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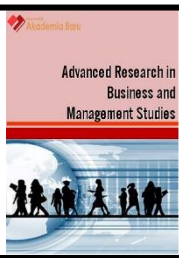

Content Analysis on Reverse Logistics and Sustainability Performance

Thoo Ai Chin[1], Yang Kaihan[1]

1 Azman Hashim International Business School, Universiti Teknologi Malaysia, 81310 SKUDAI, Malaysia

ABSTRACT

With growing awareness for environmental protection, economic and social benefits, sustainability now is served as one of the important issues in many countries. This has triggered the reverse logistics (RL) to become popular among academics and supply chain professionals since RL is the key tool used to promote sustainability. In China, the implementation of reverse logistics has expanded due to the international pressure on environmental issues and sustainable growth. Although RL can significantly improve the organization sustainability performance, limited research has been conducted to examine the relationship between RL and sustainability performance. As such, this paper aims to review the relationship between RL and sustainable supply chain performance, as well as to assess the performance of RL process using three dimensions of sustainability. Also, content analysis was used to gather and analyze the literature and published papers on RL and sustainable supply chain performance. Ultimately, this study identifies the relationship between RL and the sustainable supply chain. The analysis concludes that the social aspect of sustainability of RL and the impact of RL disposition options on sustainable performance have been largely neglected. Finally, this study suggests that future research should concentrate on gathering empirical information on how each of the disposition options may affect sustainability performance.

Keywords: Sustainability performance; reverse logistics; disposition options; economic impact; environmental impact; social Impact

1. Introduction

Nowadays, sustainability development has been the concern of all countries. The Sustainable Development Goals (SDGs) were implemented by all UN member states in 2015 with the goal of ending poverty, protecting the environment, and ensuring prosperity by 2030. In this period of sustainable development, all companies are suggested to increase awareness to pursuit sustainability development goals relating to social well-being, economic prosperity and environmental preservation [1]. Nowadays, Numerous organizations have included sustainability into their missions, and they have made ongoing attempts to fulfil their commitment to sustainability [2].

The term sustainability refers to a generation's ability to meet their own needs without jeopardizing the needs of future generations. The existence of three critical elements (social, environmental, and economic) for product manufacturing can be defined as the fundamental concept of sustainability. Adopting sustainable principles can help businesses make more surplus and stay in business for the long term. Sustainability development has been one of critical issues. On a company level, reverse logistics (RL) makes the most contribution to better global sustainability.Well-managed RL projects can achieve sustainability and create competitive advantage by increasing profits, reducing costs, and improving customer satisfaction. RL can provide tangible and intangible benefits by generating value from second-hand or returned products and extending the life of the product, rather than buying more raw materials and wasting labour and time. Furthermore, RL may play a vital part in clients' satisfaction by emphasizing repairing or replacing defective products, retaining customer loyalty. Finally, RL can develop the future product or new product design by incorporating consumer opinion and understanding product returns [3].

In fact, reverse logistics can help firms strike a fair balance between economic gains and environmental impacts. Also, logistics has also attracted increased attention in numerous sectors worldwide as the third source of profit except for resources and workforce. The logistics include forward and reverse logistics, which has been shown to have a significant impact on productivity and the environment. However, some businesses overlook reverse logistics. Almost all supply chain management research, on the other hand, focuses on the forward run, from ingredients to end products and from suppliers to final consumers. Meanwhile, the reverse flow of materials from buyers to suppliers has received far less attention [4]. The reasons, including lack of interest by top management toward reverse logistics activities, why organizations decide to refrain from reverse logistics practices [5].

Also, there has been much research have intensively investigated the economic and environmental benefits of RL. There is little research on disposition decisions in the RL process and no thorough study exploring the impact of disposition alternatives on sustainability performance and offering a strategy for selecting the most applicable one [6]. Thus, a research gap examines the influence of various RL disposition options on sustainability development involving economic, environmental, and social metrics [7]. Through the presented literature, the gaps in the literature are identified and reported as future research directions. The study makes an effort to answer the following research questions: (1) How the disposition decisions of reverse logistics impact sustainability performance? (2) In which disposition decisions of reverse logistics is better choice for sustainability performance research? As a result, the primary goal of this study is to provide a thorough examination of the relationship between RL disposition decisions and sustainability performance and suggestions for future research.

