The Reverse Logistics Management Model: 
Thailand Context

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ABSTRACT
The purpose of this paper is twofold: to define the reverse logistics management model, and to describe the relationship among reverse logistics management, forward logistics management, information technology, corporate citizenship, and logistics performance, using structural equation modeling (SEM). The research relied on mixed method theory. Documentary research was conducted involving 624 research papers to identify the construct of the model. Then, survey research was conducted with 420 logistics directors or managers from Thai electronics companies, using SEM. The documentary research confirmed that the model construct includes three major factors – namely, forward logistics management (FLM), information technology (IT), and corporate citizenship (CC) – which impact reverse logistics management (RLM). Of the three, corporate citizenship (CC) has the highest positive impact. The research also confirmed that RLM impacts logistics performance (LP). The SEM analysis confirmed the documentary research. This paper contributes to the literature on logistics performance from the perspective of reverse logistics management. It emphasizes the importance of the corporate citizenship concept. Organizations can use this concept to change the mindset and work behavior of employees to conform with the sustainability concept, which consists of legal, social, environmental, and economic factors that create the organization’s vision, mission, and work processes. The concept can also help them increase the efficiency and effectiveness of reverse logistics management.

Keywords: Reverse logistics management, corporate citizenship, structural equation model, forward logistics management, Thailand context
1. INTRODUCTION

Reverse logistics (RL) is new productivity, management, and green business concept. Reverse logistics management (RLM) gives precedence to the environmental perspective, particularly with regard to social responsibility and sustainability. It is a new way for business to achieve performance efficiency and effectiveness using the sustainability concept. It consists of three dimensions; namely, return policy and procedure (RPP), remanufacturing or refurbishment (ROR), and waste disposal (WAD). All three dimensions give precedence to recapturing value from products, especially electronics components or assemble-to-order items (Tepprasit, 2012).

In Thailand, the electronics industry is economically important because it has a greater product value than all other industries in terms of exports to foreign countries. More than 20 years ago, Thailand began exporting electronics products and parts to the United States (USA), Europe (EU), and Japan. A few years ago, however, developed countries – particularly those in Europe – began returning all electronics products to Thailand. This action has had a serious impact on the Thai electronics industry and has caused Thai entrepreneurs to lose market share and order in the European market (Tepprasit & Yuvanont, 2015). What happened? Why are Thai electronic products rejected in Europe? This question is a subject of discussion in all Thai industries. At present, it is believed that the major reason for rejection is related to the sustainability or social responsibility concept.

In 2010, the European Union (EU) launched Europe 2020, a ten-year jobs and growth strategy to create smart, sustainable, inclusive, and environmentally safe growth in its 28 member states (United Nations, 2012). Most European countries use this concept as a non-tariff barrier to protect domestic businesses in market competition. The strategy calls for every business and manufacturing entity to exhibit social responsibility. All operation processes from upstream to downstream must be environmentally friendly. In 2015, the EU adopted a new set of smarter, greener, more inclusive economic and employment policies to replace the 2010 guidelines. By 2020, these guidelines will become law. The Thai electronics industry cannot survive if it does not take these guidelines into consideration and make the necessary changes.
The current study identifies factors that can enhance performance through reverse logistics management (RLM), which takes into account sustainability and the social responsibility concept (Tepprasit et al., 2015).

According to related papers by Ke, Xie & Zhao (2014), Abdullah & Yaakub (2014), Nikolaidis (2013), Corbacioglu & van der Laan (2013), Pirlet (2013), and Cojocariu (2013), the RLM focus on efficiency and the competitive advantage of cost and quality leadership enhances the supply chain competitive advantage. This is achieved through the sustainability and social responsibility concept, which changes a traditional business to a green business.

2. LITERATURE REVIEW

This section reviews the literature on forward logistics management, reverse logistics management, information technology, corporate leadership, and logistics performance.

