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Research Article

Reverse Logistics Implementations Solutions: Interval Type 2 FAHP-FTOPSIS Approach

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In recent years, reverse logistics (RL) has come to the fore as an important issue, given the increasing environmental concerns, corporate social responsibility, and sustainable competition. Today, RL is considered a strategic activity. Legal requirements, social responsibilities, environmental concerns, economic interests, and customer awareness have led manufacturers to produce eco-friendly products and to collect returned and used products. Nevertheless, there are barriers to the implementation of RL in organizations. This study sought to prioritize solutions for overcoming the barriers to the implementation of RL in the Iranian iron and steel industry. To analyze the data, interval type-2 fuzzy AHP (FAHP) and fuzzy TOPSIS (FTOPSIS) have been used. The results revealed that "policy-related issues," "knowledge-related issues," and "economic issues" were the key barriers and showed the highest ranks, respectively. Furthermore, the results indicated that "strategic collaboration with reverse chain partners," "using advanced technologies for waste collection," and "transparent quality and product value" were the major measures to overcome the barriers. The proposed model suggests that decision-makers should consider long-term relations with supply chain partners in organizations to implement RL.

1. Introduction

Each year millions of tons of products lose their economic life and turn into waste [1]; numerous countries worldwide have been addressing environmental issues and raw materials since the early 1990s. Such concerns have led to the emergence of a series of new concepts in the industry, including reverse logistics (RL) [2]. RL, which has proved to be a topical issue, is viewed as a tool for dealing with products' end-of-life (EOL) in the environment [3]. RL strategies and operations have inspired a wide spectrum of studies as they could have important effects on companies' economic value chain [4]. In many countries, governments found it necessary to approve laws (e.g., tax payment or certain charges for industrial plants) to ensure that manufacturers take responsibility for collecting and recycling products used, damaged, or destroyed. Through this process, manufacturers would try to find solutions for managing products with a completed lifecycle; the motivations behind these activities were public awareness of the shortage of resources and raw materials and increasing environmental concerns [2].

Today, numerous companies may adopt RL to gain economic competitive advantages or other necessities associated with legal or environmental issues [5]. The reason for adopting RL is that RL is the key to green supply chain management and could help achieve better performance and provide an opportunity for companies to increase product returns [6]. This way, more companies are encouraged to use RL as a strategic move toward economic benefits and a better social image [7]. Thus, companies have come to realize that a more effective understanding of production/productivity and RL could bring about more competitive advantages for them.

Research in the field of RL is constantly growing, and various definitions of RL have been introduced. All of these definitions are inspired by the definition of the Logistics Management Council: the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal [2]. The notion of "reverse supply chain" encompasses a set of activities and actors required to collect goods after consumption, retrieve the remaining value, and create/redistribute a product or an input that is reestablished in the process of creating value [8]. Therefore, to run a successful reverse chain, design, planning, and precision control must be properly implemented [2].

Retrieving goods is an environmentally beneficial and profitable task. This activity helps conserve scarce resources, reduce energy consumption throughout the lifecycle, and improve the residual value of goods after consumption [8]. Reusing products also makes it possible to consider valuable, precious, and nonrenewable materials [9]. As such, recycling pursues several goals, the most important one of which is to create an economic and environmental advantage by using less material and fewer resources and by turning waste into inputs and economic value [10]. Hence, the establishment of circular economies, a process that mainly involves the implementation of reverse supply chains (RSCs), can have an important function in the sustainable development of companies.

Traditional supply chains do not consider reverse flow management or the integration of recovery processes. However, in order to successfully establish and operate a closed-loop supply chain (CLSC), one has to fully understand the flow of materials and information in the RSC [8]. Meanwhile, researchers have recently focused on RL/CLSC issues, considering the importance of raw materials, pollution prevention, recycling management, social responsibility, and environmental issues [11]. Efficient implementation of recycling networks in managing material reverse flow from end-users to manufacturers requires appropriate logistic structures [10]. On the other hand, reverse logistical networks demand various requirements that improve the entire supply chain, including recovering used components, regaining and/or disposing of chemicals, and efficiently recycling precious materials [1].

RL has evolved as one of the new areas of management to help companies recognize potential resources and overcome challenges associated with operations and strategies. In RL, in addition to all logistic activities, recursive processes are also taken into account. A proper application of this process would not only enable management to effectively manage the flow of returned products but also help identify opportunities to control capital and to reduce unwanted returns. Given the increasing importance of RL in organizations, measuring the performance of recursive processes represents a necessary procedure [12]. Identifying the important and driving factors and assessing the readiness of companies to implement RL are overriding issues in studies concerned with logistics; such investigations, which involve competitiveness, marketing, and economic/environmental factors, help administrators reduce logistics costs and identify barriers and critical success factors contributing to logistic planning and implementation.

In addition, analyzing the gap between the status quo and a company's full readiness for the proper implementation of the process enables managers to eliminate the barriers by providing conditions for the organization to implement the RL requirements as accurately and promptly as possible [13]. Different organizations and industries worldwide are utilizing reverse logistical methods to overcome obstacles and generate profits from opportunities. In such processes, reverse logistical operations are required to cope with global competition and strict environmental regulations, to maximize profits, and to improve corporate opportunities. One of the major industries using RL is the steel and iron industry. This industry produces sponge iron in four stages: harvesting and granulation, concentrate, pelletization, and direct reduction. In order to facilitate this process, companies seek to provide products without any complaints that are distinct from the products of other companies. To this end, they utilize RL to reduce recurring costs and control resources to provide more quality products. Implementing RL in the steel and iron industry reduces the collection time for returned products and increases the ability to dispose of them, while reducing the volume of waste, RL costs, and the cost of incoming returns that are directly related to the RL process. Nevertheless, there are barriers to the implementation of RL in organizations.

The present study proposes an integrated method composed of the analytical hierarchy process (AHP), TOPSIS, and interval type-2 to identify and prioritize solutions to overcome barriers to RL in the iron and steel industry. Interval type-2 fuzzy AHP (FAHP) is utilized to determine the importance of the weights of barriers, while interval type-2 fuzzy TOPSIS (FTOPSIS) is used to prioritize the solutions suggested. The interval type-2 approach has been employed in this study to handle uncertainty more effectively. In the following sections, the literature on RL is explored to construct a conceptual model. Section 3 explains the research methodology and the techniques utilized. Section 4 reports the results of applying the methodology. Finally, the discussion of the research findings and conclusions and suggestions for future research are presented.

2. Theoretical Framework and Literature Review

Today, recycling and sustainable development have become increasingly pressing issues in the world [14]. For this reason, some laws have been enacted over the decades to draw attention to waste management [15]. Meanwhile, in recent years, RL has become a topical issue due to increasing environmental concerns, new laws, corporate social responsibility, and sustainable competition. RL refers to the sequence of activities involved in collecting and processing used products for reuse, repair, remanufacturing, recycling, or disposal [5]. As such, companies and organizations are always responsible for returns, regardless of what kind of product they are producing.

