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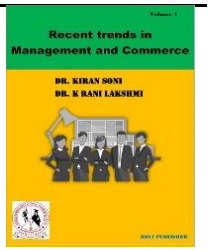

Reverse Logistics System Flexible Decision Modeling: A Value Added WSM method Approach to Alternative Selection

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Abstract

Inverse manufacturing is always the best substitute for collection centers any method for recovering products should take this into account strategically. These results are typically described as being multidimensional, transdisciplinary, complex, and unstructured. Installation of reverse logistics systems properly, due to reuse or reproduction of certain parts not surprisingly, as a result, operations expenses are reduced and consumer loyalty is improved. To explore the practices of reverse logistics in this industry with a follow-up interview conducted to present the results of a survey this is the main objective of this paper. The purpose of this study is to identify the best inventory policies for a reverse logistics system with a specialized system. Demand over a given planning horizon is assumed to be a known continuous function and the rate of return on goods consumed is a given function. MCDM decision-making method provides an alternative framework for handling these. Determining decision-making strategies for reverse logistics system (RLS) problems and a great alternative choice for reprocessing. To design a decision-making model for that, considering issues including cost/time, legal considerations, influence on the environment, quality, and market a quantitative and qualitative assessment is required. Based on these criteria Performance must be considered to determine the appropriate reversal position. The manufacturing option is subject to the judgement of subject-matter authorities. The WSM approach is based on theory in this publication. A multi-criterion decision-making (MCDM) model is what we suggest. The suggested model aids in creating adaptable revenue plans that are effective and efficient based on numerous criteria. Businesses also conduct this analysis. To build new reprocessing facilities or to utilise the facility more effectively is a tool for making strategic decisions. In this paper, a multi-criteria decision-making (MCDM) model is suggested based on WSM method set theory. Alternatives include remanufacturing, reselling, repairing, cannibalising, and refurbishing; evaluation criteria include market factor (C1), quality factor (C2), legislative impact (C3), environmental impact (C4), and cost/time factor (C4). As a result the Remanufacturing is in 1st rank and Refurbishing ailast rank. Also, based on the WSM method Flexible MCDM and inverse logistics for alternative tests This paper also attempts to come up with a well-suited team decision support tool.

Keywords: reverse logistics (RL), remanufacturing, WSM Method

Introduction

Assuring materials' regularity for proper disposal or recovering value from materials is how reverse logistics (RL) is frequently defined. The act of leaving a destination is defined as such [1]. Moving products from their point of origin to their final destination is the primary purpose of logistics systems. An RL system (RLS) replicates the flow of components or materials and includes a redesigned supply chain for resource efficiency and disposal or repair. Product turnover is now prevalent across practically all product categories, with rates reaching 20% in some sectors. Because of this, creating a thorough and economical decision-making system for handling product returns is a challenging task above and beyond operational level. Consequently, a well-developed reverse logistics and management plan can be a crucial strategic asset [3,4]. The average rate of return, according to a previous poll by the Reverse Logistics Executive Council (RLEC) [5], is 8.46%. Table 1 displays individual predicted returns. Rates of return are evident when considering the complete manufacturing value chain. like this. These rates are anticipated to rise by 20-30% or more in 2005–2006 and in the coming years. To meet the needs of this growing sector Designing a structure is intermediate, Multi-criteria decision-making is always complicated and remains a challenging issue. Especially, when many recycling alternatives are available Comparison of these options with other options (tangible or intangible) There were no reliable data with substantial variability available. utilising a variety of standards established by professionals To choose the required option, a flexible decision-making system is required. No matter how, when, or in what state the products are returned, the environment for returnable products is characterised by quantity, time, and quality variability [6]. This is a challenge for building an efficient logistics system. Many decision makers and the presence of multiple criteria The complexity can be increased by extending results from one to more dimensions. The alternative selection procedure, It is obvious that slavishly following a mathematical model or algorithm would not solve the selection problem. To support these kinds of complex, unstructured selection problems, and to manage selection and prioritisation difficulties involving multiple criteria We require fresh ideas. Of recycling alternatives the results of this examination, Prioritizing companies, Correspondingly the inversion will help to improve the production facilities. In this essay, we go through how fuzzy decision-making and reverse logistics (RL) might work together. This formal decision analysis system, Based on the analysis results enables ranking of alternatives by decision-makers. Although the goods were still new to the market, since the early 1990s, RL has garnered academic interest. RL alludes to the supply chain's inventory moving rearward [7]. This does not mean that the products end up with their original manufacturers, But RL's product returns, collection of extraction, and disposal features,

