. This way, consumers are provided with the benefit to search and evaluate more information about eco-fashion when making a purchase decision.

Fashion consumers also have psychological needs to have symbolic feeling of advantage that links to a socially responsible lifestyle and to express their personal ethical identity through purchasing from a store that behaves in ethical ways [22]. H&M is known for adopting ethical practices, from sourcing environmentally friendly materials to garment recycling. Product stewardship starts at the beginning of the product lifecycle. H&M is the world’s largest user of organic cotton. Use of organic cotton in garments is more environmentally friendly than conventional cotton. The former requires less energy and water in production; zero pesticides and 95 % of all textiles can be recycled [31]. H&M has also broadened their sustainability efforts in collaboration with the World Wildlife Foundation (WWF) to improve stewardship of their global water supply [32].

Product stewardship is not only seen in H&M production but also with old garments. H&M was the first fashion company to launch Garment Collecting, a global initiative for customers to bring any unwanted garments of any brand in any condition to H&M stores worldwide [33]. To reduce garment waste, H&M separates the old garments into three groups: rewear, reuse, and recycle. Rewear garments are sold as secondhand goods, reuse garments are no longer proper for wearing but can be transformed into other products such as cleaning cloths, or be recycled for textile fibers.

2.1.6 Summary

Product stewardship is concerned with the environmental impact of products relating to their packaging design, production, delivery, usage, and development [34]. It attends to lessen the environmental damage of products in a supply chain from materials and components sourcing, production and distribution, to disposal [35]. While the concept of product stewardship for different industries are very For example, electronics manufacturers emphasize on reducing liability and costs, therefore their product stewardship involves eco-design of products for easy disassemble of components for reuse or recycling, design of packaging to reduce materials consumption and facilitate the recycling of packaging and adoption of reusable containers for transportation [36]. For the fashion industry, on the other hand, product stewardship focuses on ethical materials sourcing, reducing energy usage in production, and recycling.

An increasing number of global fashion brands are adopting eco-fashion. H&M demonstrates extensive product stewardship practices—from the sourcing of organic cotton, reduced use of water and energy in production to garment recycling. Public relations and media on their efforts are built through on-going promotions of the “Conscious Collection” in-store and online.

Store-related attributes of eco-fashion—customer service, store design and environment, store’s ethical practices and shop convenience—are important in making eco-fashion consumption decision. Fashion companies are encouraged to promote eco-fashion through satisfying consumers’ needs by improving store-related attributes. Fashion companies should also adopt ethical practices and inform fashion consumers. So that the consumers’ need to lead a socially responsible lifestyle would be fulfilled.

2.2 Process Stewardship

Process stewardship is a process-oriented environmental management practice [37]. It is concerned with reducing adverse environmental impact in the processes ranging from production, distribution, to end-of-life product management. It emphasizes waste reduction and contributes to environmental protection through implementing such processes as recycling reengineering polluting processes, minimizing carbon emission and so on [38]. Different from product stewardship that focuses on understanding and managing a specific product or commodity, process stewardship is about understanding and managing processes that are conducted in various phases of product development (e.g. extraction, smelting, generation of by-product) in order to minimize their potential harm to people and the environment. Mechanisms of process stewardship are useful in waste reduction and preserving the environment through managing the product flows from purchasing, storing and shipping, to asset recovery activities. This environmental management practice requires firms to implement recycling processes and develop a returned product collection infrastructure to collect, sort, and disassemble the returned products with the objective to capture reusable parts for new product manufacturing. Process stewardship would also utilize transportation capacity, reduce carbon emission, make use of cleaner transportation, and so forth. It can also benefit organizations with cost savings from for example, lowered fuel consumption.

2.2.1 *Process Stewardship Example*

Panasonic Corporation, a Japanese multinational electronics corporation, is committed to offer innovative and eco-friendly products through environmental management. It adheres to the ISO 26000 Core Subjects and GRI G3.1 Sustainability Reporting Guidelines to promote a consistent approach in sustainability reporting.

Panasonic's remarkable green efforts has earned the organization 4th place in the Interbrand Best Global Green Brands 2013 ranking. Its commitments include opening advanced environmentally friendly factories India, Brazil and Vietnam. Panasonic's new Econavi products—a range of air conditioners, washing machine and refrigerators—can save energy by monitoring the user's living environment and adjust the power usage to suit. The Econavi products also comply with "China Environmental Labeling Type II," the highest environmental protection product certification issued by the Chinese Ministry of Environmental Protection [39]. This new range of products not only saves energy but also is designed for reduced CO₂ emissions and using fewer materials during manufacturing.

Examples of process stewardship efforts of Panasonic include:

2.2.1.1 Chemical Substance Management

Through enforcing REACH and Restriction of Hazardous Substances Directive (RoHS) compliance measures, Panasonic strives to minimize environmental impact of their products. First, Panasonic identifies chemical substances in products. It contributes to the global goals set at the World Summit on Sustainable Development (WSSD) by disclosing publically information on all chemical substances used in its products across the supply chain. Panasonic works with suppliers to obtain information about substances contained in the parts used. Second, Panasonic evaluates the impact of the chemical substances used in the parts. It measures the amount of substances of very high concern (SVHC) that customers would be exposed to and provides information for using products with SVHC safely. Third, Panasonic discontinues use of any chemical substances that would cause any environmental risks [40].

2.2.1.2 Water Resource Conservation

To conserve water resources, Panasonic collects, treats and reuses wastewater from manufacturing processes and air conditioning systems. For example, the Technopark of Panasonic India Group recycles 100 % of the water used. After being used inside the manufacturing plant, ground water goes through wastewater treatment. The water is then reused as toilet flushing water and for lawn sprinkling. This greatly reduces fresh water use in its operations and subsequently eases the environmental risk of water shortage [41].

2.2.1.3 CO₂ Reduction

Panasonic also participates in one of the long-term global environmental targets of reducing CO₂ emissions and other green house gases by 50 % from the 2005 level by the year 2050. It has developed a unique indicator "size of contribution in

reducing CO₂ emissions” to accelerate emissions reduction. Through improving the energy-saving performance of Panasonic products, CO₂ emission would be further reduced [42].

2.2.2 Performance Impacts of Process Stewardship

Process and product stewardship are both important mechanisms of environmental management [43]. A research study on the environmental management of Taiwanese electronics manufacturers revealed that the implementation of product stewardship by an electronics manufacturer is positively associated with its process stewardship [11].

Design for reuse or recycling, and application of reusable containers for transportation are useful for process stewardship. For example, electronic manufacturers can capture residual values of returned products, reuse containers that have returned products collected from the market, and reduce consumption of new inputs by utilizing reusable parts.

The research study has also found that process stewardship is positively associated with pollution reduction. Process stewardship controls transportation method, production, carbon emission, and disposal, which play important role in reducing waste and environmental impact. This proactive pollution reduction practice—which involves partners such as suppliers, customers, and logistics service providers—creates a first-mover advantage that is difficult for competitors to imitate.

The financial value of preventing pollution should not be underestimated. Process-oriented environmental practices are found to be important for both financial performance and pollution reduction. For example, environmentally conscious customers would be aware of the firm’s process stewardship practices and so that they would return their end-of-life products for recycling. Process stewardship would also help reducing costs through lessening resources consumption (e.g. fuel and energy usage in operations) and capturing residual values (e.g. reusable components and materials) to lower the costs of purchasing materials and components [11]. Managers should work with suppliers who are ISO 14000 certified, conduct environmental evaluation on the second-tier suppliers, reduce environmental impact in their manufacturing processes, provide ecological proof of their outputs, and communicate about their environmental management with trading partners.