Nowadays, there are various products with shorter lifespans. The ability to recycle components and materials and the economic benefits of returning products to their life cycle for consumption has encouraged manufacturers to rely on RL technologies [16]. Managers must always be prepared to accept returns or unsold products for a variety of reasons. Attending to these issues and recognizing the importance of RL increase organizations' profits and prevent losses caused by returns or not selling them [17]. As a result, with regard to environmental concerns, RL is becoming an important strategy to increase customer satisfaction [18]. Creating RL networks is important for a large number of different manufacturers.

Green laws force manufacturing companies to recycle their products and services under warranty, to minimize waste and conserve resources. Consequently, manufacturers encourage better product designs for reuse and recycling to maximize the benefits from their products [11, 19]. In general, forward and reverse logistics network design is a crucial and strategic issue, as it is associated with supply chain efficiency and accountability.

2.1. Forward and Reverse Logistics. As mentioned earlier, there are two types of supply chains, namely, forward and reverse; forward supply chains (FSC) involve a series of activities that transform raw materials into finished products. Demand management, procurement, and order fulfillment are some of the areas where managers try to improve supply chain performance. A reverse supply chain (RSC) describes operations related to collecting and recovering product returns in supply chain management. Economic features, the government, and customer pressure are three aspects of RL [20]. Ultimately, the integration of a forward supply chain and a reverse supply chain leads to the formation of a CLSC [21].

Organizations adopt business improvement measures to enhance their business performance. Logistics and supply chain management are the important factors contributing to companies' competitive advantage. In fact, logistics, like supply chain management, is a considerable notion since the early 1980s. Logistics refers to the flow of goods between the point of origin and the point of consumption and seeks to meet some of the requirements of customers or companies. Managed resources in logistics can include physical items such as food, materials, animals and equipment, or conceptual items such as time, information, particles, and energy. Physical logistics usually involves the integration of information flows, materials, production, packaging, inventory, transportation, warehousing, and often security [22].

Therefore, logistics involves the process of planning, implementing, and controlling efficient and effective flows, as well as storing goods, services, and information from the point of origin to the point of consumption. Of course, the concept of RL is used throughout the product lifecycle from the design stage to consumption and even to the point where it may return to the factory [11, 15]. The design of the forward and reverse logistics network must be optimally integrated because it encompasses key factors such as cost, service level, and accountability.

2.2. Reverse Logistics Barriers and Solutions. In more developed countries, manufacturers try to implement RL as an operation aimed at refining and disposing products; in less developed countries, however, due to a lack of social pressure, environmental issues and price sensitivity to the market are not always taken seriously. As a result, a successful RL implementation would require governments' economic and financial support and collaboration with supply chain partners [23]. Many studies have probed into the barriers to RL implementation in the field of knowledge, public participation, resources, and governance in Europe.

Nonetheless, some of the key barriers to RL implementation are the lack of support from top management, tax-related issues, insufficient planning, and the lack of awareness of environmental regulations [24]. There are numerous studies in this field, especially in Europe and India. Azadnia et al. [25] identified a list of barriers in order to ensure the reverse logistics successful implementation of electric vehicles lithium-ion manufacturing companies. They found that market and social and policy and regulation dimensions are the two main barriers to the implementation of EVs-LIBs RLs. Kaviani et al. [26] proposed a framework to evaluate barriers of RL implementation in the automotive industry. They found that economy and knowledge are the most and least important barriers, respectively. Prajapati et al. [27] developed a hybrid framework to rank RL implementation solutions in the Indian electrical manufacturing industry. The major mitigation solution to overcome RL barriers is to formulate and enforce strict yet supportive laws, policies for returns, and end of life components. Badenhorst [28] discussed product quality, prediction limitation, inadequate information, and technology systems as operational barriers to RL. Bouzon et al. [29] divided the barriers into seven categories including infrastructure and technological, governance and supply chain processes, economic, knowledge, policies, markets, and competition and management. The results indicated that policy and economic barriers were the most impactful ones. Prakash and Barua [30] conducted the research on prioritizing RL implementation solutions to overcome barriers in the electronic industry, by identifying RL barriers and dealing with them. Such barriers emerged from managerial, organizational, economic, legal, technological, structural, and market streams. Moreover, such solutions as management awareness, balanced cost-effectiveness and customer responsiveness, routine and standardized processes, and strategic partnerships with the supply chain partners were among the issues observed in the investigation. Abdulrahman et al. [31] investigated critical barriers to implementing RL in China's manufacturing sector. In this research, an RL theoretical model was proposed and the barriers were divided into four categories: the lack of RL professionals and low commitment, the lack of primary funding and budget for monitoring systems, the lack of laws and government policies, and the lack of return monitoring systems. Luthra et al. [32] investigated the barriers to RL implementation in India, identifying numerous factors in the country as a developing one, relying on different insights from stakeholders. Srivastava [33] developed a conceptual model for location assignment through interviews and precise solutions for network configuration and design. Ying [34] investigated the main obstacles to automobile RL, seeking to identify the interactions among them in the automotive industry. The results showed that the lack of top management's awareness of RL, the lack of commitment, and the lack of strategic planning were three major barriers in the field under investigation. Liu et al. [35] conducted a study on RL costs for electricity recycling and electronic products. Their research proposed a mathematical programming model that minimized the total cost of processing several types of technology changes and of expanding the market for electrical and electronic products. The monetary factors considered in this model included collection and transportation costs, as well as sales revenue from various sectors responsible for returned products. The literature review dealing with the barriers and solutions for RL implementation in different industries could be summarized as in Tables 1 and 2.

As the literature on RL suggests, RL is prevalent in European countries, although the process is facing several problems in developing countries such as Iran. Therefore, this research identifies and prioritizes the solutions that could help overcome RL implementation barriers in the Iranian iron and steel industry. Inspired by the findings of the study, managers will be able to focus more on solving problems, sustaining their companies' survival, and creating a potential competitive advantage.

3. Methodology

The purpose of this study was to prioritize solutions that could help overcome RL implementation barriers in the steel and iron industry. To accomplish this, after the related literature was reviewed, two methods were integrated, namely, interval type-2 FAHP and FTOPSIS. Primarily, the barriers and solutions were refined through content validity ratio (CVR) by referring to the opinions of 12 experts through the purposive sampling method in the field of supply chain management and logistics in iron and steel industries in the south of Iran. In this research, the required information was obtained from two university professors who had experience working in the iron and steel industry as well as ten experts consisting of production, quality control, procurement, and logistics managers and specialists. In the present study, three types of questionnaires were used to collect data including content validity checklist, pairwise comparisons' questionnaire to determine the weights as well as questionnaire to determine the scores of solutions to overcome barriers based on interval type-2 fuzzy linguistics terms, and Excel software was also used to perform calculations.