2.1 Forward Logistics Management (FLM)

The term forward logistics management is defined by the Council of Logistics Management (CLM) as the operation plan, processes, and controls necessary for the efficient and effective manufacture, movement, and distribution of materials and products. The CLM, founded in 1963, is a global trade organization based in the United States. Effective January 1, 2005, it changed its name to the Council of Supply Chain Management Professionals (CSCMP). The CLM definition conforms with that of Martin Christopher (1992, 2011), a logistics specialist and academician. Christopher (2011) defines forward logistics management as the process of strategically managing the procurement, purchase, movement, and storage of finished materials, products, inventory, and the related information flow through the departments of the organization and its marketing channels in such a way as to reduce cost and increase efficiency. This definition has been accepted by other researchers, such as Bowersox, Closs & Cooper (2012) and Mangan & De Marco (2014).

Chantijiraporn (2008), president of Thai Logistics and Productions (TLAPS), defines forward logistics management as all of the activities involved in the procurement, purchase, storage, movement, and distribution of materials and products, including related customer services, which contribute to high quality and value of service. Tepprasit & Yuvanont (2015) define the term as the process of
producing and moving finished products and the related information flow from the origin point (upstream) to the end-user (downstream). Earlier, Tepprasit (2012) called forward logistics management “the balance,” meaning that supply (upstream) matches customer demand (downstream).

In their theoretical article, Stock & Lambert (2011) identify 14 activities that are included in forward logistics management; namely,

- Materials movement
- Storage and warehousing
- Packaging
- Transportation
- Inventory management
- Order fulfillment
- Forecasting
- Time scheduling and manufacturing plan
- Procurement and purchasing
- Customer service
- Location
- Reverse logistics
- Sporting activity
- Waste and remanufacturing

Today, many academicians and theoreticians consider two of these activities – reverse logistics and waste and remanufacturing – to be part of reverse logistics management.

From the literature review, the authors of the current paper identified six dimensions that explain the impact on reverse logistics management:

1. **Product design and materials management (PDMM).** This activity refers to designing the component of a product so that it can be reused or recycled, thus recapturing value. It can also refer to waste disposal.

2. **Procurement and purchasing (PP).** As part of the sustainability and social responsibility concept, destination countries trace a product to its origin and inspect all activities and manufacturing processes so as to identify and reject any with illegal or non-social responsibility.
3. **Inventory and warehouse management (IWM)** (Aitken & Harrison, 2012). If an organization does not handle the materials properly or use the correct storage method, some electronics part, component, or the product itself will lose quality. The organization, therefore, must use materials handling processes and storage methods that match the product.

4. **Manufacturing and operation process (MOP)** (Allen, 2014). This is one of the most important activities in forward logistics management because it involves assembly of the parts and components of finished goods. Most product defects occur in MOP.

5. **Transportation and movement (TM)**. It is important that the organization design or choose the most suitable routes, tools, and vehicles for transportation and movement of the product to market or end-users. Using inappropriate packaging for the product will definitely cause failure during transport (Bernon et al., 2013).

6. **Distribution (DIS)**. This activity involves the marketplace network. The more complex the network, the greater the risk for failure of the product. It is important that the design and operation of the network fit the product (Aydın, 2014).

### 2.2 Reverse Logistics Management

In 1998, reverse logistics management (RLM) was a new productivity and management concept introduced by Rogers & Tibben-Lembke (1998). They defined RLM as a process that involves management planning, operation, and control of cost efficiency and effectiveness, starting with raw materials flow and extending through work-in-process inventory to the finished goods. They also included the flow of information from point of origin to end-user for the purpose of recapturing value from product defects or waste disposal.

Three years later, Fleischmann (2001) expanded the definition developed by Rogers & Tibben-Lembke (1998). His new definition describes RLM as a process that involves management planning, operation planning, and enhancement of the efficiency and effectiveness control of inbound flow, inventory management, and information flow in supply chain management so as to recapture the value from product defect or waste disposal. According to Fleischmann (2001), the important objective of RLM is to recapture value from product defect. At the time,
Fleischmann was a European professor who worked with IBM and Heineken in logistics and supply chain management. At present, he works with MIT Sloan Management Review (Fleischmann, 2001) and the European Journal of Operational Research.