2.2.3 Summary

Process stewardship concerns using recycled or environmentally friendly materials, reducing waste, and adopting environmentally oriented technologies to lessen environmental impact in supply chain processes from production, distribution, to

disposal [44]. Process stewardship is valuable for firms to reduce environmental pollution impacts and achieve financial performance. Through environmental protection practices of collecting and recycling returned products, reducing emissions and so forth, firms can attract and retain environmentally friendly consumers. Process stewardship also brings forth the benefits of product stewardship. Product stewardship efforts such as eco-design, recycling packaging, and use of nonhazardous materials for product development enables process stewardship to achieve environmental and financial performances.

The impact of product stewardship and process stewardship on environmental and financial performance is further improved if a manufacturer works with suppliers of high environmental management capability. When the environmental management capability of suppliers is high, product stewardship and process stewardship have significant positive influence on pollution reduction as the research study on the environmental management of Taiwanese electronics manufacturers has found [11]. When manufacturers work with suppliers of high environmental management capability, process stewardship also brings positive impact on return on asset, return on equity, net profit, and earnings per share. However, this relationship does not exist when working with suppliers of low environmental management capability.

2.3 Green Services

In environmental management, green practices of organizations are not confined only to the manufacturing aspect. The green services sector is also an important element to improve environmental performance through environmental management practices. The distinction between goods manufacturing and service production is irrelevant for understanding service systems [45]. Similar to product manufacturing, providing services also requires and consume resources and creates waste and pollution [46]. For example, the leisure and tourism, hotel and catering industries consumes natural resources and contributes to pollution through solid waste and water disposal [47]. Some product-oriented industries would also provide such services as logistics services, which consume fuel and emit greenhouse gas. A lifecycle study on greenhouse gas emissions has found that household consumption of services—excluding electric utilities and transportation services—is responsible for 37.6 % of total industrial greenhouse gas emissions in the United States. This amount is almost twice of what is produced through household consumption of electric utility and transportation services [48]. This case clarifies that the service industries would not have less environmental impact on the climate change than the manufacturing industries and environmental management for service industries is just as important. Jim Hanna, the director of environmental impact of international coffee chain Starbucks revealed to TheDailyGreen.com—part of Hearst Digital Media—that Starbucks is pursuing Leadership in Energy and Environmental Design (LEED) because they “have a commitment to reduce our

environmental impact... [And] also realize that operating sustainably absolutely makes good business sense.”[49].

2.3.1 Green Services Definition

Green service practices have been defined as the provision of services that take into account environmental sustainability [50]. The Environmental Protection Agency (EPA) of the United States has developed the Environmentally Preferable Purchasing Guidelines. According to these guidelines, environmentally preferable services can be defined as “services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose. This comparison may consider raw materials acquisition, product, manufacturing, packaging, distribution, reuse, operations, maintenance, or disposal of the product or service.” [51].

Green services practices of service firms can be divided into *green service delivery* and *green service support* [52]. Green service delivery represents a firm’s practices and efforts to be environmentally responsible while performing its core service businesses. It is concerned with the extent to which firms manage a mix of tangible and intangible aspects in service operations, where the combination of goods, information, and services are delivered in an environmentally friendly manner with an aim to satisfy customer expectations [53]. Ranked in the top 50 of Interbrand’s Best Global Green Brands 2013, United Parcel Service of North America, Inc. (UPS) has innovative fleets and green facilities as one of their environmental sustainability efforts. In 2011, the UPS headquarters earned Leadership in Energy and Environmental Design (LEED) Gold certification from the U.S. Green Building Council and Energy Star certification from the U.S. Environmental Protection Agency. This certifies that the UPS complex uses less energy, is less expensive to operate and generates fewer greenhouse gas emissions than 75 % of similar buildings in the U.S [54]. This is an example of green service as UPS manages their complex in an environmentally friendly way where their tangible service operations consuming less energy with lesser greenhouse gas emissions. They have also recently announced one of the largest single deployments of zero-emission vehicles in the world; a fleet 100-strong that will reduce consumption of conventional motor fuel by approximately 126,000 gallons per year [55].

The peripheral or after sales services that supplement core services to enhance value to customers and service delivery are also part of service operations [56]. Green Service support is considered a peripheral service that supplements core service delivery by providing information and benefits, such as online inquiry, product collection for maintenance, and product end-of-life management, with an aim towards environmental protection. Green service support adds value to core services while reducing environmental impacts. Service support is important in addressing and meeting the expectations of customers. Additional costs may be incurred while providing service support and prior research has recommended the

use of Web-based service support to enable efficient and responsive service operations [57]. For example, courier customers are often concerned with where their parcels were located and estimated arrival time. Courier services nowadays—including UPS have efficient tracking systems that allow customers to see the statuses of their parcels online. Additionally, customer enquiries could also be handled through a live chat system for UPS United States and Canada. This approach facilitates sustainable consumption of services because it requires less customer contact (e.g., less transportation) and less consumption of physical resources (e.g., paperwork) [58].

2.3.2 Green Services Example—the Hotel Industry

In the early 1990s, Scandic Hotels—Nordic Europe’s biggest hotel chain—was on the verge of collapsing. The new CEO, Roland Nilsson, saved the company by introducing decentralized management and sustainable development. This new value system focused on the concept of sustainability, subsequently linked customers and employees, who were concerned for environmental responsibility. Scandic was then revived within a few years with profit and remarkable environmental sustainability efforts [59].

To stabilize the company and to grow towards the future, Nilsson believed it was essential to gear the company towards environmental sustainability, and that it would create a tighter bond with customers in a service industry like hospitality. Nilsson aimed to build customer loyalty and hence financial stability through establishing “an emotional tie between the customers and the company” based on the common desire for environmental improvement [59].

Although the restoration of profitability by Scandic relied on traditional turn-around tactics, such as cost cutting, management restructuring, and layoffs, sustainability also played a large part to their improved financial performance. Nilsson wrote in the company’s 1997 annual report that their “commitment to environmental issues has also contributed to an improvement in margins, e.g., through the resource hunt...” Scandic’s sustainability strategy showed the importance of green services implementation, and brought the organization visible benefits of cost savings and employee satisfaction.

The Scandic Hotels case was a prime success example of how the service industry can benefit financially from environmental protection practices. Nowadays numerous corporations in the hospitality industry have jumped on to the green services bandwagon. Hyatt Hotels Corporation is an American international company in the hotel industry. The group established Hyatt Thrive in 2011 as its corporate responsibility platform. Environmental sustainability is one of the four pillars that Hyatt Thrive focuses on. Its aim is to take focused, aggressive steps to reduce environmental impact by implementing more sustainable business practices across its operations. It recognizes the environmental impact associated with the

group's hotels and therefore makes strong, focused commitment to implement more sustainable business practices.

Hyatt has been measuring the environmental performance of its managed, full-service hotels against a 2006 baseline. Its primary goals are to reduce the energy and water usage, waste sent to landfills and greenhouse gasses emission. Due to the size of their cooperation, Hyatt empowers "Green Teams" at hotels around the world to implement a wide range of environmental initiatives. For example, the Green Team at Hyatt corporate headquarters in Chicago has started a competition to reduce paper consumption, which resulted in saving 2.5 million sheets of paper, amounting to a total cost savings of US\$22,000 [60].

2.3.2.1 Responsible Purchasing

As an international player in the hospitality industry, Hyatt consumes numerous amounts of resources while providing their services. Therefore responsible purchasing is a large part of its global environmental protection initiatives. The amenities packaging such as shampoo and lotion bottles are made of recycled plastic, which reduces 209,000 pounds of plastic waste sent to landfills in one year. Actively encouraging guests to participate in its environmentally friendly initiatives such as providing guests with reusable cloth laundry bags and promoting towels and linin reuse. Additionally, it uses detergents that help reducing energy and water use during laundry cleaning; this alternative helps saving 168,000 therms of energy [61].