To this end, first, the experts were asked to identify the relevant barriers and solutions. These barriers and solutions were then screened to determine the most important ones through content validity ratio (CVR) analysis. Following that, the weights of the barriers were computed through interval type-2 FAHP as developed by Celik and Akyruz [72]. Finally, the solutions were ranked using interval type-2 FTOPSIS as constructed by Mendel et al. [73]. After reviewing the literature and extracting the barriers and solutions, the study categorized the dimensions of RL barriers into "technology and infrastructure," "management-related issues," "governance and supply chain processes," "economic issues," "knowledge-related issues," and "policy-related issues." All the barriers derived were divided into 6 dimensions and 15 indicators; meanwhile, through CVR, 15 solutions were identified in the literature that could help overcome these barriers. The hierarchical conceptual model is illustrated in Figure 1.

3.1. Type-2 Fuzzy Set.

Zadeh [74] called type-2 fuzzy sets an extension of fuzzy sets. After that, to distinguish between fuzzy sets and type-2 fuzzy sets, fuzzy sets are called type-1 fuzzy sets. Type-2 fuzzy sets have a fuzzy membership degree which, in the face of uncertainties, has the ability to reduce the effect and model them [75]. In fact, the type-1 fuzzy set represents the first-order approximation of uncertainty, and the type-2 fuzzy set represents the second-order approximation of uncertainty (Coupland and John, 2008). The membership function of the type-2 fuzzy set is like a three-dimensional function, whose third dimension is the value of the membership function at any point of its two-dimensional domain, which is called the footprint of uncertainty [73]. This type of fuzzy set has been successfully used in various MADM methods. The present study proposes an integrated method composed of interval type-2 fuzzy AHP and type-2 fuzzy TOPSIS to identify and prioritize solutions to overcome barriers to RL in the iron and steel industry. The interval type-2 approach has been employed in this study to handle uncertainty more effectively. In the type-2 fuzzy AHP, decision-makers use linguistic terms for judgments related to pairwise comparison. Due to the inability of the fuzzy hierarchical analysis process to control the uncertainty, the type-2 fuzzy is more suitable and has the potential to be integrated with the analytical hierarchical method [76]. After weighting the obstacles using type-2 fuzzy AHP analysis, the solutions are prioritized through the type-2 fuzzy TOPSIS.

Table 3 shows the review of the background of the techniques used in this research and the field under study. This investigation illustrates that type-2 AHP-TOPSIS techniques are mostly used in the field of supplier selection or location selection, and its development into the field of reverse logistics is considered a novel approach in this type of fuzzy sets and techniques.

In the following subsections, each of the methods used in this paper is explored in detail.

3.2. Interval Type-2 FAHP.

Fuzzy systems can partially reduce the effect of uncertainty as they include membership functions with exact degrees of belonging. Interval type-2 is an improved version of type-1 because it can deal with more uncertainty. This type of fuzzy method was introduced by Zadeh [74]. The membership function is a generalized type-2 fuzzy set, like a three-dimensional function in which the third dimension is the membership function of each point of its two-dimensional domain; this mode is called the

Table 1: Reverse logistic barriers.

Barriers	References
Lack of technical skills	Abdulrahman et al. [31]; Aitken and Harrison [36]; Bouzon et al. [29]; Chan and Kai Chan [37]; Ganjali et al. [38]; Govindan et al. [39]; Hillary [40]; Ravi and Shankar [41]; Rogers and Tibben-Lembke [42]; Shaharudin et al. [43]; Sharma et al. [44]; Prakash and Barua [30]; González-Torre et al. [45]; Kapetanopoulou and Tagaras [46]; Sarkis et al., [47]; Starostka-Patyk et al. [48]; Wiel et al. [49]; Bei & Linyan [50]; and Yusuf and Raouf [51]; Daugherty et al. [52]
Lack of IT systems standards	Abdulrahman et al. [31]; Aitken and Harrison [36]; Bernon et al. [53]; Bouzon et al. [29]; Chan and Kai Chan [37]; Ravi and Shankar [41]; Srivastava and Srivastava [23]; Thierry et al. [54]; Li and Olorunniwo [55]; Lau and Wang [56]; González-Torre et al. [45]; Janse et al. [57]; Sharma et al. [44]; Starostka-Patyk et al. [48]; Bei & Linyan [50]; and Yusuf and Raouf [51]; Jindal and Sangwan [24]
Lack of most recent technologies	Abdulrahman et al. [31]; Bouzon et al. [29]; Chan and Kai Chan [37]; Lau and Wang [56]
Lack of (in-house) facilities (storage, transportation)	Abdulrahman et al. [31]; Bouzon et al. [29]; González-Torre et al. [45]; Jindal and Sangwan [24]; Hung Lau and Wang [56]; PWC report [58]; Zhou et al. [59]; Ravi and Shankar [41]; Rogers and Tibben-Lembke [42]; Li and Olorunniwo [55]; Thierry et al. [54]
Technology and research and development issues related to product recuperation	Govindan et al. [39]; Bouzon et al. [29]; Rahimifard et al. [60]
Complexity in operation	Kapetanopoulou and Tagaras [46]; Wang and Sun [61]
Difficulties with supply chain members	Abdulrahman et al. [31]; Agrawal et al. [5]; Bernon et al. [53]; Bouzon et al. [29]; Ravi and Shankar [41]; Sharma et al. [44]; Wang and Sun [61]; González-Torre et al. [45]; Sharma et al. [44]; Starostka-Patyk et al. [48]
Limited forecasting and planning	Abdulrahman et al. [31]; Abraham [62]; Bouzon et al. [29]; Hung Lau and Wang [56]; Sharma et al. [44]; Janse et al. [57]; Starostka-Patyk et al. [48] and Yusuf and Raouf [51]; Rogers and Tibben-Lembke [42]; Ravi and Shankar [41]; Zhou et al. [59]; PWC report [58]; Lau and Wang [56]; Jindal and Sangwan [24]; Thierry et al. [54]; Guide and Srivastava (1997), Mutha and Pokharel [19]; Hillary [40]
Inconsistent quality	Abraham [62]; Bouzon et al. [29]; Ravi and Shankar [41]; Sharma et al. [44]; Yusuf and Raouf [51]; González-Torre et al. [45]
Complexity for finding third party for RL	González-Torre et al. [45]; Ganjali et al. [38]; Govindan et al. [39]; Shaharudin et al. [43]; Ravi and Shankar [41]; Jindal & Sangwan [24]; Hung Lau and Wang [56]; PWC report [58]; Zhou et al. [59]; Rogers and Tibben-Lembke [42]; Abdulrahman et al. [31]
Lack of suitable performance management system	Abdulrahman et al. [31]; Ravi and Shankar [41]; Shaharudin et al. [43]; Sharma et al. [44]; Li and Olorunniwo [55]; Janse et al., [57]; Starostka-Patyk et al. [48]; Yusuf and Raouf [51]
Inappropriate organizational co-operation	González-Torre et al. [45]; Govindan et al. [39]; Ravi and Shankar [41]; Shaharudin et al. [43]

Table 1: Continued.