2.3 Information Technology (IT)

Daugherty, Myers & Richey (2002) define information technology as the tool that introduces and describes the information used to support an organization’s decision-making and competitive advantage. Their definition conforms with that of Queiroz & Oliveira (2014). According to Melre da Silva & Neto (2014), IT can support the design of an organization’s business role and responsibility to fit employees and can also support standardization of operations and services.

In the RLM concept, IT can play an important role in supporting the efficiency and effectiveness of a number of reverse logistics activities. These include monitoring operation activities, identifying the problem and details of product return, and supporting the decision-making process in difficult circumstances (Queiroz & Oliveira, 2014).

Studies have shown that IT has three dimensions:

1. Information system capabilities (ISC). These capabilities can provide support for faster, more valuable logistics management (Hazen & Bryd, 2012).

2. Information sharing (IS). This dimension is the key to success in creating innovation in an organization.

3. Technology innovativeness (TIN) (Melre da Silva & Neto, 2014). New technology can give an organization greater efficiency and effectiveness than its competitors and thereby enable it to change the world (Prajogo & Olhager, 2012).

2.4 Corporate Citizenship (CC)

The concept of corporate citizenship (CC) was developed from the theory of business citizenship (BC) pioneered by Wood & Logsdon (2001). Under their concept of corporate citizenship, organizations have a social responsibility in terms of legal, environmental, social, community, and economic activities that together
make up the integrated sustainability concept (Wood & Logsdon, 2001). Their work was further developed by Matten & Crane (2005, 2007), who explained how to adapt the CC concept into the operation of an organization.

In 2015, Wood et al. (2015) defined corporate citizenship as the role and responsibility that entrepreneurs and the managers and employees of an organization have with regard to human and stakeholder rights. They stated that, in order to change from an organization culture to a social responsibility culture, an organization must include corporate citizenship in its vision and mission statement (Wood et al., 2015).

Studies have shown that corporate citizenship (CC) has four dimensions:

1. *Code of conduct (COC).* This term refers to the set of ethical principles or regulations that govern corporate practices to ensure compliance with acceptable standards.

2. *Local implementation (LIM).* This refers to issues of merit and morality relating to local law and customs when the organization interacts with other businesses in a host country.

3. *Problem analysis and experimentation (PAE)* (Matten & Crane, 2005). This dimension refers to the skill that is needed to analyze ethical uncertainty in local practices and to test ways to meet the demands of local culture while adhering to ethical principles.

4. *Learning within and outside the organization (LIO).* This refers to the continuous practice of learning from experience, both inside and outside the organization, and ensuring that the results are made available to all decision-makers in the organization.

### 2.5 Logistics Performance (LP)

Logistics performance (LP) relates to how an organization performs with regard to the procurement and movement of goods to its customers or end-users. An organization’s LP is assessed in relation to the highest performance level, or benchmark, to be equaled or exceeded in an industry, as exhibited by a best-in-class company (BICC).

In assessing LP, some organizations traditionally considered only cost or lead time performance, which did not adequately reflect the organization’s real logistics
performance. In 2011, Bolstorff & Rosenbaum (2011) explained how an organization can dramatically improve its logistics and supply chain performance to the level of excellence by using the supply chain operation reference (SCOR) model. The model integrates the business concepts of re-engineering, benchmarking, and measurement into its framework, which can be used to assess both forward and reverse logistics management.

The SCOR model consists of five dimensions; namely, reliability, responsiveness, agility, cost, and assets (Alarn et al., 2014). These can be used to evaluate five steps in the supply chain (Grawe, Daugherty & Roath, 2011):

1. **Plan.** This step includes demand and supply planning and management along the entire chain with regard to resource requirements, production, scheduling and rough-cut capacity, transportation, distribution network, and regulatory compliance (Huang & Yang, 2014).