2. Literature Review

2.1 Reverse Logistics

The reverse logistics concept has received increased attention as a result of multiple factors, including competition among organisations, environmental interference, social marketing, and economic elements [8,9]. Reverse logistics can revert flows from the consumption point to the origin point to recover value or appropriate disposal. Reverse logistics denotes the reverse flow of information and materials for reuse, recondition and recycling valuable parts that can be resold in the market after undergoing transformation into new products [10]. Nevertheless, from a comprehensive viewpoint, reverse logistics is deemed as a management process, including the cost-effective and efficient inputs flow, partially completed products, end products, and the related information from the end-user to the organisation that initially sold the products to capture the value and for environmental protection through appropriate disposal [11]. According to this review, the study definition considers the sustainable development aspect. Thus, reverse logistics mainly indicates putting the products from the consumption point back to the origin point in this study. The objective of reverse logistics does not only pursuit economic and environmental benefits but also pursuit social performance.

Based on the sustainability concept, waste prevention via reverse logistics practice has recently drawn scholars' attention [12]. Reverse logistics practice is defined as recovery of the goods whose lifetime fails to end. Similarly, reverse logistics can also be considered to salvage goods that are not beneficial for users [13]. Figure 1 shows the typical reverse logistics practices that include recycling, reuse, remanufacture, repair and disposal, updated from [9]. The reverse logistics practices have been acknowledged as a crucial aspect of the sustainable supply chain management (SSCM) strategy [13]. Furthermore, recalling customers' used products to reuse, remanufacture, recycle, repair, and disposal can increase the value of returned products and reduce the total cost [14]. Also, salvaging used products is more economical than direct disposal. Thus, deciding dispositions appropriately, including reuse, repair, remanufacture or recycling, is necessary for organisations to recapture value [15].

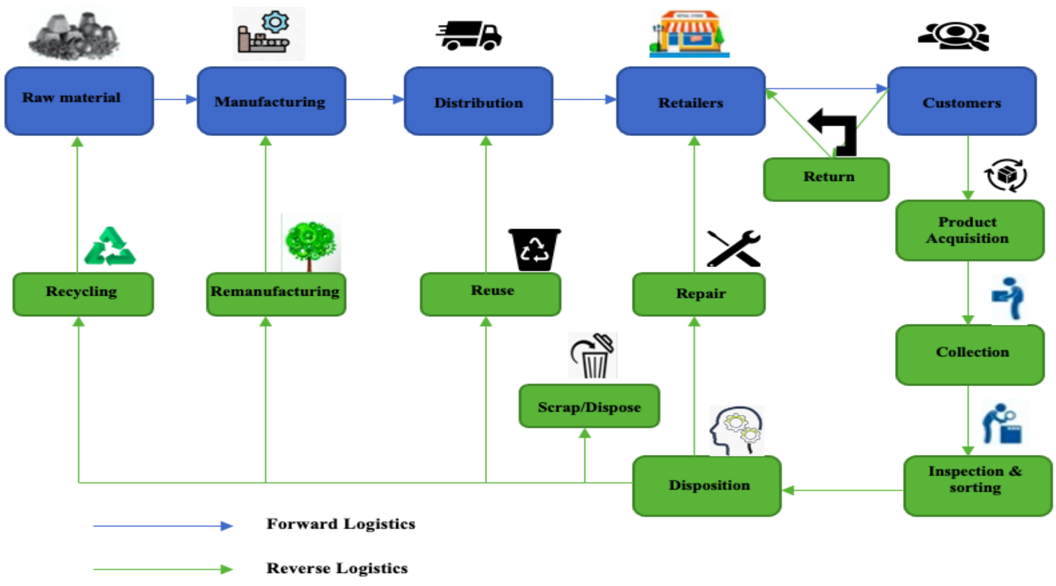

Fig. 1. The basic concept of reverse logistics practices [9]

2.1.1 Recycle

Recycle as the used product or waste products, which went through breakdown, changed into adaptable parts and recycled into their original or new form [16]. Similarly, recycling can also be denoted as a process, where the products, tagged as waste, are salvaged from the surrounding, segregated and recycled to reuse them as processed materials or end products. Furthermore, recycling items mainly include metal scrap, raw material and components and parts [9] which are subsequently reutilized as raw materials in other products [6].