Barriers	References
Lack of initial capital	Abdulrahman et al. [31]; Bouzon et al. [29]; Chan and Kai Chan [37]; Ganjali et al. [38]; Sharma et al. [44]; Ravi and Shankar [41]; Govindan et al. [39]; Carter and Ellram [63]; González-Torre et al. [45]; Lau and Wang [56]; Rogers and Tibben-Lembke [42]; Starostka-Patyk et al. [48]; Wiel et al. [49]; Bei and Linyan [50]; and Yusuf and Raouf [51]
Funds for training	Abdulrahman et al. [31]; Ganjali et al. [38]
Financial burden of tax	Abdulrahman et al. [31]; Sharma et al. [44]; Hung Lau and Wang [56]; Starostka-Patyk et al. [48]
Uncertainty related to economic issues	Abdulrahman et al. [31]; Ganjali et al. [38]; Kapetanopoulou and Tagaras [46]; Bouzon et al. [29]; González-Torre et al. [45]; Starostka-Patyk et al. [48]
Lack of knowledge on RL practices	Abdulrahman et al. [31]; Bouzon et al. [29]; Prakash and Barua [30]; Agrawal et al. [5]; Ravi and Shankar [41]; Thierry et al. [54]; Zhou et al. [59]; Jindal and Sangwan [24]; Li and Olorunniwo [55]; Thierry et al. [54]; PWC report [58]; Luthra et al. [32]
Lack of information on take back channels	Abdulrahman et al. [31]; Bouzon et al. [29]; Shaharudin et al. [43]
Lack of awareness concerning RL and its benefits	Abdulrahman et al. [31]; Bouzon et al. [29]; Shaharudin et al. [43]; Agrawal et al. [5]; Presley et al. [64]; Ravi and Shankar [41]; Thierry et al. [54]; Hung Lau and Wang [56]; Rahimifard et al. [60]; González-Torre et al. [45]; Sharma et al. [44]; Starostka-Patyk et al. [48]; Wiel et al. [49] and Yusuf and Raouf [51]; Presley et al. [64]; Thierry et al. [54]; PWC report [58]; Zhu et al. [7]; Jindal and Sangwan [24]; Li and Olorunniwo [55]; Luthra et al. [32]
Lack of specific laws/lack of motivation laws	Abdulrahman et al. [31]; Bouzon et al. [29]; Agrawal et al. [5]; Shaharudin et al. [43]; Sharma et al. [44]; Ganjali et al. [38]; Chan and Kai Chan [37]; Li and Olorunniwo [55]; Hung Lau and Wang [56]; Barker and Zabinsky [65]; Zhu et al. [7]
Wide informal waste management practices	Abdulrahman et al. [31]; Bouzon et al. [29]; Ganjali et al. [38]; Janse et al. [57] and Starostka-Patyk et al. [48]; Jindal and Sangwan [24]; Luthra et al. [32]; PWC report [58]; Li and Olorunniwo [55]; Zhou et al. [59]; Ravi and Shankar [41]; Rogers and Tibben-Lembke [42]; Thierry et al. [54]; Hung Lau and Wang [56]
Company polices against RL	Abdulrahman et al. [31]; Aitken and Harrison [36]; Chan and Kai Chan [37]; Rogers and Tibben-Lembke [42]; Sharma et al. [44]; Ravi and Shankar [41]; Stock [13]; Rahimifard et al. [60]; and Starostka-Patyk et al. [48]
Perception of a poorer quality product	Bouzon et al. [29]; Sharma et al. [44]; Rahimifard et al. [43, 60], Abraham [62]
Undeveloped recovery marketplaces	Abdulrahman et al. [31]; Bouzon et al. [29]; Shaharudin et al. [43]; Thierry et al. [54]; Hung Lau and Wang [56]; Mutha and Pokharel [19]; Rahimifard et al. [60]; Jindal and Sangwan [24]; Li & Olorunniwo [55]; Ravi and Shankar [41]; Stock [13]
Low importance of RL relative to other issues	Abdulrahman et al. [31]; Bouzon et al. [29]; Ganjali et al. [38]; Chan and Kai Chan [37]; Shaharudin et al. [43]; Wang and Sun [61]; Kapetanopoulou and Tagaras [46]; Rogers and Tibben-Lembke [42]; PWC report [58]; Zhou et al. [59]; Ravi and Shankar [41]

Table 1: Continued.

Barriers	References
Lack of top management commitment	Abdulrahman et al. [31]; Bouzon et al. [29]; Bernon et al. [53]; González-Torre et al. [45]; Govindan et al. [39]; Ravi and Shankar [41]; Rogers and Tibben-Lembke [42]; Sharma et al. [44]; Shaharudin et al. [43]; Li and Olorunniwo [55]; Barker and Zabinsky [65]; Stock [13]; Sarkis et al. [47]; Starostka-Patyk et al. [48]; Wiel et al. [49]; Yusuf and Raouf [51] and Zhu et al. [59]; PWC report [58]; Jindal and Sangwan [24]; Thierry et al. [54]; Luthra et al. [32]
Limited approval of disposal licenses	Srivastava [33]
Lack of strategic planning	Abdulrahman et al. [29, 31], Ganjali et al. [38]; Rogers et al. [42]; Chan and Kai Chan, [37]; Shaharudin et al. [43]; Ravi and Shankar [41]; Li and Olorunniwo [55]
RL not integrated with SC business process	Abdulrahman et al. [31]; Agrawal et al. [5];
Lack of proper organizational structure & support	González-Torre et al. [45]; Prajapati et al. [27]
Uncertain return & demand	Stock [13]; Ravi and Shankar [41]; Thierry et al. [54]; Hung Lau and Wang [56]; Li and Olorunniwo [55]; Jindal and Sangwan [24]. Thierry et al. [54]; Hung Lau and Wang [56]; Mutha and Pokharel [19]; Srivastava [33]; Li and Olorunniwo [55]; Stock [13]; Guide & Wassenhove [21]; Jindal and Sangwan [24]; Prakash and Barua [30]
Market compretive pressure	Rogers and Tibben-Lembke [42]; Shaharudin et al. [43]; Bouzon et al. [29]; Rahimifard et al. [60]

Table 2: Solutions to overcome RL barriers.