2.3.2.2 Energy Efficiency and Waste Reduction

Hyatt has invested in over US\$37 million on environmental initiatives. It has completed more than 200 projects on energy efficiency improvements as of 2012. It has achieved significant reductions in the intensity values of energy use, greenhouse gas emissions, and water consumption. For example in 2012, energy intensity saw a 11 % decrease since the baseline year in 2006 and greenhouse gas emissions intensity decreased by 13 % since the baseline year as well [62].

In 2013, Grand Hyatt Beijing reduced energy use by 40 % over the past seven years. The Beijing engineering team launched several efficiency projects such as implementing central plant and lighting upgrades. These initiatives helped the hotel achieve cumulative cost savings of US\$4.9 million. At the same time, the Green Team also organized hotel-wide campaigns that focused on waste reduction, switching off lights, and powering down kitchen equipment.

2.3.2.3 Consistency in Carbon Reporting

For tracking and recording greenhouse gas emissions data, Hyatt has collaborated with the World Travel & Tourism Council in the Hotel Carbon Measurement

Initiative (HCMI). The HCMI joins forces in the hotel sector in the reporting of carbon emissions, and develop a common language, which provide clarity on understanding of carbon footprint. This also helps organizations achieve their own carbon reduction goals [63]. In 2013, Hyatt integrated the HCMI framework into its in-house environmental data tracking system, EcoTrack. This allows it's reporting to be of world standards.

2.3.3 The Value of Green Service Practices

The Natural Resource-Based View (N-RBV) theory explains how green service practices create value. The resource-based view (RBV) theory credits valuable resources, capability, and business processes that are socially complex and causally ambiguous to a firm's performance improvement [15]. Business processes that exploit firm resources enable firms to utilize and expose the tangible or intangible assets to the market for performance gains, and thus becomes a source of competitive advantage [64]. An extension of the resource-based view (RBV) theory, the N-RBV recognizes the dependency of businesses on natural resources and the need for capabilities in terms of pollution prevention, product stewardship, and sustainable development to achieve lower cost, preempt competitors, and enhance future position [16].

The main premise of an N-RBV is that effective green services practices incorporate environmental protection concepts into service operations by adopting and utilizing environmentally friendly resources, technologies, and materials. And thus based on RBV, firms achieve environmental performance improvement and cost reduction from resource synergy across (intangible) organizational processes and tangible assets [64]. Taking Hyatt as an example, the new environmental sustainability practices that were implemented were intangible value creating processes that gains them a competitive edge. Making use of energy and water reducing detergents, installing energy-efficient lighting at 97 % of Hyatt hotels, and having a "Green Team" culture are all aspects that are intangible and difficult for competitors to imitate.

2.3.4 Green Services Impacts

Many service industries, such as leisure and tourism, hotel, and catering sectors involve a wide range of physical components and natural resources. A research study examining environmental management systems of service firms in Hong Kong has found that green service delivery can reduce service operation costs and environmental damage. Service firms in Hong Kong have recognized their dependency on natural resources and the need for green service capabilities have managed to lower cost and also improve environmental performance. The study

shows that the adoption of appropriate green service delivery and support practices could lead to improved cost and environmental performance, as illustrated in the aforementioned hotel industry examples.

The study also demonstrates the importance of green service support practices. After sales and peripheral services contribute towards improving cost efficiency and environmental protection. The adopting green service support practices include offering online support centers, especially to those that facilitate maintenance and return collection. This supports the argument for the use of online service support for virtual interactions between service firms and customers [65], to reduce unnecessary transportation of materials and passengers [47].

For example, The Outnet.com—a fashion outlet website of Net-a-Porter the online luxury fashion retailer—offers a live chat facility for customers. For the ease of the customers, the live chat box appears on the bottom right corner of the screen during office hours. This virtual service allows customers to enquire about products and reduces the chance of purchasing a wrong item. This is an environmentally friendly way to offer help to customers and reduces unnecessary shipment and packaging materials of the products at the same time. Customer loyalty is also gained because potential shoppers would be able to get professional opinions easily before making a purchase; this greatly reduces customer disappointment by clarifying product information with them.

2.3.4.1 Environmental Management Systems

The main purpose of an EMS is to develop, implement, manage, coordinate and monitor corporate environmental activities to achieve compliance and waste reduction.¹ Compliance meaning a firm is reaching and managing the minimal legal and regulatory standards for acceptable pollution levels and would not incur sanctions. An EMS involves a formal system and database, which integrates procedures and processes for the training of personnel, monitoring, summarizing, and reporting of environmental performance information to internal and external stakeholders of the firm. This documentation is primarily internally focused on design, pollution control, waste minimization, training, reporting to top management, and so forth [66].

The International Organization for Standardization developed the ISO 14001, a certified EMS, which provides the criteria for an environmental management system. This voluntary EMS is not a set of performance standards but a framework of processes that organizations should follow to set up an effective EMS. It facilitates standardized EMS worldwide. ISO 14001 can be divided into two categories: organizational evaluation, which includes EMS, environmental auditing, and environmental performance evaluation; product and process evaluation, which

¹Sayre, D., 1996. Inside ISO 14001: the competitive advantage of environmental management. St. Lucie Press, Delray, Beach, FL.

includes environmental labeling, life cycle assessment, and environmental aspects in product standards [67].

Sometimes organizations opt for uncertified EMS, which allows them more freedom to develop the most appropriate system for the organization. For example, not all of Hyatt hotels have ISO 14001 certifications, however all hotels of the organization are part of the Hyatt Thrive program making use of Hyatt Eco Track, which is an in-house central database to track environmental data such as monitoring water consumption and waste produced.

The Hong Kong research study findings also suggested that an uncertified environmental management system (EMS) strengthened the cost reduction and environmental performance impact of green services rather than a certified one. A certified EMS requires formal systems developed by a firm to adhere to international standards (e.g., ISO 14000). Whereas an uncertified EMS could have a less rigorous, but more flexible, set of environmental practices (e.g., eco-labels) [66]. A firm being ISO 14001 certified would often lead to a ceremonial behavior intended to superficially show that they are up to standards [68]. According to the NRBV, it has been argued that competitors can easily copy a formal EMS such that it is insufficient to improve operational performance. For the service industry, firms face uncertainty as their operations relies on a high level of perishability, heterogeneity, and customer involvement. Performance improvement would be difficult to achieve under a rigid system. Uncertified service firms would have the flexibility to innovate and provide environmentally friendly services without the pressure to meet audit requirements. Therefore an uncertified EMS would strengthen the relationship between green service delivery with cost and environmental performance.

The same goes for green service support. The study has found that uncertified EMS strengthened the relationship between green service support and environmental performance only. This shows that green service support is critical to both financial and environmental performance regardless of an uncertified or certified EMS is in place. As there is a high customer involvement in green service support, there is also high uncertainty that requires flexibility in managing service maintenance processes to achieve performance. Strict rules and ceremonial behavior associated with a certified EMS would not allow firms flexibility to achieve better performance with green service support. Additionally, firms such as Procter & Gamble, argued that their uncertified EMS meets or even exceeds the international standards and contributes to significant performance improvement [69]. This suggests that firms with an uncertified EMS are able to develop their own set of practices tailored for their unique operations and subsequently achieve performance improvement with green service support.

2.3.5 Summary

Green service practices can be divided into two key areas: green service delivery and green service support. Green service delivery is when a firm is environmentally

responsible while delivering its service. It is an environmentally responsible practice that focuses on the use of environmentally friendly materials, conservation of materials, recycling, and energy efficiency. Green service support is a value adding peripheral service that supplements core service delivery. By offering technical support, product support, help desk support, repair services, maintenance service, recycling, training, and upgrading green service support further satisfies customer needs.

Green service delivery and green service support both contribute to cost reduction and environmental performance of service firms. Green service delivery and support would have stronger performance impact on firms with uncertified EMS in contrast to certified EMS. It has been argued that firms with a certified EMS would have rigid and strict practices in place that would actually hinder the highly versatile service industry operations and performance outcomes.