regardless of where they end up [8]. When confined to the total of steps that guarantee sustainable or environmentally sound material recovery [9,10], several writers' RL products and Broad Definitions: unnecessary items, Including income and guaranteed income All types of products indicate income [1, 11,12]. Additionally, [13] functions between research and environmental management Deal with a range of issues and talk about value-chain cooperation for recycling. Lippmann [14] coupled location-orientation issues and discussed the factors that contribute to successful supply chains that are environmentally conscious. In Procurement, Industrial Ecology, and Industrial Ecosystems There is an abundance of literature on areas related to environmental issues [15-18]. The scope and perspective of earlier studies and reviews are constrained. They include all aspects of RL [19], Features are also not adequately covered. Most of the work is empirical and deals with decision modeling and network design issues and not paying enough attention to the complexity of procedures. We want to adopt "RES Focus" to promote further study, training, and research by providing a thorough integrated picture of RL as an organisational system. Here, a broad definition of RL can be used as a reverse organizational structure. Additionally, the phrases "product return" and "reverse logistics" are used interchangeably in this essay. Thierry and others [20] the phrase Product Recovery Management was introduced to recover economic value as much as is reasonably practicable, hence lowering the quantity of trash (PRM).

Material and Methods

Prior studies on product revenue have concentrated on network architecture [21], technological concerns including shop floor control [22] and inventory control [23], and marketing difficulties. Began concentrating on this area after seeing the value that was concealed in RL. The necessity of comprehending the financial implications of RL choice techniques was shown by Mollenkopf and Closs [24]. Profit-driven: Srivastava and Srivastava [25] they created a hierarchical decision-making framework to investigate the viability of RL networks. They developed an analytical model of the profitability of RL operations for selected types of products. Coordination of product recovery actions is now greatly aided by information and communication technology (ICT), real-time decision-making, and these techniques [26, 27]. RL activity integration problems inside organisations citing Chouinard et al. Determine IT integration solutions, you may think of it as a flexible model that improves RL performance. Strategic decision-making is thus supported by current literature rather than analytical frameworks. From the perspective of sophisticated operational decision-making the study reveals that the model has improved. Considering functional traits when choosing the most advantageous reverse manufacturing option we suggest a strategic framework. Five distinct possibilities can be found by concentrating on various recovery options: cannibalism, replication, renewal, repair, and resale. There is an ordered list of the required extractions. Various authors describe and categorise the healing process in various ways. A combination of remanufacturing, reuse, and recycling is how Johnson and Wang [30] define it, whereas Thierry et al. [20] define it as retrieving, renewing, and reproducing Cannibalism and recycling are separated. Procedures for proper recuperation are defined by Melis Chen and de Ron [13]. Give terminologies and definitions. The following is an explanation of these substitutions: Restoring discarded goods to usable condition is referred to as repair and reuse. Repairs may not be as high-quality as brand-new ones. Restoration involves the removal of damaged components, and examining and upgrading the materials used raises the quality to a particular degree. Technically, refurbishing involves replacing outdated modules or parts. It entails replacing outdated technologies with more advanced ones [20]. Used products are reused. Bringing new goods up to the same high standards of quality, including thorough component-level disassembly, thorough examination, and replacement of any damaged or outdated parts [23]. One of the three aforementioned functions is cannibalism. relative to the materials employed for anything recovering a few reusable components and modules. Finally, recycling from spent materials and parts makes it easier to reuse resources through different separation procedures and reuses them in the creation of original or other products [3]. Regarding the materials used for anything, recovering a few useful components and modules is one of the three aforementioned functions. Last but not least, recycling from used materials and parts facilitates resource reuse through various separation techniques and reuses them in the development of original or alternative goods [3]. Decision-making occurs at different levels of the hierarchy in organisations, according to this language evaluation of these factors. or to build a facility for repeated processing. "Return Evaluation Criteria" is used here. The importance weights assigned to each decision maker's quality ratings are taken into account as linguistic variables. Since these linguistic estimates are only approximations, [2-4] to explore the ambiguity of these linguistic assessments we can assume that linear trapezoidal membership functions are sufficient. Based on the WSM Method rationale and influencing factors introduced above, As shown in Table 1, A model for alternative selection throughout the recovery process can be created. The original equipment manufacturer (OEM) has real-world production data (brown goods) for high-value and medium-sized goods that can be used to validate the model (OEM). The corporation wants to get involved in product revenue because of numerous internal and external environmental needs. The company may derive revenue from the end user (consumer) or the forward supply chain Business income can be derived from various fronts. Further, Expert knowledge of and about influencing factors is provided by Knowledge Institute. Of management familiar with forward and return supply in discussion with various degrees of specialists, we found the most favorable reprocessing alternative. These specialists are chosen based on the level of knowledge maturity, cost/time, environmental impact, market factor, quality factor, and legislative impact (C1, C2, C3, C4, and C5). The following criteria have been identified. The proposed method, To reprocess returned products through these linguistic evaluations Used to select the appropriate alternative, A computational algorithm is summarized as follows.