2. **Source.** This step pertains to the acquisition and receipt of materials from suppliers (Abdullah & Yaakub, 2014).

3. **Make.** This refers to all aspects of the manufacturing process that transforms raw materials or equipment into finished products to fulfill demand. It includes not only production, but also packaging, staging, and release of the product.

4. **Deliver.** This step includes the process of delivering finished products to customers, wholesalers, or retailers, on-time-in-full (OTIF) (Cheng & Chen, 2013).

5. **Return.** This step involves the return of defective or damaged products by end-users, wholesalers, or retailers. Activities at this level will help the organization provide warranty service to its customers and achieve value recapture from damaged goods (Hazen et al., 2013).

3. **METHODOLOGY**

This research used the quantitative method. The authors created a conceptual framework and questionnaire based on their review of 624 research papers, articles, and journals. Then, they developed the research model based on in-depth interviews with 21 logistics and supply chain specialists and on focus group discussions.
discussions with 15 additional logistics and supply chain specialists. In developing
the questionnaire, the authors assessed content validity and reliability using IOC
and Cronbach’s alpha. The result was an IOC score of 1.0 for every subject and
item and a Cronbach’s alpha of 0.8 (standard score = 0.7). The data collected from
420 Thai electronics exporters was analyzed using structural equation modeling
(SEM) to test four hypotheses (Creswell, 2013).

The first hypothesis pertains to forward and reverse logistics management. Research has indicated that forward logistics management (FLM) is a priority of reverse logistics management (RLM). Because FLM involves physical flow, information flow, and the flow of funds from upstream to downstream, the forward flow occurs before the reverse flow. The organization must therefore give precedence to all activities pertaining to forward logistics because these activities have a powerful positive influence on reverse logistics activity.

**H1:** Forward logistics management (FLM) has a positive impact on reverse logistics management (RLM).

The second hypothesis relates to information technology (IT), which is a key factor in the efficiency and effectiveness of reverse logistics management (RLM). The IT process supports reverse logistics, for example, when managers receive products returned by distributors (wholesalers or retailers) or end-users because of defects or obsolescence. When a product is returned to the manufacturer’s internal process, information technology is essential to count or separate the product or equipment defects in order to obtain accurate information on reverse logistics activity.

**H2:** Information technology (IT) has a positive impact on reverse logistics management (RLM).

The third hypothesis concerns corporate citizenship (CC), which involves the green concept, or sustainability concept. It motivates organizations and entrepreneurs to support a green vision and a green mission, both of which can enhance the efficiency and effectiveness of reverse logistics activity as a subset of green logistics. Corporate citizenship can provide the best solution or idea to improve the organization membership to enhance reverse logistics management (RLM).

**H3:** Corporate citizenship (CC) has a positive impact on reverse logistics management (RLM).
The fourth hypothesis focuses on reverse logistics management (RLM) in regard to logistics performance (LP). As noted, RLM is the element in the supply chain that involves both forward logistics and total logistics and supply chain performance. It can support long-term cost reduction when an organization uses it in the recycling, refurbishing, or re-manufacturing process, thus obtaining value recapture from product defects or damage.

**H4**: Reverse logistics management (RLM) has a positive impact on logistics performance (LP).

Before using structural equation modeling (SEM), the authors tested the convergent and discriminant validity of the measurement model (Table 1).

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Items</th>
<th>Factor Loading</th>
<th>Cronbach’s Alpha</th>
<th>CR</th>
<th>AVE</th>
<th>MSV</th>
<th>ASV</th>
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<tr>
<td>Information Technology</td>
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<td></td>
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<td></td>
<td>RES</td>
<td>0.929</td>
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<td></td>
<td>REL</td>
<td>0.892</td>
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<td>Reverse Logistics Management</td>
<td>RPP</td>
<td>0.617</td>
<td>0.754</td>
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<td>0.752</td>
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<td></td>
<td>WAD</td>
<td>0.839</td>
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<td>Corporate Citizenship</td>
<td>COC</td>
<td>0.702</td>
<td>0.854</td>
<td>0.877</td>
<td>0.797</td>
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<tr>
<td></td>
<td>LIM</td>
<td>0.715</td>
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<td></td>
<td>PAE</td>
<td>0.886</td>
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<td>LIO</td>
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As shown in Table 1, the authors used average variance extracted (AVE) and composite reliability (CR) to test the convergent validity of the measurement model. They used the maximum shared squared variance (MSV) and the average squared variance (ASV) to test the discriminant validity.