Green service delivery and support are critical to the success of environmental protection and cost reduction. Service firms need to source environmentally friendly materials, energy saving equipment, and facilities in their service delivery to reduce the use of electricity, fuel, carbon emissions, and waste disposal. Managers should be aware that green service delivery becomes more valuable to environmental and cost performance when a firm has an uncertified EMS. Green service support works with synergy to green service delivery as a peripheral service, for example if customers can access assistance online easily, customer value and satisfaction would be improved.

2.4 Logistics Management

Logistics concerns the organized movement of goods, services, and sometimes people. Logistics is the handling of the physical movement of products between one or more parties in the supply chain [70]. The Council of Supply Chain Management Professionals (CSCMP) in America—a worldwide professional association dedicated to supply chain management—defines logistics management as “part of supply chain that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers’ requirements.” [71]. Logistics activities include inbound and outbound transportation management, fleet management, warehousing, inventory, logistics network designs, supply and demand planning and so forth [72]. In some cases, logistics functions can also include sourcing and procurement, packaging and assembly, and customer service.

Logistics is an energy intense sector, which has rapidly expanded due to globalization. Transportation has been recognized as one of the main sources of pollution, namely in the form of air and noise pollution [73]. Transportation was expected

to increase even faster than the general growth of GNP in the industrialized world, where transportation volumes in the European Union have increased more than GNP in 15 years, since 1986 [73]. The globalization of production, procurement, and marketing has increased the ‘freight transport intensity’ of the economy, generating more tonne-kilometers of freight movement per unit of output. Much of energy usage has been associated with logistics, due to the rapid growth in demand for logistical services. A recent study on reducing energy consumption and emissions in the logistics sector has estimated that freight movement by truck, rail, and ship accounts for roughly a third of the total energy used by transport and around 6–7 % of total global energy consumption using statistics compiled by the IEA [74].

There are increasing concerns about negative environmental effects of logistics practices and that they are unsustainable in long run. Freight transport in the logistics sector accounts for around 8 % of energy-related CO₂ emissions worldwide [75]. The European Commission estimated that the amount of energy used to move freight might over take the energy consumed by cars and busses in the European Union by the early 2020s [76]. And that the International Energy Agency (IEA) has forecasted that—where everything remains unchanged—tonne-kms moved by trucks and ships will double between 2005 and 2050, while rail freight volumes will rise by 50 % [74]. The proportion of CO₂ emitted by logistics will rise rapidly because there are some logistics activities—such as shipping, long haul trucks and aircraft—will always rely on liquid and carbon-based fuel, subsequently requiring a large amount of fossil fuel. Therefore, mitigation of the negative environmental impacts of logistics management has drawn increasing attention.

2.4.1 Definition of Green Logistics Management

Green logistics management (GLM) aims to deploy processes that produce and distribute goods in a sustainable way, with a view to reducing waste and conserving resources in performing logistics activities. Green logistics activities include measuring the environmental impact of different distribution strategies, reducing the energy usage in logistics activities, reducing waste and managing its treatment [77].

GLM can be viewed as a management approach by which firms manage, evaluate, report, and control the environmental impacts of their actions throughout the life cycles of their products [78]. This management approach requires firms to:

1. Adopt procedures to operate, document, and report their logistics activities
2. Conduct evaluation of their performance
3. Inform and communicate with various stakeholders regarding their logistics activities
4. Comply with environmental standards

2.4.2 Drivers of GLM

Transport and logistics is a rapidly growing activity worldwide, especially when multinational organizations actively participate in global sourcing and production. With oil prices on the rise and greenhouse gas emissions concerns, optimizing logistics is one of the primary focuses for firms, in relation to both financial and environmental pressures. In 2008, BearingPoint Insight's global survey examined companies' viewpoints and practices on green supply chain management. The study collected data from over 600 professionals located in Europe, North America, and Japan. The survey found that green logistics is the link in the supply chain that attracted most interest. 81 % of the responding companies indicated that they made changes to their transport and logistics operations, out of which overhauling logistics organization to reduce the number of journeys was the most common approach, which accounts for 41 % out of all environmental measures [79]. As of 2012, in another report from 2012 done by BearingPoint interviewing more than 600 professionals worldwide, 66 % of the companies surveyed had started to green their logistics network. Out of which 37 % companies collaborate with partners to share logistics resources and 37 % and subsequently reduce environmental footprint [80]. Green logistics management enables firms to reduce pollution and energy consumption, while improve volume and cost performance. The 2012 report identified the main drivers for green logistics implementation include environmental regulations, costs reduction, and improving brand image [80].

The public is another main driver for green logistics. A research study investigating how environmental regulations, customer pressure, and economic pressure are associated with the implementations of GLM by Chinese export manufacturers finds that customer pressure is a significant factor affecting the extent of GLM implementation [81]. The findings suggest that regulatory and economic pressures are not primary considerations of manufacturers, whereas the GLM implementation is stimulated more by legitimacy and relationship continuation with customers. Similarly, a survey done by Eyefortransport—a business intelligence provider in the transport, logistics and supply chain industry—found the same general message in 2007, where the top two key drivers for initiating green logistics are to improve public relations and improve customer relations [82].

The research study based on Chinese manufacturers finds that economic pressure is not significant enough as a primary driver for firms to implement GLM. As the aforementioned surveys done by BearingPoint and Eyefortransport have mentioned, the primary driver is on satisfying customer requirements. Manufacturers implement GLM when they experience a higher level of the ecological modernization forces, in terms of environmental regulations, customer pressure, and economic pressure. The performance outcomes are positively associated with the extent of GLM implementation. Firms pursue GLM can reap environmental, operational, and financial benefits [81]. The surveys done by Insight (2008) and Eyefortransport (2007) also find that in addition to customer pressures, companies implement GLM for reducing logistics costs and gaining return on investment [82].

2.4.3 Performance Impacts of GLM

GLM can be reflected in the adoption of various environmental management practices such as reducing carbon dioxide emissions in distribution, remanufacturing, reuse, recycling, extending the product life cycle, and capturing value from used products [83]. By collecting and analyzing returned products, firms can identify problems related to product use patterns. This will allow firms to identify and develop breakthroughs for product improvement and new product development. This indirect market feedback provides valuable input to firms for improvement in product design, sourcing decisions, forward and reverse logistics planning, and new product development [84]. By implementing GLM, firms can reap the benefits of reducing the environmental burden of developing, distributing, and disposing of products, while improving financial, and operational performance.

The research study investigating how environmental regulations, customer pressure, and economic pressure are associated with the implementations of GLM by Chinese export manufacturers finds that GLM mediates the relationships between the ecological modernization forces—as characterized by customer, economic, and regulatory pressures—and their environmental, financial, and operational performance [81]. GLM is highly valuable to the ecological modernization of firms, in Chinese firms in particular. With the environmental problems in China worsening day by day to a point of eroding its GDP growth [85], the country calls for a balance between its economic development and environmental conditions [86]. Firms need to efficiently use natural resources such as energy, fuel, raw materials, and water, as well as cost and environmentally effectively manufacture and distribute products with economic value. Through pursuing GLM, firms can improve their environmental, financial and operational performance.

In 2010, McKinsey & Company conducted a survey examining how companies manage sustainability activities and how they assess and communicate these engagements of 1946 executives representing a wide range of industries and regions. The findings reveal that more than 50 % of executives consider sustainability “very” or “extremely” important in regards to new-product development, reputation building, and overall corporate strategy [87]. According to BearingPoint Insight’s global survey on green supply chain management, firms recognize the benefits of green logistics in terms of improved brand image, customer satisfaction, differentiation from competitors, costs reduction, and so forth [79].