Results and Discussions

The proposed framework for using the WSM method is Flexible in choosing the best product recovery option the

demonstration shows that a multi-criteria decision-making problem can be solved. Using this model WSM method, Provides a systematic approach. However, the idea based on the WSM technique shows that making decisions in a system for product recovery is feasible. This technique has great value efficiency and generates medium-sized items (brown goods). Demonstrated with a business as an example. This method is challenging to utilise due to the extensive nature of the model, the Data needs, and the calculations and analysis that go along with them. By using a computer-based application, not only is this model quick to implement but processing results can be delivered easily and efficiently. The developed prototype program can then be developed as a decision support tool for reverse engineering systems. Also, assess other criteria and sub-criteria we can create a demonstration prototype. The WSM method is reasonably accurate; In exchange for dependability and flexibility, it also gives up some clarity. And there is no such concept of truth-justification as a rule-based system [2]. Also, due to many dynamic environmental and legislative issues Since the RLS system can be greatly affected, your decision on the chosen alternative can affect. Considering these issues, A more complicated system might be needed to handle these dynamics. However, given that this is only a preliminary analysis, it can increase RLS's effectiveness and offers some supporting data.

TABLE 1 Evaluation parameters Criteria for segmental attractiveness

C1	Market factor
C2	Quality factor
C3	Legislative impact
C4	Environmental impact
C5	Cost/time factor

Table 2 presents the evaluation parameters. Parameters for evaluating practices are Market factor (C1), Quality factor (C2), Legislative impact (C3), Environmental impact (C4), and Cost/time factor (C5).

TABLE 2 Alternatives parameters Criteria for segmental attractiveness

A1	Remanufacturing
A2	Reselling
A3	Repairing
A4	Cannibalization
A5	Refurbishing

Alternative methods are presented in Table 1. Alternative methods for A1(Remanufacturing), A2(Reselling), A3(Repairing), A4(Cannibalization) and A5(Refurbishing).