Solutions	References
Top management awareness and support	PWC report [58]; Hung Lau and Wang [56];
Balancing cost efficiency with customer responsiveness	PWC report [58]
Simplified and standardized processes	PWC report [58]; Cheung et al. [66]; Hung Lau and Wang [56]
Detailed insight of cost and performance	PWC report [58]; Hung Lau and Wang [56]
Cross-functional collaboration	PWC report [58]; Hung Lau and Wang [56]
Strategic collaboration with reverse chain partners	PWC report [58]; Hung Lau and Wang [56]
Aligned policies and processes	PWC report [58]
Perceive returns as perishable goods	PWC report [58]
Reverse logistics as part of sustainability program	PWC report [58]
Reclaiming value from returns	PWC report [58]; Srivastava and Srivastava [23]
Control over turnaround times	PWC report [58]
Create public awareness on environmental issues and conservation	PWC report [58]; Hung Lau and Wang [56]
Enforce environmental legislation, regulations, and directives	Hung Lau and Wang [56]
Develop infrastructure support and facility	Hung Lau and Wang [56]
Develop closed loop SC by integrating RL	Hung Lau and Wang [56]
Develop outsourcing strategy for recovery and collection of end-of-life products	Dat et al. [67]; Efendigil et al. [68]
Transparent quality and product value	Tibben-Lembke [69]
Clear policy towards customers about recycled products	Glenn Richey et al. [70]
Use of superior technologies for waste collection	Kim et al. [71]
Proper financial resources	Fleischmann et al. [17]

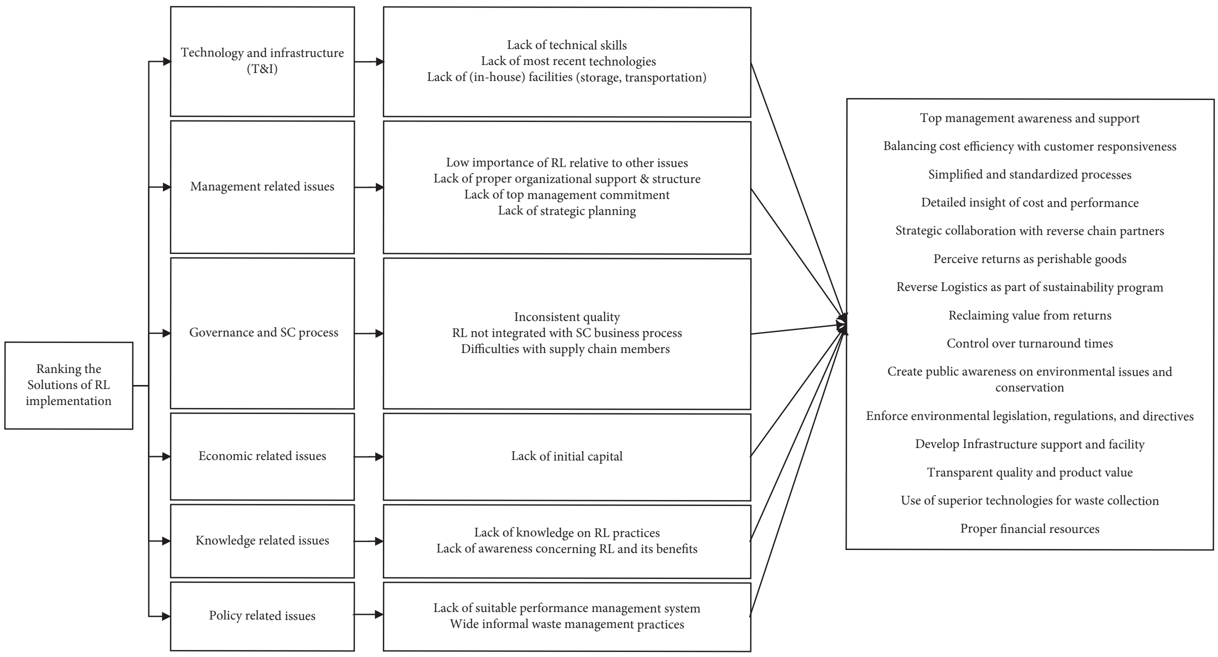

Figure 1: Conceptual hierarchical model.

Table 3: Background related to the type-2 FAHP-FTOPSIS.

References	Techniques	Field of study
Sari et al. [77]	Interval type-2 FAHP	Warehouse location selection
Chiao [78]	Interval type-2 FAHP	Location selection problem
Kayapinar Kaya and Aycin [79]	Interval type-2 FAHP COPRAS-G	Supplier selection
Sen et al. [80]	Interval type-2 FAHP ARAS	Selecting optimal wire electrical discharge machining
Wu et al. [81]	Interval type-2 FTOPSIS	Large scale group decision making
Ilieva [82]	Interval type-2 FTOPSIS	Business intelligence platform selection
Dymova et al. [83]	Interval type-2 FTOPSIS	Hiring system engineer
Hoseini et al. [84]	Interval type-2 FTOPSIS	Resilient supplier selection

footprint of uncertainty. In an interval type-2 set, the third dimension is the same everywhere, and the mathematics required is simple. On the other hand, because FAHP is incapable of controlling uncertainty, second-generation sets can be potentially integrated with the AHP method [76]. The linguistic terms of the interval type-2 fuzzy set are specified in Table 4.

The steps of the interval type-2 FAHP method are as follows [72]:

Step 1: Define the problem and create the hierarchical structure. This step determines the purpose, criteria and subcriteria (barriers), and alternatives (solutions). This structure is depicted in Figure 1.

Step 2: Construct the pairwise comparison matrix under interval type-2 using linguistic terms based on experts' opinions.

$$\overset{\approx}{Y} = \begin{pmatrix} 1 & \dots & \overset{\approx}{a}_{1n} \\ \vdots & \ddots & \vdots \\ \dfrac{1}{\overset{\approx}{a}_{1n}} & \dots & 1 \end{pmatrix}. \tag{1}$$

Where

$$\begin{aligned} \overset{\approx}{a} &= \left(\left(a_{11}^{U}, a_{12}^{U}, a_{13}^{U}, a_{14}^{U}; H_1\left(a_{12}^{U}\right), H_2\left(a_{13}^{U}\right)\right), \left(a_{11}^{L}, a_{12}^{L}, a_{23}^{L}, a_{24}^{L}; H_1\left(a_{22}^{L}\right)\right), H_2\left(a_{33}^{L}\right)\right), \\ \frac{1}{\overset{\approx}{a}} &= \left(\left(\frac{1}{a_{14}^{U}}, \frac{1}{a_{13}^{U}}, \frac{1}{a_{12}^{U}}, \frac{1}{a_{11}^{U}}; H_1\left(a_{12}^{U}\right), H_2\left(a_{13}^{U}\right)\right), \left(\frac{1}{a_{24}^{L}}, \frac{1}{a_{23}^{L}}, \frac{1}{a_{22}^{L}}, \frac{1}{a_{21}^{L}}; H_1\left(a_{22}^{L}\right)\right), H_2\left(a_{32}^{L}\right)\right). \end{aligned} \tag{2}$$

Table 4: Linguistic terms and their corresponding interval type-2 fuzzy set.

Linguistic terms	Interval type-2 fuzzy sets
Very poor (VP)	((0, 0, 0.1, 0.2, 1, 1); (0, 0, 0.1, 0.2, 1, 1))
Poor (P)	((0, 0, 0.1, 0.2, 1, 1); (0, 0, 0.1, 0.2, 1, 1))
Medium poor (MP)	((0.2, 0.3, 0.4, 0.5, 1, 1); (0.2, 0.3, 0.4, 0.5, 1, 1))
Fair (F)	((0.4, 0.5, 0.5, 0.6, 1, 1); (0.4, 0.5, 0.5, 0.6, 1, 1))
Medium good (MG)	((0.5, 0.6, 0.7, 0.8, 1, 1); (0.5, 0.6, 0.7, 0.8, 1, 1))
Good (G)	((0.7, 0.8, 0.8, 0.9, 1, 1); (0.7, 0.8, 0.8, 0.9, 1, 1))
Very good (VG)	((0.8, 0.9, 1, 1, 1, 1); (0.8, 0.9, 1, 1, 1, 1))

Shahanagi and Yazdian [85].