2.4.4 Example of Green Logistics Management

Kraft Foods Group Inc., an American grocery manufacturing and processing multinational firm recognized the potential environmental and cost impact of logistics operations and has aimed at improving its distribution network efficiency since 2005. In 2009, Kraft announced that it has saved more than 50 million truck

miles since 2005 in its transportation sustainability efforts. As quoted in Kraft Foods' press release, Steve Yucknut, Kraft Foods' vice president of sustainability stated, "We are finding ways to drive fewer miles, reduce inventory piles, and eliminate idling trucks. We are collaborating with customers and suppliers. And we are using a number of high-tech innovations for our trucks and warehouses to reduce energy and CO₂ emissions." [88].

2.4.4.1 Increased Rail Use

Rail networks are less polluting however, not many logistics operations opt for this transport, as it is relatively less flexible. Kraft Foods started with "riding the waves (and rails) to environmental efficiency" as stated in its press release. It has greened their logistics through shipping via water channels and railways. Instead of shipping wheat to a Toledo, Ohio flourmill by truck, Kraft Foods saved more than a million miles (1.6 million km) by shipping via waterways. Replacing 10,000 truck shipments and reduced 2000 tons of CO₂ emissions [88]. Kraft Foods also sends products to customers by train instead of trucks in the United Kingdom and Austria, saving more than 40,000 miles and 150,000 miles respectively. Kraft Foods has gained a first mover advantage as the recent BearingPoint study reveals that the share of rail use is low in product transportation, representing only 5 %. However, Deutsche Bahn—European railway operator—expects an increase in demand for green rail operations, as customers will prefer green products more and more. Additionally, transporting goods by rail is a more competitive option for organizations in the long run, as oil prices are very volatile. French rail operator SNCF also revealed that it would increase operations in cargo transportation [80].

2.4.4.2 Fuel-Efficient Fleet Optimization

Saving fuel and energy is another key aspect for greener logistics. Inefficiencies in freight operations result in empty trucks most of the time. Kraft Foods addressed this by establishing a single hub in Bratislava, Slovakia, and has modernized its transportation network in Europe reducing 20 % fewer trips between its European plants and distribution centers. Additionally, the firm has utilized a special software to optimize truck loads that helps to reduce more than a million miles [89]. These direct store delivery vehicles and electronic refrigeration technology use up to 30 % less fuel a conventional truck. Optimizing freight operations to help saving energy consumption is not only applicable to large organizations like Kraft Foods, but also smaller firms and even self-employed individuals. For example, under the Guangdong Green Freight Demonstration Project—a World Bank initiative—has helped optimizing truck freight. The Guangdong government has helped Lin'an—a logistics brokerage information center that connects distributors with truck drivers—expand its online business [90]. This has greatly reduced the amount of empty trucks inefficiently wasting time and fuel in the province.

2.4.4.3 Technology Investments and Collaboration

Kraft Foods has started working with the U.S. Environmental Protection Agency—a market-driven partnership aimed at helping businesses move goods in the most efficient way possible—to work out the best practices and latest technologies best for the firm. Kraft Foods participated in the EPA’s SmartWay Transport Partnership where the firm adopted a no-idle engine policy at its shipping locations, piloted a hybrid frozen delivery truck program and increased its use of intermodal transport. Philippe Lambotte, senior vice president of customer service and logistics at Kraft Foods told Consumer Goods Technology that “full trucks that never stop... We believe we can move from approximately 12 percent of our volume moving on cooperatively routed lanes to a possible 30 percent,” [91].

Additionally Kraft Foods has collaborated with Oracle Transport management and rolled out the Project MOST (Management Optimized Sustainable Transportation) initiative. It has worked with Oracle consultants to develop the software that enhances performances and is functional for the company. The software can analyze Kraft Foods’ complex network of locations, measures truck movements, analyzes routes and devises new tracks to eliminate empty miles. Project MOST has cut more than 500,000 miles in 2009. “Overall, this transportation management project has allowed us to create unique capabilities for our business units and customers, allowing Kraft Foods to balance cost and service in a sustainable manner. We believe this will raise the bar of our performance levels for years to come,” Lambotte commented [91]. The green logistics efforts continued, in 2010, Kraft Foods has increased 36 % of sustainable sourcing, cut 45 million pounds of packaging, and eliminated 20 million kilometers of travel miles [92].

Apart from technology advancements that require a large amount of monetary investment, smaller firms can start with partnering with other logistics organizations. This has also become a trend in recent years, the BearingPoint report has revealed that more than 37 % companies interviewed are working with partners to share logistics resources in order to reduce environmental footprint. The report also forecasts a significant increase in logistics collaboration [80]. Procter & Gamble (P&G) has set a target to reduce road kilometers travelled by trucks by 30 % in the United Kingdom by 2015, and it has already achieved the target in 2013. The company revealed that the key is collaboration, working with retail partners and logistics suppliers; it also saw a trend in collaboration with firms in the same industry as well [93].

2.4.5 Summary

Globalization and multinational organizations made a jump in the transportation and logistics operations in the past decade. Without doubt, there are increasing concerns on the various environmental detrimental impacts of these operations. For example, energy consumption and greenhouse gas emissions draws primary

interests for companies with truck shipments. Companies with green logistics management (GLM) aim to implement processes and practices that produce and distribute goods in an environmental way, with a focus to reduce waste and conserve resources while performing logistics activities. Measuring environmental impact of distribution strategies, reduction in energy usage and reducing waste in logistics activities are all part of green logistics practices.

The main drivers for organizations to implement GLM are namely customer pressure, public relations, energy saving and subsequently cost saving. GLM allow firms to reduce pollution and energy usage while still achieving the same or improved volume and cost performance. Customer pressure is a significant factor affecting the extent of GLM implementation. Research findings suggest that customer pressure is a primary consideration rather than regulatory and economic pressures. GLM implementation is stimulated more by legitimacy and relationship continuation with customers.

GLM implementation is positively correlate with environmental, financial, and operational performance. As GLM requires that enterprises adopt various environmental management practices such as reducing carbon dioxide emissions in distribution, remanufacturing, reuse, recycling, extending the product life cycle, and capturing value from used products. Through collecting and analyzing returned products, firms also acquire valuable indirect feedback for product problems and product development. GLM also mediates the relationships between the ecological modernization forces—namely customer, economic, and regulatory pressures—and their environmental, financial, and operational performance. The current environmental situation worldwide calls for a balance between economic and environmental performance. Firm can achieve this balance by efficiently using resources such as energy, fuel, raw materials, and water, as well as effectively manufacture and distribute products that create customer value. Through pursuing GLM, firms can improve their environmental, financial and operational performance.

Organizations and business managers should be aware of the environmental impact of logistics activities. Implementing GLM is a crucial part of the greening of supply chains. Firms should also work with logistics providers to communicate and share a mutual agreement on the importance of environmental protection. Implementing GLM requires participation of the whole organization. Top management commitment and staff training as well as human resources participation such as campaigns to raise staff awareness can support the adoption of green logistics.

2.5 Green Logistics Management

2.5.1 Green Logistics Management

Green logistics management (GLM) is a management approach by which firms manage, evaluate, report, and control the environmental impacts of their logistics operations throughout the product life-cycle (Sroufe 2003). Firms implementing

GLM often: (i) adopt procedures to operate, document, and report logistics operations, (ii) evaluate of the logistics performance, (iii) communicate with various stakeholders regarding their logistics activities, and (iv) comply with environmental standards and regulations [94]. GLM are involved with reducing pollution in distribution, remanufacturing, reuse, recycling, capturing value from used products, and extending the product life cycle. GLM enables firms to produce and distribute goods in a sustainable way so as to reduce waste and conserve resources in logistics performance [77].