Recycle as a key reverse logistic element is standardly recognised, but fewer companies adopt recycling. An efficient method is to sensitise users on the significance of recycling through adverts. Different significant methods include integrating well-documented recycling policies into organizational operations [16]. Moreover, organisations can develop awareness by placing recycling symbols on product packaging and provide appropriate motivations to users returning used items for recycling [17].

2.1.2 Reuse

Reuse is deemed a vital reverse logistics method where products can be reutilised for a similar objective initially designed or created for [16]. In simple terms, direct reuse indicates that an item only needs minor restoration and cleaning before being returned to distributors (e.g., returnable packaging materials) [18]. Reuse involves recuperating a product or a component returned to the company but retained a specific value [19].

The product is reintroduced in the supply chain when this occurs. Typically, reusing involves washing and recovering utilised products, returning utilisable packaging resources, restoring and reparation [20]. Reusing is deemed as the eco-friendliest in waste management practices within reverse logistics [21]. However, reverse logistics studies primarily focus on recycling, remanufacture, and repair, while inadequate emphasis was given to reuse in the four reverse logistics practices [22].

2.1.3 Remanufacture

Remanufacture as a pacemaker for economic and ecological sustainability has been an excellent and effective technology in the past two decades [23]. In addition, remanufacturing has become a prevalent research title with practitioners and scholars. Prior studies on remanufacture topics include vital technologies, marketing tactics, aftermarket services, crucial factors for remanufacturing advancement, assessment of remanufacturing and policy establishment [24]. Remanufacturing implies the process of returning used, damaged or discarded products up to the quality standards of new products and with an equivalent warranty [25].

Additionally, remanufacturing refers to retailers returning goods that need to support the manufacturing to recreate due to a product inventory backlog. Conversely, remanufacture suggests reusable products [26]. Remanufacture maintains the product through disposition, returns it to the manufacturer and restores it to a new quality level [6]. Thus, product quality is maintained in remanufacture, but the quality is transformed through reconditioning and reparation [23].

2.1.4 Repair

The repair is defined that the waste becomes new feedstock through sorting, separation, and processing at a similar or other industry with a lower cost Ghisolfi *et al*., [27]. Reparation can identify and restore the lost product functionality wholly or with an acceptable loss of quality. The retailers can sell the product directly after reparation [6].

Numerous researchers have been interested in repair, such as [28]. They created a reverse logistic network model that tackles returns requiring repairing services. Min *et al*., [29] evaluated the issue to identify the number and location of repair where returned products from retailers or end users are examined. The repair objective is to salvage the broken-down products to function again, although the quality loss is possible. Repaired products quality is often lesser than new products quality. Reparation for utilised products can be undertaken at the user's location or repair centres handled by manufacturers. The operations include fixing or substituting the damaged parts, whereas the remaining parts are retained [30].

2.1.5 Disposal

Disposal mainly indicates that the products that cannot be sold or reutilised, the remaining disposition alternatives are not efficient, maybe incinerated or put into landfill [31]. Besides, the components or products that face complex disposition conditions or nearly non-existence sales in the aftermarket should be sent to landfills. The final disposal ends the product's lifecycle as it ends up in a landfill or dumping area [32]. Landfills are environmentally suitable for final disposal as they are equipped with leachate and biogas controls. Specific waste carriers can make the destination. The waste is returned to the production cycle through wholesale recyclable materials trade. The remaining reverse logistics cycles are completed as the wholesale trade sells the recyclable materials to the industry [33]. According to Khor *et al*., [32], the effectiveness of dispositioning is positively associated with economic and environmental performance and might contribute to the social performance of reverse logistics [34].

2.2 Sustainability Performance

The sustainability concept has become increasingly popular in the last ten years as a result of the rising socio-environmental crisis, inclusive of climate changes, pollutions and numerous health issues caused by pollutions [35]. Sustainability involves the attainment of social, economic, and environmental sustainability development [36]. Firms and businesses do not focus only on the economic sustainability aspect. However, they strive for environmental and social performances as these two indicators have gained impetus despite the complications in measuring the performance. Thus, many organisations shift to sustainable results as stakeholders emphasise society and the environment [37].

Attaining sustainability has emerged as an innovative tactical lever and focuses on numerous prominent firms and supply chains [38]. Besides, organisations need to effectively manage sustainability practices to enhance performance and reduce losses that result from non-compliance to supply chain partners' sustainability standards [37]. Organisational performance primarily denotes that an organisation obtains intangible gains related to enhancing corporate identity, corporate social legitimacy and competitive benefits.