Step 3: Apply the geometric mean to obtain the fuzzy geometric mean of the opinions

$$\begin{aligned}\tilde{\tilde{P}}_{ij} &= \left[\tilde{\tilde{a}}_{ij}^{1} \otimes \cdots \otimes \tilde{\tilde{a}}_{ij}^{n}\right]^{1/n},\\ \sqrt[n]{\tilde{\tilde{a}}_{ij}} &= \left(\sqrt[n]{a_{ij1}^{U}}, \sqrt[n]{a_{ij2}^{U}}, \sqrt[n]{a_{ij3}^{U}}, \sqrt[n]{a_{ij4}^{U}}; H_1^{u}(a_{ij}), H_2^{u}(a_{ij})\right), \left(\sqrt[n]{a_{ij1}^{L}}, \sqrt[n]{a_{ij2}^{L}}, \sqrt[n]{a_{ij3}^{L}}, \sqrt[n]{a_{ij4}^{L}}; H_1^{L}(a_{ij}), H_2^{L}(a_{ij})\right).\end{aligned} \tag{3}$$

Step 4: Calculate the fuzzy weights of the barriers. The ($\tilde{\tilde{p}}_i$) represents the fuzzy weight of the barrier i

$$\tilde{\tilde{p}}_i = \tilde{\tilde{r}}_j \times \left[\tilde{\tilde{r}}_i \oplus \cdots \oplus \tilde{\tilde{r}}_s \oplus \cdots \oplus \cdots \tilde{\tilde{r}}_n\right]^{-1}. \tag{4}$$

Step 5: Defuzzify the weights using the center of area method and normalize the weights

$$\text{DTtrT} = \frac{(u_U - l_U) + (\beta_U.m_{1U} - l_U) + (\alpha_U.m_{2U} - l_U)/4 + l_U + [(u_L - l_L) + (\beta_L.m_{1L} - l_L) + (\alpha_L.m_{2L} - l_L)/4]}{2}. \tag{5}$$

3.3. Interval Type-2 FTOPSIS. The TOPSIS technique, first proposed by Hwang and Yoon [86], is one of the most important multicriteria decision-making methods for dealing with everyday life decisions. The technique rests on the assumption that the alternative should exhibit the greatest distance from the negative solution and the shortest distance from the ideal solution. Interval type-2 TOPSIS is computed as follows [73]:

Step 1: Construct the weighted decision matrix $\tilde{\tilde{Y}}$. where $\tilde{\tilde{p}}_i$ is the weight of the criteria, $\tilde{\tilde{p}}_s$ is weight of the subcriteria and $\tilde{\tilde{f}}_{\text{ijl}}$ is the fuzzy rating of each alternative.

$$\begin{aligned}\tilde{\tilde{f}}_{\text{ijl}} &= \left(\frac{\tilde{\tilde{f}}_{\text{ijl}}^{1} \oplus \tilde{\tilde{f}}_{\text{ijl}}^{2} \oplus \cdots \oplus \tilde{\tilde{f}}_{\text{ijl}}^{k}}{k}\right),\\ \tilde{\tilde{Y}} &= \left(\tilde{\tilde{v}}_{ij}\right)_{m\times n} = \begin{pmatrix}\tilde{\tilde{V}}_{111} & \cdots & \tilde{\tilde{V}}_{1n}\\ \vdots & \ddots & \vdots\\ \tilde{\tilde{V}}_{m1} & \cdots & \tilde{\tilde{V}}_{mn}\end{pmatrix},\\ \tilde{\tilde{v}}_{ijk} &= \tilde{\tilde{p}}_i \otimes \tilde{\tilde{p}}_s \otimes \tilde{\tilde{f}}_{\text{ijl}}.\end{aligned} \tag{6}$$

Step 2: Calculate the values of rank (v_{ij}) of the interval type-2 fuzzy set (v_{ij}) using the (7).

$$\bar{Y}_w^* = \left(\text{Rank}\left(\tilde{\tilde{V}}_{ij}\right)\right)_{m\times n}. \tag{7}$$

Where

$$\begin{aligned}\text{Rank}\left(\tilde{\tilde{A}}_i\right) = {} & M_1\left(\tilde{A}_i^U\right) + M_1\left(\tilde{A}_i^L\right) + M2\left(\tilde{A}_i^U\right) + M2\left(\tilde{A}_i^L\right) + M_3\left(\tilde{A}_i^U\right) \\ & + M3\left(\tilde{A}_i^L\right) - \frac{1}{4}\left(S_1\left(\tilde{A}_i^U\right) + S_1\left(\tilde{A}_i^L\right) + S_2\left(\tilde{A}_i^U\right) + S_2\left(\tilde{A}_i^L\right) + S_3\left(\tilde{A}_i^U\right) + S_3\left(\tilde{A}_i^L\right)\right. \\ & \left. + S_4\left(\tilde{A}_i^U\right) + S_4\left(\tilde{A}_i^L\right)\right) + H_1\left(\tilde{A}_i^U\right) + H_1\left(\tilde{A}_i^L\right) + H_2\left(\tilde{A}_i^U\right) + H_2\left(\tilde{A}_i^L\right),\end{aligned} \tag{8}$$

$$M_P\left(\tilde{A}_i^j\right) = \frac{\left(a_{ip}^j + a_{(p+1)}^j\right)}{2}, \quad 1 \le p \le 3,$$

And where standard deviation for $a_{i(q+1)}^j a_{iq}^j$ is

$a_{iq}^j, a_{i(q+1)}^j, 1 \le p \le 3,$

$$S_P\left(\tilde{A}_i^j\right) = \sqrt{\frac{1}{4}\left(\sum_{k=q}^{q+1}\left(a_{ik}^j - \frac{1}{4}\sum_{1}^{q+1} a_{ik}^j\right)\right)^2}. \tag{9}$$

Step 3: Determine the ideal solution X_{ji}^+ and negative solution X_{ji}^-

$$X_{ji}^+ = \left(v_{11}^+, v_{12}^+, \cdots, v_{ns}^+\right) = \begin{cases} \max_{1\le j\le n}\left\{\text{Rank}\left(\tilde{\tilde{v}}_{ijl}\right)\right\}, f_i \in F_1, \\ \min_{1\le j\le n}\left\{\left\{\text{Rank}\left(\tilde{\tilde{v}}_{ijl}\right)\right\}, f_i \in F_2, \end{cases}$$

$$X_{ji}^- = \left(v_{11}^-, v_{12}^-, \cdots, v_{ns}^-\right) = \begin{cases} \max_{1\le j\le n}\left\{\text{Rank}\left(\tilde{\tilde{v}}_{ijl}\right)\right\}, f_i \in F_1, \\ \min_{1\le j\le n}\left\{\left\{\text{Rank}\left(\tilde{\tilde{v}}_{ijl}\right)\right\}, f_i \in F_2. \end{cases} \tag{10}$$

Step 4: Calculate the distance between each alternative for the ideal and negative solution, where $1 \le i \le m$, $1 \le j \le n$

$$\begin{aligned} d^+(x_i) &= \sqrt{\sum_{j=1}^{n}\text{Rank}\left(\tilde{\tilde{V}}_{ij} - v_{ji}^+\right)^2}, \\ d^-(x_i) &= \sqrt{\sum_{j=1}^{n}\text{Rank}\left(\tilde{\tilde{V}}_{ij} - v_{ji}^-\right)^2}, \end{aligned} \tag{11}$$

Step 5: Compute the closeness of each alternative A_i to the ideal solution and negative solution as follows:

$$C(A_i) = \frac{d^-(A_i)}{d^-(A_i) + d^+(A_i)}, \tag{12}$$

where the greater the value of $C(A_i)$ is, the higher the preference for the alternatives A_i will be.