Lai and Wong [1] identified that there are four attributes of GLM:

- *Procedure-based practices:*
Procedure-based practices are the practices to perform GLM based on corporate structure and reporting systems in firms. These practices serve as a communication tool between organizational functions about their responsibility in GLM.
- *Evaluation-based practices:*
Evaluation-based practices reflect organizational ability to evaluate, monitor, and improve performance on a periodic basis. They aim to offer formal documents and reports to managers, reducing equivocality on the success of GLM.
- *Partner-based practices:*
Partner-based practices reflect organizational ability to coordinate with internal staff members and external partners in information sharing and communication on the development of GLM. A firm not only should provide staff communication and training on GLM but also should enhance partnership with suppliers and customers so as to competently mitigate the environmental impact arising from product flows.
- *General environmental management practices:*
General environmental management practices require visibility in product development and compliance with global environmental standards along the logistics chain. Firms maintain records in satisfying environmental standards with a formal reporting system for stakeholder access, such as publishing corporate social responsibility reports [95].

2.5.2 Driver of Green Logistics Management

The drivers of GLM can be broadly classified into customer pressures, economic incentives, and regulatory requirements.

- **Economic Incentive**
GLM is an important environmental practice that satisfies the growing organizational quest for productivity, while reducing pollution and resources consumption. It helps address the environmental issues incur in a product life-cycle.

For instance, distribution of products in an environmentally friendly manner would require guidelines to ensure product recovery can be achieved efficiently with compliance requirements and partner collaboration. Firms encounter two types of economic pressures in the global market, namely dematerialization and decoupling [95]. Dematerialization is referred to lower consumption of natural resources for each unit of output, while decoupling is concerned with lower dependency on the input of natural resources for continuous productivity growth. In view of economic pressures, GLM is a viable approach to resolve cost challenge and respond to the environmental request. Examples of economic incentive include governmental subsidies and material costs savings.

Rapid industrialization in recent years increases public's concern about the polluted air and water, energy shortage, and deforestation, posing challenges to firms in conserving natural resources in their operations (Economy and Liebertha [85]). Resource scarcity and rising raw material prices (e.g. crude oil, copper, nickel, steel, and resin) lead to an increase of material costs, which in turns raises economic pressure to firms to take environmental initiatives, such as using reprocessed or scrap materials in new product development. For example, Kraft Foods Group Inc., an American grocery manufacturing and processing conglomerate, engaged in making its distribution network more efficient and used a combination of alternative transportation and technology to reduce its logistics footprint. Motivated by saving the expenses on energy use, Kraft has been finding ways to drive fewer miles, reduce inventory piles, and eliminate idling trucks. In order to reduce emission, Kraft ships wheat to a Toledo, Ohio, flour mill by ship rather than by truck, eliminating the equivalent of 10,000 truck shipments and roughly 2000 tons of carbon dioxide emissions. Meanwhile, hybrid technologies are being used for store delivery vehicles to reduce fuel consumption and carbon emission (GreenBiz staff 2009).

- **Customer Pressure**

The rise of corporate social responsibility has laid foundation for transparency and accountability in sustainability performance of firms [85]. The environmental disclosures serve as a channel for firms to communicate and share information about their environmental performance, which helps shape public perception and environmental reputation of firms. A green image enhances the reputation of firms, which helps gain acceptance in the global market, especially for those export-orientating firms that are required to comply with environmental requirements and market expectations in sales to foreign customers. These requirements and expectations are imposed by customers to fulfill their own environment-related obligations, as well as to demonstrate their environmental responsibility [85]. The customer-based environmental requirements vary from ISO 14000 certification to retrieval of reusable components or products from their countries.

GLM implementation can generate spillover effects to nurture customer preference for related products so as to avoid environmental incidents and the consequential legal costs and fines [1]. GLM implementation not only facilitates

and promotes product return and recycling services, but also cultivates a firm's positive image through feature news to attract and retain environmentally conscious customers [17]. Customers often boycott companies and their products if the company is found with violation of environmental laws [96]. Many anecdotes suggest that sourcing from environmentally irresponsible manufacturers can damage the reputation of customer firms (e.g. retailers). Therefore, there is a rising trend for firms seeking suppliers who are ISO 14000 certificated, and monitoring suppliers performance through environmental auditing, in order to satisfy the environmental expectations of their customers. The implementation of GLM may signal the congruence of the "going green" expectation of the international community.

For example, Maersk Line, the shipping company responsible for around 1 percent of global carbon dioxide emissions, has saved US\$764 million on fuel over 2013 by cutting its carbon dioxide output by 12 percent. Maersk's eco-performance improvement is largely driven by the increase in its customer demand. Large customers representing 19 % of Maersk's business have requested tailored sustainability information as part of the service requirements. To comply with its customer requests, Maersk moves goods with a smaller environmental impact for its customers, delivering their sustainability promises (BusinessGreen 2014).

- **Environmental Regulatory Requirement**

Environmental regulatory pressure is concerned with regulations enacted by local and oversea regulatory authorities to control environmental impacts of organizational activities ranging from production, transportation, to disposal [1]. In many cases, these pressures are mandatory for firms to comply with due to legal requirements. Firms are required to comply with the environmental policies, such as WEEE and REACH [97], when exporting their products to the EU market. The products must be free from hazardous substances in accordance with Restriction of Hazardous Substances Directive (RoHS) and Registration, Evaluation, Authorization and Restriction of Chemicals (REACH). Also, the manufacturers and suppliers are required to undertake the responsibility of collection, treatment, and recycling of end-of-life products. These regulatory pressures reflect the environmental concerns by the local community and regulatory bodies as negative externalities caused by imports [98].

RoHS, was imposed in February 2003 by the European Union and its directive took effect in July 2006. Toshiba, a Japanese multinational engineering and electronics conglomerate corporation, took actions immediately to address the EU environmental directives and unveiled its first RoHS-compatible notebook, the Tecra S3, for the business channel in October 2005. Toshiba also introduced the first RoHS-compatible notebook with the Satellite A55-S1064 at its retailer Wal-Mart in December 2005 (GreenBiz Staff 2007). RoHS is closely linked with the Waste Electrical and Electronic Equipment Directive (WEEE), which sets collection, recycling and recovery goals for electrical products and is part of a legislative initiative to resolve the problem of toxic e-waste. Since 2004,

Panasonic, Thomson, and Victor Company of Japan (JVC) cooperated to develop a recycling scheme for the electronics and electrical equipment industries to comply with the requirements of WEEE. Their cooperation agreement include (1) establishing a recycling scheme in EU, (2) supervising the entire recycling operations, and (3) inviting other manufacturers and recyclers to join the scheme (GreenBiz staff 2004).

Based on survey data from 128 Chinese export manufacturers, Lai et al. [94] found that customer pressure is significantly and positively associated with the extent of their GLM implementation while environmental regulations and economic incentive are less likely to affect the manufacturers' pursuit of GLM. Lai and Wong [1] further suggested that the positive effect of customer pressures on GLM implementation is enhanced by environmental regulatory pressure.

2.5.3 *Summary*

GLM helps minimize the environmental impact of forward and reverse flows of products, information and services between the point of origin and the point of consumption. GLM can be driven by three incentives—economic pressure, customer pressure, and environmental regulation. Governmental subsidies and material costs savings provide economic incentives for firms' green logistics operations. In addition, firms need to comply with environmental regulatory requirements and address customer pressure if their products are to compete in global markets.

2.6 **Extended Producer Responsibility**

Extended producer responsibility (EPR) originated from Europe as a policy concept aimed at extending producers' responsibility for their products to the post-consumption stage of product life with the presumption that manufacturers have the capability to manage the end-of-life products to reduce environmental impacts [99]. The Product Stewardship Institute defines EPR as a type of product stewardship that includes, at a minimum, producers are responsible for post-consumer management of their products as well as packaging [100]. EPR in some countries, such as the European Union, South Korea, and China, is mandatory in such context as WEEE and ELV Directives, which require producers to be responsible in managing product-life-cycle from production to post-consumption stages of products and their packaging. Governments promote EPR for two major reasons. First, the policy allows local governments to be relieved from financial burdens of waste management. Second, the policy encourages reduction of primary resources consumption, urging manufacturers to utilize alternative materials and commence product design innovations for reducing disposal and waste in production activities [101].