TABLE 3 given a data set

	C1	C2	C3	C4	C5
Remanufacturing	56.23	75.48	76.43	29.15	21.12
Reselling	75.43	86.43	49.73	33.69	27.30
Repairing	45.36	79.42	69.43	36.42	23.10
Cannibalization	56.14	65.43	85.00	24.60	45.13
Refurbishing	69.13	66.43	57.13	35.00	20.43

Table 2 is given The Data Set. Remanufacturing values is high values for the data set. Cannibalization is low values for the data set. Table 1 shows the data set for the Reverse logistics using WSM method for the Remanufacturing, Reselling, Repairing, Cannibalization, Refurbishing of the Market factor, Quality factor, Legislative impact, Environmental impact, Cost/time factor.

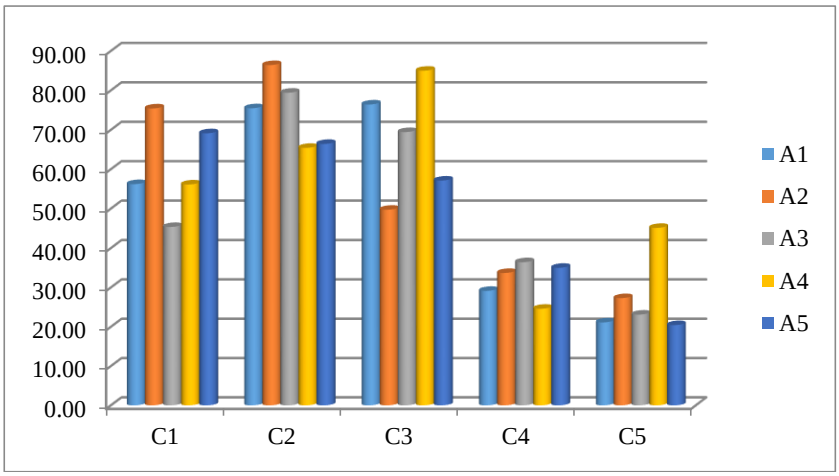

FIGURE 1 Give a data set graph

Figure 1 shows the data set for the Remanufacturing, Reselling, Repairing, Cannibalization, Refurbishing of the Market factor, Quality factor, Legislative impact, Environmental impact, Cost/time factor.

TABLE 4 Normalized data

A1	0.74546	0.87331	0.88430	0.70086	0.96733
A2	1.00000	1.00000	0.57538	0.60641	0.74835
A3	0.60135	0.91889	0.80331	0.56096	0.88442
A4	0.74427	0.75703	0.98345	0.83049	0.45269
A5	0.91648	0.76860	0.66100	0.58371	1.00000

Table 4 is given Normalized data of the data set. Given this data is easily calculated seeing in figure 2.

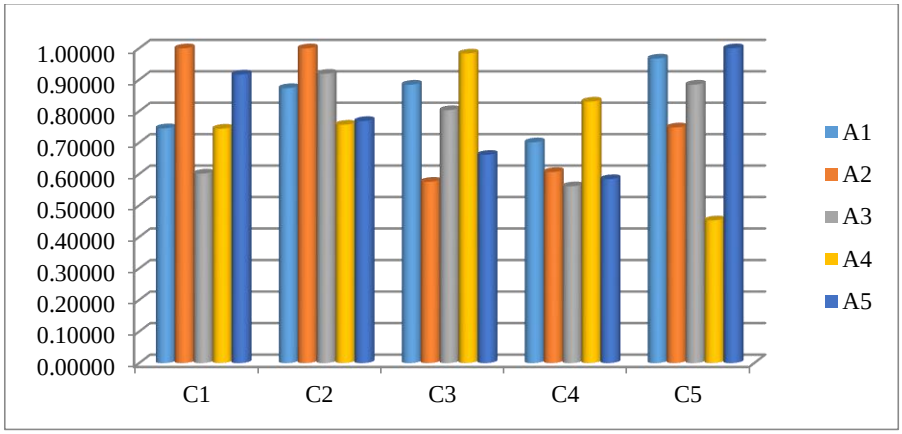

FIGURE 2 gives the normalized data

TABLE 5 Gives weight matrix

A1	0.25	0.25	0.25	0.25	0.25
A2	0.25	0.25	0.25	0.25	0.25
A3	0.25	0.25	0.25	0.25	0.25
A4	0.25	0.25	0.25	0.25	0.25
A5	0.25	0.25	0.25	0.25	0.25