4. Results

In this study, 32 barriers and 21 solutions to overcome these barriers were identified through a review of the literature. Following Lawshe's [87], the CVR value for the 12 experts was 0.56. As such, any barrier or solution showing a value less than 0.56 was eliminated from the analysis. Screening through CVR revealed 15 barriers and 15 solutions (which could help overcome the barriers in the iron and steel industry). In the second step, the weights of the barriers to RL implementation were calculated using interval type-2 FAHP. Following the experts' opinions, 6 main barriers (dimensions) and 15 related barriers were observed and calculated as demonstrated in Table 5. Furthermore, the ranks of all barriers could be computed based on the calculated weights.

Finally, the solutions were prioritized through interval type-2 FTOPSIS as listed in Table 5. The rank of each solution was calculated based on the fuzzy weights obtained via the interval type-2 FAHP method and the geometric means of the experts' opinions. These ranks were used to determine the distance between each alternative and the ideal and negative options. For example, the ranks were calculated as follows:

Table 5: The weight of RL barriers.

Dimensions (main barriers)	Weights	Barriers	Weights	Final weights	Ranks
Technology and infrastructure	0.094	Lack of technical skills	0.38	0.035	8
		Lack of most recent technologies	0.275	0.026	12
		Lack of (in-house) facilities (storage, transportation)	0.35	0.033	9
Management related issues	0.117	Lack of top management commitment	0.14	0.016	15
		Low importance of RL relative to other issues	0.40	0.047	7
		Lack of proper organizational structure & support	0.27	0.031	10
		Lack of strategic planning	0.19	0.022	13
Governance and SC process	0.099	Inconsistent quality	0.21	0.020	14
		RL not integrated with SC business process	0.51	0.050	6
		Difficulties with supply chain members	0.285	0.028	11
Economic related issues	0.118	Lack of initial capital	0.118	0.118	3
Knowledge related issues	0.210	Lack of knowledge on RL practices	0.41	0.087	4
		Lack of awareness concerning RL and its benefits	0.59	0.12	2
Policy related issues	0.325	Lack of suitable performance management system	0.75	0.24	1
		Wide informal waste management practices	0.25	0.081	5

$$\text{Rank}\left(\tilde{\tilde{v}}_{11}\right) = 0.025 + 0.020 + 0.030 + 0.025 + 0.020 + 0.030 - \sqrt{\frac{1}{4}(0.00002 + 0.000001 + 0.0002 + 0.0004 + 0.00002 + 0.000001 + 0.0002 + 0.0004)} + 1 + 1 + 1 + 1 = 4.13. \tag{13}$$

Ultimately, the distance from the ideal and negative solutions, the degrees of closeness, and the final priorities were calculated and shown in Table 6.

As can be seen in Table 6, “strategic collaboration with reverse chain partners,” “using advanced technologies for waste collection,” and “transparent quality and product value” display the highest priorities.

4.1. Validation of Results and Sensitivity Analysis. In order to examine the obtained results using the IT2 FTOPSIS method, the solutions will be ranked using three other methods: IT2 FSAW (simple additive weighting methods) method, IT2 COPRAS (Complex Proportional Assessment of alternatives), and IT2 FVIKOR (VIseKriterijumska Optimizacija I Kompromisno Resenje) method. The result of ranking the solutions with these methods is shown in Figure 2. As can be seen, there is very little difference between the rankings. The difference is only in rank 1 and 2 and rank 14 and 15. In this way, it has been proven that the results using the IT2 FTOPSIS method do not deviate from the results obtained using other interval type-2 methods.

Although it was obvious that the deviations were not significant, the results were verified by applying Spearman’s correlation coefficient (SCC) [88]. The SCC values are given in Table 7.

As can be seen from Table 7, the SCC values range from 0.992 to 1, indicating a very high degree of rank correlation. Accordingly, it can be concluded that the results of the IT2 FTOPSIS method are satisfactory, respectively, and the robustness of the presented method has been proven.

5. Discussion

Due to the increasing importance of materials, environmental factors, and government laws, reverse logistical issues have attracted the attention of many researchers. However, determining which solutions could help overcome barriers to RL implementation can be considerably difficult. By using type-2 fuzzy techniques, more accurate weighting and prioritization can be conducted. This study aimed to prioritize solutions to overcome barriers to RL implementation in the steel and iron industry in the south of Iran.

To do this, a model was developed primarily to prioritize the solutions through reviewing the literature. The proposed model is composed of six dimensions (main barriers): “technology and infrastructure,” “management-related issues,” “governance and supply chain processes,” “economic issues,” “knowledge-related issues,” and “policy-related issues.” These dimensions included 15 obstacles and 15 solutions in the industry. Policy and knowledge barriers are the most important barriers that should be reduced in the implementation of reverse logistics. To make a policy in the industry, company managers must first create the necessary policy for implementing reverse logistics. They must also create the desired knowledge in companies by raising awareness of its benefits. In the policy-related issues, the lack of a suitable performance management system (0.24) has more weight than the lack of widespread informal waste management practices. Similarly, in the knowledge-related issues, the lack of awareness concerning RL and its benefits (0.12) has more weight than the lack of knowledge on RL practices. Also, RL not integrated with SC business process

Table 6: Distance from the ideal and negative solutions, the degree of closeness, and priority.