All of the AVE values are above 0.7, which is considered very good, and all of the CR values are above the acceptable value of 0.7. The results show that the variables also have a high convergent validity (Fornell & Larcker, 1981). The test of discriminant validity indicates that the MSV and ASV results are less than the AVE values, which means that the discriminant values hold and that the measurement model is according to the assumptions that were initially made.

4. CONCEPTUAL FRAMEWORK
The conceptual framework encompassing the four hypotheses is depicted in Figure 1.

![Figure 1. Conceptual Framework for Current Study](image)
5. RESEARCH FINDINGS

The researchers used structural equation modeling (SEM) to analyze data from the questionnaire. Before SEM analysis, they checked the quality of data by using the KMO and Bartlett’s test. The test indicated that the KMO was 0.940 and that the Bartlett’s test was 0.000. The authors then used CFA to confirm the model structure for each factor (Figure 2). The results indicate that the model conforms with standard indexes. The results yielded $p$-value = 0.60; $\chi^2/df = 1.184$, CFI = 0.960, CFI = 0.993, NFI = 0.958, RMSEA = 0.021, and TLI = 0.991. All scores conform with the statistics standard and SEM method (Blunch, 2013). These results demonstrate that the model is correct and that it conforms with the findings of the literature review.

![Figure 2. The Structural Equation Model (SEM)](image-url)
Next, the researchers used path analysis to test the hypotheses. The results, shown in Table 2, indicate that all the variables had a positive coefficient. As indicated, logistics performance (LP) had both direct and indirect effects. The results also show that forward logistics management (FLM), information technology (IT), and corporate citizenship (CC) had a positive impact on reverse logistics management (RLM). There was also an indirect positive impact on LP via reverse logistics performance. In addition, RLM was found to have a positive impact on LP. These results support all four hypotheses set forth in this study.

### Table 2. Standard Coefficient of Path Analysis

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<th>Reverse Logistics Management Model</th>
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<td>Indirect Effect</td>
<td>Direct Effect</td>
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<td>Indirect Effect</td>
<td>Direct Effect</td>
<td>Total Effect</td>
<td>Indirect Effect</td>
<td>Direct Effect</td>
<td>Total Effect</td>
<td>Indirect Effect</td>
<td>Direct Effect</td>
<td>Total Effect</td>
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<tr>
<td>FLM</td>
<td>-</td>
<td>0.814</td>
<td>0.814</td>
<td>0.983</td>
<td>-</td>
<td>0.983</td>
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<tr>
<td>IT</td>
<td>-</td>
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<td>0.779</td>
<td>0.941</td>
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<td>0.941</td>
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<tr>
<td>CC</td>
<td>-</td>
<td>0.826</td>
<td>0.826</td>
<td>0.997</td>
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<td>0.997</td>
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<td>RLM</td>
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<td>1.208</td>
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Chi-square = 1793.89, df = 152, p-value = 0.060, GFI = 0.960, AGFI = 0.939, SRMR = 0.0309

### 6. DISCUSSION

As shown in Table 2, FLM, IT, and CC all had a positive impact on RLM. Results indicate that FLM was the origin point of RLM. In an organization, forward logistics management (FLM) starts upstream and proceeds downstream via activities and processes such as product design, purchasing, manufacturing, distribution, and transportation. If an organization does not focus on the sustainability concept and the reverse logistics process from the start, it cannot obtain value recapture through reuse or recycling. In order for this to happen, the product must have sustainability from the point of origin. When a product that is designed with this in mind is later returned to the point of origin, the organization can obtain value recapture for components of the product through re-manufacturing or refurbishing. In logistics theory, FLM is an important factor in the efficiency and effectiveness of reverse logistics.
With regard to information technology (IT), organizations use IT to motivate and support operations as well as manage and improve reverse logistics activities. From IT activities, organizations can collect data in the reverse process to identify products, lots, and defects. Innovations in technology that increase accuracy and speed can give an organization a major advantage over competitors.