Table 5 shows the weight of the data set the weight is equal for all the value in the set of data in the table 1. The weight is multiplied with the previous table to get the next value.

Table 6 Weighted normalized result matrix

A1	0.18636	0.21833	0.22107	0.17521	0.24183
A2	0.25000	0.25000	0.14384	0.15160	0.18709
A3	0.15034	0.22972	0.20083	0.14024	0.22110
A4	0.18607	0.18926	0.24586	0.20762	0.11317
A5	0.22912	0.19215	0.16525	0.14593	0.25000

Table 6 shows the weighted normalization decision matrix it is calculated by multiplying the weight and performance value in table 4 and table 5.

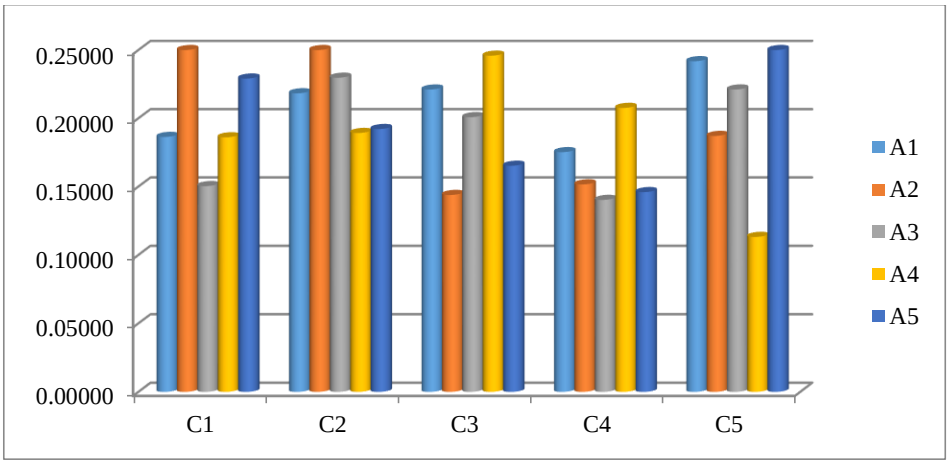

FIGURE 3 Weighted normalized result matrix

Table 7 Preference Score

A1	1.04281
A2	0.98254
A3	0.94223
A4	0.94198
A5	0.98245

Table 5 gives the Preference Score. A1 is highest values for preference values shown in figure 4.