The sustainable supply chain performance dimensions are mainly connected to the TBL, including social, environmental and economic performance, as shown in Table 1. The table summarizes the most relevant study indicators concerning sustainability and TBL, and journals related to manufacturing were chosen. The TBL (comprising environmental, social and economic aspects) is a shared trait in the majority of literature sources investigated within the supply chain sustainability context. In addition, the sustainability performance should concurrently evaluate and stabilise the three sustainability dimensions and the connections, specifically in incorporating social and environmental elements alongside the economic dimension [39].

Therefore, this research's sustainable supply chain performance mainly refers to firms need to operate organization activities by considering all three basic dimensions (economic, social and environmental performance). Subsequently, the firms can minimise the cost of returns, improve customers' satisfaction, reduce community complaints, highlight the design of recyclable pallets and packaging, decrease unwarranted deliveries, and utilise green substances on product design to minimise environmental influences. Thus, supply chain sustainability can be assessed according to the economic, society, and environmental impact [40].

Table 1
Sustainability performance dimensions

	Author	Year	Economic	Environmental	Social
1	Bai et al	2012		√	
2	Faisal	2012	√	√	√
3	Hassini et al	2012	√	√	√
4	Uysal	2012	√	√	√
5	Zailani et al	2012	√	√	√
6	Büyük zkan and Cifçl	2013	√	√	√
7	Reefke and Trocchi	2013	√	√	√
8	Chardine-Baumann and Botta-Genoulaz	2014	√	√	√
9	Varsei et al	2014	√	√	√
10	Ahi and Searcy	2015	√	√	√
11	Gopal and Thakkar	2015	√	√	√
12	Tajbakhsh and Hassini	2015	√	√	√
13	Xu et al	2016	√	√	√
14	Liebetruth	2017	√		√
15	Stindt	2017		√	√
16	Sopadang et al	2017	√	√	√
17	Izadikhah and Saen	2018	√	√	√
18	Popovic et al	2018			√
19	Baba et al	2019	√	√	√
20	Sangwan et al	2019	√	√	√
21	Narimissa et al	2020	√	√	√
22	Verdecho et al	2020	√	√	√
23	Marulanda-Grisales and Figueroa-Duarte	2021		√	
24	Neri et al	2021	√	√	√
TOTAL			20	22	22

3. Research Method

Since the content analysis method is suitable for observational research and its own ability to systematically analyze the symbolic content of all types of written records, the content analysis approach was used to perform the literature review in this paper. The content analysis approach also aids researchers in identifying and analyzing literature in order to shape various categories, which can aid in the development of a new research domain.

This study only contains the papers published in academic journals and conferences in English between 1990 and 2019. This eliminates the papers written in other languages. Data in this study were obtained from Scopus database. Scopus is the largest database of abstracts and citations, with 1.4 billion citations and 16 million author data [6]. Data mining was carried out in 2020. “Reverse Logistics”, “Sustainability”, “Sustainability performance”, “Sustainable development” and “Performance evaluation” these keywords were used for searching articles. The keywords were appeared to the title and abstract in the search and sorted by relevance. Figure 2 shows all the details of the query strings used.