The notion of EPR is largely different from green supply chain management, green purchasing, and corporate environmental management. Yet, the implementation of EPR requires supply chain efforts, and the support of these activities is crucial to its success. Green supply chain management focuses on the inter-organizational efforts in managing the supply chain processes to reduce adverse environmental impact from materials purchase, production, to distribution of finished products [81]. EPR, on the other hand, extends green supply chain management to manage take-back, recycling, and final disposal of products. As EPR manages residual values of returned products, its implementation is highly related to green purchasing that takes account of organizational sourcing decision with a focus on reducing use of environmentally unsustainable materials by developing purchasing policy, defining environmental objectives, and monitoring environmental performance of suppliers [102]. Green purchasing is involved in sourcing environmentally sustainable raw materials to facilitate recycling of returned products. It is also responsible to identify reusable components and parts of returned products for new product development to reduce purchase of virgin materials. As such, green purchasing supports EPR implementation by ensuring use of environmentally sustainable raw materials and making use of residuals retrieved from returned goods. Moreover, EPR is different from the concept of corporate environmental management that is confined to organizational efforts and practices to reduce their adverse environmental impact through product and process stewardship with an emphasis on reducing liability and costs [103]. Nonetheless, EPR requires the support of these efforts and practices to ensure environmentally friendly product design for disassembly and recycling, and to enable and facilitate production of new product and recycling of returned goods to be done with low level of environmental impact.

EPR emphasizes on the principle of waste prevention by manufacturers with practices such as recycling, reprocessing, and reusing the components or materials with residual values. Encouraging manufacturers to use sustainable materials and design sustainable products for recycling, and consequently reducing disposal, waste, and consumption of resources is an important goal of EPR. Many industries such as the automobile [104] and electronics [105] industries have established standards as reference for manufacturers to develop corresponding solutions for mitigating disposal and waste of reusable materials or components caused by their industrial activities. EPR practices can be a feasible way for manufacturers to seek more sustainable forms of development by improving their overall eco-efficiency in product development.

2.6.1 Approaches of EPR

EPR can be applied voluntarily by organizations or mandated by governments. EPR is implemented differently in different countries and organizations, sharing the common theme of having the producer bearing larger responsibility for product end-of-life management. The following are some of the most common approaches.

2.6.2 Product Take-Back Programs

Take-back requirement is a major element of an EPR policy, mandating manufacturers to collect and treat end-of-life products. This policy is highly beneficial for manufacturers to incorporate environmental consideration at the product design stage to facilitate their subsequent take-back programs. This product stewardship emphasis improves and advances the treatment of returned products [106] by disassembled parts inspection, reusable parts separation, recycling, reprocessing, and reusing the parts with residual value in the product take-back process [107]. This collection of EPR practices enhances producer ability to competently satisfy both the local and international requirements on environmental protection.

Some firms offer voluntary product take-back program to be environmentally responsible. For example, Apple Inc., an American multinational electronics company, offers voluntary take-back programs in different parts of the world. Apple Inc. reuse and recycling program varies somewhat differently across countries, but runs along the same lines, such that customers can return their old Apple Inc. electronics for free and discount will be offered to these customers for purchasing new Apple Inc. products. Taking the Apple Inc. U.S. Recycling Program as an example, customers can trade-in their iPhone, iPad, Mac, or PC to get an Apple Inc. Store Gift Card of the estimate market value of the returned product [108]. The implementation of product take-back program not only encourages customers to return their old products for recycling, but also promotes customers to continue to use the company's products.

A mandatory take-back program is when a government imposes regulations to mandate manufacturers or retailers to take-back their end-of-use products. For example, the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety of the Federal Republic in Germany enforced the End-of-life Vehicle Act, which is applicable to all vehicles sold in the Germany market after 1 July 2001. The regulation requires manufacturers and importers to set up nationwide collection system or commission third parties to collect their end-of-life vehicles. Along with this regulation, a recycling target was set, manufacturers, importers, and the third-party waste management firms have to meet the recycling rate goal of 80 % from 2006 onwards [109].

2.6.3 Advanced Recycling Fee (ARF)

An advanced recycling fee (ARF) is a fee added on top of product sales to cover the cost of recycling in California, U.S. Customers are charged with an extra fee when purchasing an electronic product. This fee would be used for the recycling of the product, allowing responsible disposal of electronic products. In California, ARF is imposed in the form of the Electronic Waste Recycling Fee under the Electronic Waste Recycling Act of 2003. Retailers collect the fee on the electronic devices

from consumers for end-of-life products management. The fee varies depending on the size of the devices, ranging from USD\$3 to USD\$5 [110].

2.6.4 Voluntary Industry Practices

In some countries, some firms of the same industry group together to develop a set of voluntary EPR guidelines, which provides a set of instructions for recycling and waste diversion tailored for the particular industry. For example, the Carpet America Recovery Effort (CARE) in the U.S. is founded by representatives of the industry, and it develops market solutions for the recycling and reuse of post-consumer carpet. The organization's mission "is to advance market-based solutions that increase landfill diversion and recycling of post-consumer carpet, encourage design for recyclability and meet meaningful goals as approved by the CARE Board of Directors." [111]. In 2012, CARE members have recycled 294 million pounds of carpet and diverted 351 million pounds of carpet from landfill, which was an increase of 17 and 5 %, respectively, in comparison to 2011. The organization has diverted over 2.6 billion pounds of post-consumer carpet from landfills since its foundation in 2002 [112].

2.6.5 Example of EPR

Sony Electronics Inc. has based its Green Management 2015 mid-term environmental targets on the idea of EPR, where it "strives to achieve an environmentally conscious recycling system and effective operation for collection and recycling of end-of-life products." [113]. The following are Sony's various EPR efforts.

2.6.5.1 Take-Back and Trade-in Programs

Sony was one of the first companies to launch a nationwide electronics-recycling program in the U.S. in 2007 [114]. The Sony Take Back Recycling Program encourages consumers to recycle and dispose electronics equipment responsibly. Consumers can drop off Sony products at collection centers free of charge. In the beginning, Sony started a partnership with Waste Management, a waste management company in the U.S., with 75 collection centers. Currently, Sony extends its partnership with other waste management company and works in collaboration with different waste administration and recycling companies in U.S. with 417 collection centers [115].

Sony also developed a website dedicated for trade-in and recycling electronic products in the U.S. Consumers can gain website credits by trading in electronic products, even non-Sony ones, and can search for recycling centers to drop off

devices with no trade in value. Website credits gained can be redeemed when purchasing Sony products. As of March 2013, Sony has cumulatively collected 280 million pounds of electronics equipment scrap for recycling, reducing disposal of electronics to landfill and using of virgin materials significantly.

2.6.5.2 Mandatory Compliance

In some countries, Sony is required to comply with specific EPR regulations. For example, the Regulation for the Administration of the Collection and Disposal of Waste Electric and Electronic Products in China, more commonly known as the China WEEE [116], requires Sony to be responsible in treating waste electronic and electronic equipment products. This regulation aims to conserve natural resources and develop a circular economy, subsequently achieving environmental protection. The regulation establishes a system for end-of-life electronics collection and disposal of WEEE products with a state-established and state-administered WEEE Disposal Fund supported by payments from manufacturers and producers [117]. Sony makes regular contributions to the fund and treats its waste electronic in compliance to this regulation.