Solutions	Code	d_i^+	d_i^-	$C(Ai)$	Priority
Top management awareness and support	S1	0.62	0.49	0.44	5
Balancing cost efficiency with customer responsiveness	S2	5.4	0.78	0.13	11
Simplified and standardized processes	S3	2.23	0.3	0.12	12
Detailed insight of cost and performance	S4	1.33	0.07	0.05	13
Strategic collaboration with reverse chain partners	S5	0.36	0.55	0.6	1
Perceive returns as perishable goods	S6	0.94	0.84	0.47	4
Reverse logistics as part of sustainability program	S7	8.65	0.17	0.02	14
Reclaiming value from returns	S8	5.48	0.08	0.01	15
Control over turnaround times	S9	1.17	0.32	0.21	7
Create public awareness on environmental issues and conservation	S10	1.16	0.27	0.19	8
Enforce environmental legislation, regulations, and directives	S11	1.28	0.7	0.36	10
Develop infrastructure support and facility	S12	4.3	0.78	0.15	9
Transparent quality and product value	S13	0.91	0.92	0.5	3
Use of superior technologies for waste collection	S14	2.31	2.9	0.56	2
Proper financial resources	S15	1.89	0.95	0.33	6

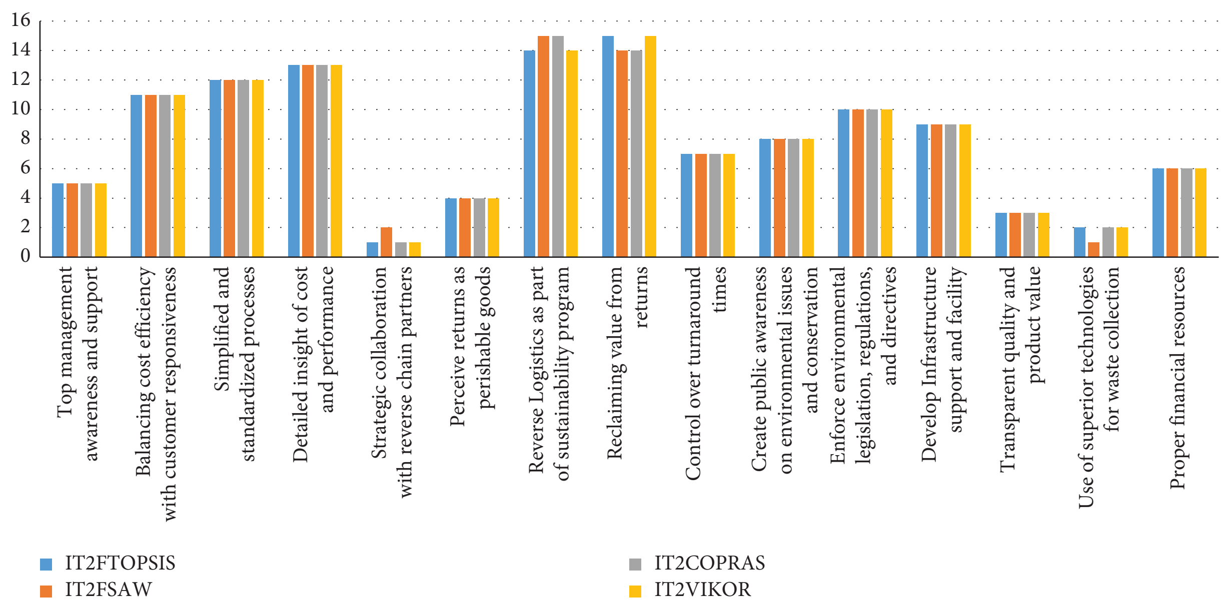

Figure 2: Results of the validation result.

Table 7: SCC values for alternative ranks obtained by different interval type-2 methods.

	IT2FTOPSIS	IT2FSAW	IT2COPRAS	IT2VIKOR
IT2FTOPSIS				
IT2FSAW	0.992857			
IT2COPRAS	0.996429	0.996429		
IT2VIKOR	1	0.992857	0.996429	

(0.05) has the highest weight in the governance and SC process barriers. In management-related issues, low importance of RL relative to other issues (0.047) has the highest weight compared to other issues. Finally, in obstacles related to technology and infrastructure, lack of technical skills (0.035) affects the implementation of reverse logistics in steel companies.

Using IT2 AHP-FTOPSIS techniques developed in this research, strategic collaboration with reverse chain partners, use of superior technologies for waste collection, and clarification of the quality and transparent value of products are known as the most important solutions that can be used to reduce the effect of obstacles in the company. The main feature of this technique is to prioritize solutions more precisely in comparison with the type-I fuzzy approach, by providing realistic results with less inconsistency.

The literature revealed that the studies conducted in the field of RL ([31, 38, 41]) mainly observed barriers arising from management, technology, market, knowledge, finance, and economy. These barriers were proposed in most models. Prakash and Barua [30] used the integrated fuzzy AHP-TOPSIS method to overcome the obstacles of implementing reverse logistics solutions in the electronics industry. The main difference between these research studies is that although they are aligned in all dimensions, their research also paid attention to the market dimension, which was not important in our model and was excluded from our study. Abdulrahman et al. [31] identified main obstacles in the implementation of reverse logistics in China's manufacturing sector, and these obstacles were divided into four categories: managerial, financial, infrastructural, and policy-making. The lack of senior management's commitment, lack of initial capital, lack of knowledge about reverse logistics and its benefits, and infrastructure facilities (storage, transportation) align with Abdulrahman et al. [31]. The use of IT-2 techniques to overcome the uncertainty of the results and comprehensiveness of the identified obstacles is one of the contributions and advantages of the present study.

6. Conclusions and Suggestions

The findings of this research demonstrated that the barriers observed were prioritized as follows, respectively: "policy," "knowledge," "economy," "governance," "management," "the supply chain process," and "technology and infrastructure." "The lack of a proper performance management system" was the most important barrier among all barriers. Similarly, in the barriers associated with "knowledge," "the lack of awareness of RL and its benefits" showed the highest rank in RL implementation. Furthermore, "the detachment of RL from business processes in the supply chain" was the most important barrier that could halt the implementation of RL in the governance and supply chain process. Finally, "the relative unimportance of RL compared to other issues" and "the lack of technical skills" were the most serious problems that could lead to RL implementation failures in the "management" and "technology and infrastructure" dimensions, respectively. The solutions were also ranked as follows:

$$\begin{aligned} &S5 \succ S14 \succ S13 \succ S1 \succ S15 \succ S9 \succ S10 \succ S12 \succ S11 \succ S2 \succ S6 \\ &\quad \succ S3 \succ S4 \succ S7 \succ S8. \end{aligned} \tag{14}$$

"Strategic collaboration with reverse chain partners," "using advanced technologies for waste collection," and "transparent quality and product value" showed the highest ranks. In line with the results of the research, some suggestions are shared here that could possibly guide organizational top-level managers: RL implementation could be accelerated by cooperating with partners in the supply chain and other stakeholders in the organization; the waste management system should also be implemented. Moreover, RL issues must be taken into account as components of a strategic factor. This study, like any other research, has faced limitations. Difficult access to experts due to work assignments in different countries and cities was a major challenge to this study and disturbed the research schedules. However, the present study provides valuable key results by using powerful decision-making techniques in interval type-2 fuzzy space. The results of the research, which are obtained by relying on the limited expert opinions, cause the generalizability of the research results to be associated with caution. As far as research is concerned, scholars and researchers could investigate this area by focusing on other similar organizations, using the model designed in this study, and comparing the results. Furthermore, other methods of multicriteria decision-making could be developed to weight the criteria and prioritize solutions based on the interval type-2 fuzzy approach; as such, the efficiency of calculations could be enhanced and methods used could be further validated.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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