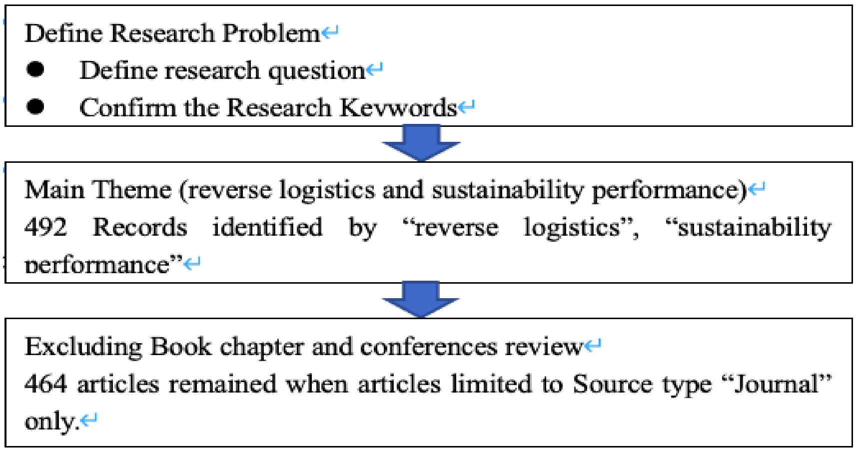

Fig. 2. Search String with Article Inclusion & Exclusion Criteria

4. Discussion and Results

Undoubtedly, reverse logistics in the industry supply chain management is increasingly significant [41]. Those concerned with the manufacturing industry are enthusiastic about engaging in the reverse logistics process due to the associated benefits [42]. The significance of reverse logistics motivated numerous organisations to design dismountable and renewable products in the sustainable development framework [43]. Similar to the supply chain, the planning and decision-making phases implement reverse logistics measures [44].

Reverse logistics boost the improvement of a company with profits and strategic benefits. Firms with products subjected to renewal can save equal to 60 % of the new product's total estimated cost [43]. Similarly, reverse logistics practices can increase the product value by making it re-attractive to customers [26].

Furthermore, reverse logistics stimulate alternative resource usage that is cost-effective and environmentally friendly via lengthening the product life cycle [41]. Additionally, reverse logistics improve economic and environmental performance and enhances social performance. For example, reverse logistics can play a crucial part in customer satisfaction and maintain customer loyalty by repairing or restoring broken-down products [7]. Well-managed reverse logistics programmes can direct sustainable advancement and establish a competitive advantage through profit-enhancement, reducing cost and improved customer satisfaction [15].

Therefore, reverse logistics is extensively evaluated in recent times as a critical element to develop a sustainable performance [22]. For instance, [44] Haji Ali Vahabzadeh *et al.*, [44] investigated reverse logistics disposition alternatives' implications solely on one sustainability dimension element, such as the environmental dimension. Several scholars investigated the implications of reverse logistics implementation and disposition options on economic and environmental performance [31]. For example, Khor *et al.*, [31] examined the impact of reverse logistics disposition alternatives on profit, sales development and environmental performance among electrical and electronic equipment manufacturing companies. Besides, reuse, repair, remanufacture, recycle, and disposal are the standard disposition alternatives in reverse logistics. Several researchers examined the impact of every disposition alternative on distinct sustainability elements discretely, as portrayed in Tables 2, 3 and 4.

Table 2 shows the review on different disposition reverse logistics options and environmental performance. Several researchers examined the environmental performance of reverse logistics implementation and disposition alternatives [31]. The studies concluded that implementing reverse logistics could be a factor to improve environmental sustainability performance. As shown in Table

7, recycle is ranked at the top, followed by remanufacturing and finally, reuse. Khor *et al.*, [31] demonstrated that recycling was most profitable for organisations when regulatory pressure is absent.

Similarly, as highlighted by several studies, recycling is the most preferred sustainable management alternative [30,45,46]. Recycled materials are beneficial as these materials leave a lower carbon footprint compared to raw materials turned into completed goods in an intensive carbon process [45,47]. Furthermore, recycling is a technique utilised to decreases the solid waste stream volume, although the reverse logistics channels used seem to have received minimal attention [44,48].

Zanghelini *et al.*, [47] concluded that remanufacture in a long-term viewpoint is additionally carbon saving compared to a new or a repaired compressor. Remanufacturing presents the best environmental performance when recycling is end-process. For example, the consumed antimony (a toxic heavy metal element) is decreased by 4.18 kg, but when remanufacturing is the end-process, the consumed antimony equivalents are decreased by 5.30 kg.

Table 2
The review on different reverse logistics and environmental performance disposition options [7]

	Reverse logistics disposition options				
Authors	**Reuse**	**Repair**	**Remanufacture**	**Recycle**	**Disposal**
Haji et al (2015)		√	√	√	√
Khor et al (2016)		√	√	√	√
Jindal and Sangwan (2016)		√	√	√	
Agrawal et al (2016)	√	√	√	√	√
Ahmed et al (2016)	√	√	√	√	
Kang (2015)				√	
Oliveira and Magrini (2017)				√	√
Wibowo et al (2014)				√	
Sabharwal and Garg (2013)					
Yalabik et al (2014)			√		
Zanghelini et al (2014)			√	√	√
O'Connell et al (2013)	√				
Bahrami and Jafari (2019)				√	
Wanjiku and Mwangangi (2019)					
Nußholz and Whalen (2019)					
Oliveira Neto and Correia (2019)				√	