2.6.5.3 Voluntary Industry Practices

The Japan Home Appliance Recycling Law (revised in 2009) covers LCD/Plasma televisions, refrigerators, washing machines, air conditioners and clothes dryers. This law requires consumers to be responsible for the fees associated with disposing of these home appliances for retailers to take back and for manufacturers to recycle. To comply with this regulation, Sony partners with five other manufacturers in Japan to establish a nationwide cooperative recycling network to collect and recycle their returned products. This regulation also requires manufacturers to achieve recycling rate targets of minimum 55 %. In 2012, Sony has achieved a recycling rate of CRT televisions and flat screen televisions of 81 and 89 %, respectively [118].

2.6.6 Impacts of EPR

EPR encourages manufacturers to treat their products at the end-of-life to protect the environment and reduce costs incurred from the developing landfill. The aim of this policy is to reduce waste generation at the source, promote environmentally friendly product design, and facilitate achieving the public goals of reduction, recycling, and reuse in materials management.

2.6.7 Benefits

Success in addressing environmental concerns can create business value and gain market acceptance. Recent studies find that practicing EPR can improve the performance of enterprises with less environmental damage [106]. Manufacturers can gain from recycling used products in many ways. For example, manufacturers can extract and collect rare earth materials for recycling and reduce consumption of virgin materials for manufacturing new units. Manufacturers would also be in a better position to negotiate for exchange terms in business with international partners that emphasize waste prevention and disposal in their local market [119].

The product stewardship emphasis in EPR policy accentuates environmental burden reduction with less use of hazardous and nonrenewable materials for product manufacturing. EPR can attract and retain environmentally conscious customers by offering take-back and recycling of end-of-life products, while producing new products with recycled materials. By doing so, manufacturers can gain an environmentally friendly corporate image, which is a valuable intangible asset difficult for competitors to imitate. Such a positive image also helps gain customers' confidence in the environmental impact of the products and increases their patronization of products [120].

Modular design in EPR facilitates ease of product components disassembly and recycling, reducing the use of virgin materials. Modular product design also increases flexibility of manufacturing systems in the supply chain [121]. Product modularity allows manufacturers to assemble a product from a set of smaller components, which can function collectively as a whole [122] and form different products in different variations of combinations. Such product stewardship also brings benefits to manufacturers in pollution reduction and financial gains due to cost saving through waste reduction [11]. For example, Levi Strauss, an American jeans and casual wear manufacturer, has established a returns-processing system, known as R.I.S.E. (returns, irregulars, samples, exit strategy). The system allows Levi Strauss to shorten the time needed to process returned products from weeks to days by sorting the returned products and shipping them to different locations for reprocessing or resell [123]. The system helps Levi Strauss increase turnover of the returned products to save costs and generate incomes.

Modular designs encourage recycling and reuse of product components, where reusable parts are valuable for recovery of assets and cost containment concerning returned products that reduces materials acquisition costs and inventory requirements. For instance, Gap Inc, an American multinational clothing retailer, has a "solid waste and recycling program" that uses less corrugated cardboard and utilizes recyclable materials for its containers. This program reduces cardboard waste by 5700 tons and saves Gap US\$20 million per year. EPR practices, including recycling, reuse, reprocessing, and recovery, are also helpful for generating new source of revenue by capturing reusable components to be sold at after-market [124]. IKEA is an example of capturing residual values of returned products from the market. IKEA uses its returned and damaged products as spare parts and restores

them to a saleable condition to be sold at a discount. This practice helps capture the residual values of products, and lessen consumption of virgin materials by utilizing reusable parts recovered.

2.6.8 Moderating Role of Customer Integration in EPR Performance

Customer integration is concerned with the participation of customers in product return process and their attention and efforts made to facilitate the manufacturers' EPR practices. For manufacturers to meet EPR goals, integrating with customers is vital. EPR emphasizes on managing post-consumer products, however it also implicitly assumes the requirement for a degree of customer involvement that they would fulfill their responsibility voluntarily by returning the end-of-life products to the manufactures [125]. Manufacturers are required to develop a system to facilitate the take-back and collection of products returned from customers in local as well as other overseas to implement EPR policy.

The contingency theory views a firm as an open system, where the firm's business environment affects its performance [126]. Organizational processes are endogenous, which are mainly decided and controlled by firms, whereas the business environment is exogenous that firms have relatively less control over [127]. According to this theory, EPR practice performance is not only dependent on a firm's ability but also the level of integrating with customers in support of the EPR implementation. The EPR practices-performance relationship depends on how well customers take up their responsibility to retrieve usable products from the markets and take part in product return programs. A high level of customer integration can help improving corporate image and organization positioning in the marketplace, subsequently strengthening the relationship between EPR practices and market performance.

A recent research study examining the market and financial performance of EPR practices by manufacturing exporters in China finds that integration of customers on EPR practices to recycle, reprocess, and reuse their products can improve market acceptance of firms [128]. Customer integration in EPR practices allows manufacturers to develop an environmentally responsible corporate image, and increases opportunities of accessing international markets. The study results show that manufacturers seeking to establish market position with their EPR practices should strengthen customer integration with their environmental initiatives. For example, proactively inviting customers to be part of their environmental audits and product return program to encourage more support in their EPR practices.

Customer integration, however, causes uncertainty to the implementation of EPR practices from the financial perspective. Uncertainty is increased in the firms' environmental efforts because the amount of products returned and delivery time is highly dependent on customer willingness to cooperate [129]. This increased uncertainty would incur costs to manufacturers because of additional organizational

efforts, such as managing inventory and incurring repair costs. Customer integration may lead to excess or shortage of returned products, which makes inventory management difficult for manufacturers [130]. Subsequently, the financial performance of EPR practices is compromised when customer integration is high.

Prior research study on Chinese manufacturers also finds that firms with EPR practices implemented with lower level of customer participation achieve better financial performance [128]. This indicates that firms need to develop a mechanism to coordinate with customers for EPR implementation, to reduce costs in handling returned products and streamline cross-firm processes [95]. Managers should implement an efficient system for customer returns and inventory to control the cost of coordination, so that financial performances would not be jeopardized. Partnering with other manufacturers to establish a large returns system or with recycling firms would improve the effectiveness in managing EPR practices. For example, Apple partners with PowerOn Service Inc., one of the industry leaders in the responsible reuse and recycling of post-consumer information technologies and electronics, for its reuse and recycle program.

2.6.9 Summary

EPR is defined as a type of product stewardship that requires at a minimum the producer to be responsible for their product and that responsibility extends to the end-of-life processes. In some countries, such as South Korea and China, EPR is mandated by regulations. Governments promote EPR mainly to decrease waste management financial burdens and to provide incentives for reducing resources consumption. EPR encourages manufacturers to make use of sustainable materials and to design products suitable for recycling, subsequently reducing waste through recycling, reprocessing, and reusing components.

There are various approaches of EPR, the most common types are namely take-back programs, advanced recycling fee, and voluntary industry practices. Take-back programs can be voluntary or mandatory. Take-back programs can help manufacturers to determine product problems and use this information in product improvement. It also allows them to capture residual values and to reuse working components, which helps to save materials costs. Advanced recycling fee (ARF) is a fee charging customers on top of product sales to cover the cost of the post-consumer life of the purchased product. Voluntary industry practices are undertaken when different firms from the same industry come together to develop a set of voluntary EPR principles for the industry.

Performance benefits of EPR include improved market performance. Where firms can gain market by producing products manufactured with recycled materials with less environmental damage. Additionally, residual materials extracted from returned products can help saving the cost for virgin materials consumption. Modular design in EPR can improve ease of product components disassembly for recycling and reuse, enabling financial gains due to cost savings.

Customer integration has a moderating role on the performance of EPR practices. Customer integration can benefit market performance of a firm implementing EPR. Customer integration helps firms to develop an environmentally responsible corporate image, and increase opportunities of accessing international markets. Managers should consider reinforcing customer awareness on their responsibility, and to remind them of the environmental impacts of their return of usable products.

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