Results of the current study indicate that corporate citizenship (CC) has a higher positive impact than other factors because it involves top management and the organization’s vision and mission. When top management focuses on the sustainability concept, it can enhance the organization’s image through corporate citizenship practices such as power use reduction, production of high-quality products, and adherence to moral and merit concepts in its operations.

Study results also show that reverse logistics management (RLM) has a positive impact on logistics performance (LP) by enabling value recapture. This can lead to long-term cost reduction, increased productivity, and greater agility in re-manufacturing. Furthermore, by supporting the customer who wants to return a product, RLM can greatly increase an organization’s reliability and responsiveness.

7. CONCLUSION

For most entrepreneurs and businesses in Thailand, logistics theory and the reverse logistics concept are new and unfamiliar ideas with which they have no experience. Small- and medium-sized enterprises in particular do not know how to create value and reduce costs through RLM. As a result, Thailand last year had a total logistics cost of around 13-14%.

As the first step in the current study, the researchers reviewed the literature to define the factors and elements necessary to create a conceptual framework for studying and testing logistics theory in the Thailand business environment. Study results will help Thai entrepreneurs and organizations to better understand and effectively use the criteria of reverse logistics to improve operations.

From the literature review and their in-depth interviews and focus group discussions with key informants, the authors identified three major factors that impact reverse logistics management; namely, forward logistics management (FLM), information technology (IT), and corporate citizenship (CC). They also ascertained that reverse logistics management (RLM) can improve logistics
performance (LP). The authors then created a conceptual framework and designed a questionnaire to collect data from 420 Thai electronics exporters. Before analyzing the data by structural equation modeling (SEM), the authors checked the quality of the data using KMO and the Bartlett's test and used confirmatory factor analysis (CFA) to verify the factor structure of a set of observed variables.

The SEM analysis indicated the consistency of the model’s structure and demonstrated that the coefficients could explain the four hypotheses posited in this study. Results show that:

1. Corporate citizenship (CC) has a higher positive impact on reverse logistics management (RLM) because it can help managers improve RLM processes and revise the organization’s ideas and concepts about operations in the world’s dynamic business environment;
2. Forward logistics management (FLM) and information technology (IT) have a positive impact on RLM; and
3. Reverse logistics management (RLM) has an impact on logistics performance (LP) through efficiency and effectiveness of cost and value criteria.

The study has important implications for entrepreneurs and business organizations. First, it provides information on how to set up resources to facilitate reverse logistics management. Second, it increases awareness of the importance of the corporate citizenship concept. Third, it stresses the need to change corporate mindset and work behavior to conform with the sustainability concept, which consists of legal, social, environmental, and economic principles that should be incorporated in the organization’s vision and mission and communicated to all employees. Fourth, it explains the importance of writing a code of conduct to govern business practices in conformance with the sustainability concept and to promote knowledge-sharing with all members of the organization. Fifth, it discusses activities that can increase the efficiency and effectiveness of reverse logistics management.

With regard to forward logistics, entrepreneurs and organizations must focus on eco-friendly design methods such as eco-packaging and product design, environmentally safe waste management, lean manufacturing and distribution, and efficient transportation. These activities are important because the efficiency and effectiveness of forward logistics impact the outcome of reverse logistics management. In addition, organizations should recognize that information
technology is a critical factor in the collection of accurate data to support the decision-making process at every step of the supply chain.

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