Regaining the return value through reuse, remanufacture, repair, and recycle can generate competitive advantages for companies [6,31,44]. Table 3 shows the review on different disposition options of reverse logistics and economic performance. A literature review found that recycling and reuse are more significant than disposal activities [44,46,48,49], as shown in Table 8. For example, reuse and recycle are correlated with the economic significance of decreasing costs of input materials and managing value-adding activities [47,49,50]

Similarly, recycling and reuse play a significant role in cost reduction and higher market share [46,48,51]. Additionally, the economic elements focus on regaining value from the products that are returned, including salvaging integrated circuit boards from electrical products or obtaining valued components from the product via recycling and reuse processes [31,44]. Nevertheless, Jindal and Sangwan [51] discussed that repair is the best recovery process followed by remanufacturing and recycling in profit and energy consumption. The recovery of products for repair through proper disposition is a good advantage for companies [6].

Table 3
The review on different disposition reverse logistics and economic performance options [7]

	Reverse logistics disposition options				
Authors	**Reuse**	**Repair**	**Remanufacture**	**Recycle**	**Disposal**
Haji et al (2015)	√	√	√	√	√
Khor et al (2016)	√	√	√	√	√
Jindal and Sangwan (2016)	√	√	√	√	
Agrawal et al (2016)	√	√	√	√	√
Ahmed et al (2016)	√	√	√	√	
Kang (2015)					
Oliveira and Magrini (2017)					
Wibowo et al (2014)				√	
Sabharwal and Garg (2013)			√		
Yalabik et al (2014)			√		
Zanghelini et al (2014)					
O'Connell et al (2013)	√				
Bahrami and Jafari (2019)					
Wanjiku and Mwangangi (2019)	√			√	
Nußholz and Whalen (2019)	√				
Oliveira Neto and Correia (2019)				√	

Table 4 shows the review on different disposition options of reverse logistics and social sustainability performance. Hence, recycling is the most vital reverse logistics disposition option for social performance [6,49,51]. Recycling plays a significant role in attaining social performance involving customer satisfaction [48]. Nevertheless, reuse can offer employment to the vulnerable and unemployed equal opportunities provided by recycling if conducted via social enterprises [31,49,51]. Nevertheless, the United States Environmental Protection Agency (US EPA) approximated that 10,000 tons of materials create one job at the incinerator, six jobs at landfills, 36 jobs at recycling centres, and 28 to 296 jobs for the reuse industry by observing reuse and recycling process. However, reuse may not develop more employment compared to recycling. Recycling and reuse characterise a notable feature that provides employment opportunities and social development [6,46].

Table 4
The review on different disposition reverse logistics and social performance options [7]

	Reverse logistics disposition options				
Authors	**Reuse**	**Repair**	**Remanufacture**	**Recycle**	**Disposal**
Haji et al (2015)					
Khor et al (2016)					
Jindal and Sangwan (2016)		√	√	√	
Agrawal et al (2016)	√	√	√	√	√
Ahmed et al (2016)	√	√	√	√	
Kang (2015)					
Oliveira and Magrini (2017)					
Wibowo et al (2014)				√	
Sabharwal and Garg (2013)					
Yalabik et al (2014)					
Zanghelini et al (2014)					
O'Connell et al (2013)	√				
Bahrami and Jafari (2019)					
Wanjiku and Mwangangi (2019)	√			√	
Nußholz and Whalen (2019)					
Oliveira Neto and Correia (2019)					

5. Conclusion

The objective of this study was to conduct a comprehensive review of the literature to assess the performance of the RL process in terms of the three dimensions of sustainability: environmental, economic, and social. Undeniably, many RL disposition tactics positively impact economic, environmental, and social performance [52]. However, few studies have focused on disposition decisions of RL impacting sustainability performance, and no comprehensive research has been found that explores the different disposition options and provides a method for selecting the most suitable for sustainability development [6].

In attempting to fill these gaps, this research measures the impact of various RL disposition options on economic, environmental, and social sustainability factors. In addition, many factors, including operating costs, value-added recovery, environmental effects, consumer demand, technical/operational viability, and corporate responsibility, must be considered when evaluating the impact of various types of disposition options (repair, refurbishing, remanufacturing, disposal, and recycling) on sustainability performance. Considering these factors, the recycling was determined to be the best choice.

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