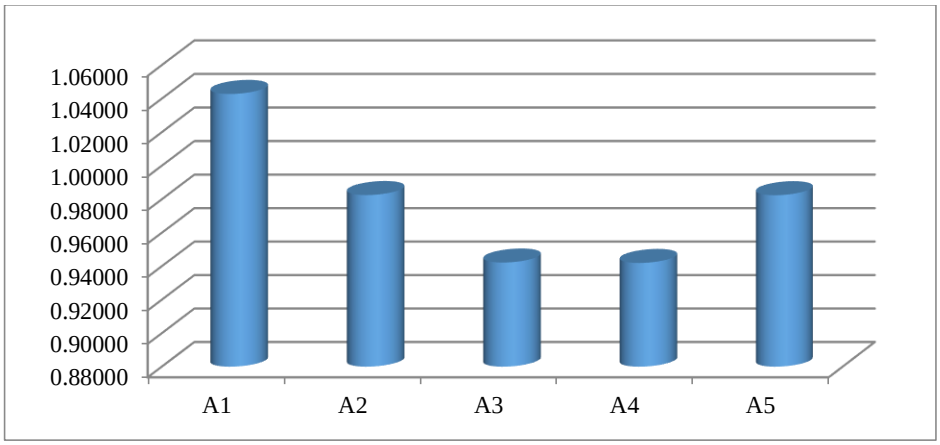

FIGURE 4 preference values

TABLE 8 Ranking

A1	Remanufacturing	1
A2	Reselling	2
A3	Repairing	4
A4	Cannibalization	5
A5	Refurbishing	3

Table 8 shows that the Remanufacturing is on 1st rank, Reselling is on 2nd rank, Refurbishing is on 3rd rank, Repairing is on 4th rank, Refurbishing is on 5th rank.

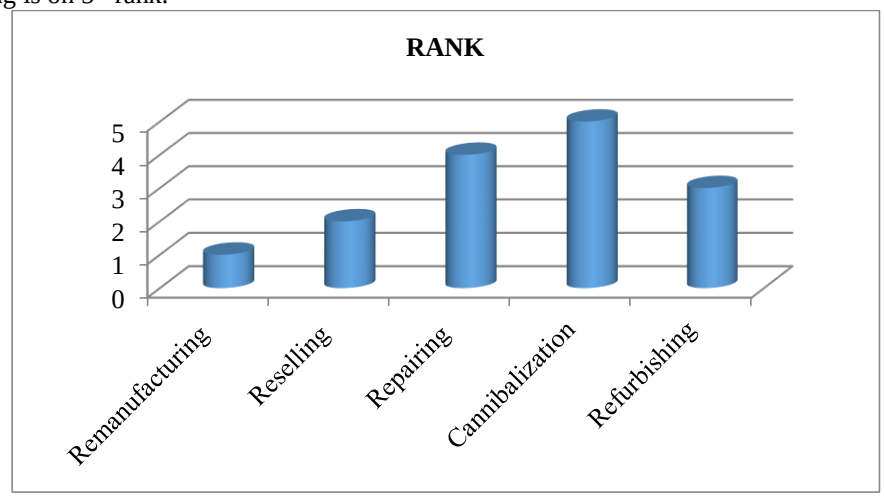

FIGURE 5 shown in ranking

Figure 4 shows that the Remanufacturing is in 1st rank and Refurbishing are last rank. Figure 5 shown in ranking.

Conclusion

Problems with alternative selection in the process of recovering a product's worth are transient and adhere to complicated and unreliable facts. In this paper, an algorithm for the WSM method is demonstrated in an alternative selection process. Alternatively put, it depends on the criteria and importance weights. It is appropriate to evaluate potential reverse manufacturing alternatives using linguistic characteristics rather than numerical numbers. In the process of solving alternative

selection difficulties, expert experience frequently pops up. Due to perceptions and arbitrary assessments suggested in this research, WSM approach. The suggested approach is quite adaptable and offers more objective data for RLS's alternative selection. Future research on using artificial intelligence to develop team decision support system this model encourages progressive introduction. The problem of reverse logistics has been resolved in this work. The required ideal conditions are also present due to the buildup of production, reproduction, and disposal costs. Optimum production in the process of reverse logistics system in WSM method and It was shown that removal processes dominate. The last function from production and disposal behaviour is reproduction. It is possible to do additional study to determine how sensitive the ideal production-inventory policy is to changes in the rate of return. The WSM method is the most widely used of the two criteria selection methods. One, sweet reaction rate and exceptionally bad For the set of possible options finding the response rate offers a pleasant opportunity. This approach is used to solve critical problems determined by the researchers. We analyzed that the Remanufacturing is on 1st rank, Reselling is on 2nd rank, Refurbishing is on 3rd rank, Repairing is on 4th rank, Refurbishing is on 5th rank.

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