The Barriers to the Practice of Reverse Logistics: The Delphi Technique as a Methodological Approach

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Abstract

Reverse logistics (RL) extends the life of the product with a circular economy approach by recycling raw materials or semi-finished products or by performing maintenance and repair. Although RL activities have recently attracted considerable attention from researchers, the practice of RL is relatively scant in real life. In the literature, the barriers to RL practice have been investigated in the context of many countries and different industries. However, in this domain, there is a lack of study to find out which barriers exist in the context of the Turkish manufacturing industry. This paper's purpose of identifying the barriers hindering the practice of RL in the Turkish manufacturing industry based on practical life insight. In order to realize the research purpose, the Delphi process consisting of three stages was carried out. In the first stage, literature reviews were made and expert opinions were taken, and obstacles were listed under 6 main headings: barriers related to management, barriers related to infrastructure and technology, social and cultural barriers, barriers related to law and legislation, financial and economic barriers, and barriers related to knowledge and ability. Then, the 2nd and 3rd stages of the Delphi study were carried out by using the survey method with twenty managers who are competent in their fields. The result of the research indicates that management-related barriers (reluctance of supply chain members to reverse logistics, resistance to innovative methods, etc.) as well as infrastructure and technology-related barriers (deficiency of new information systems, lack of human resources, etc.) are most common barriers in the Turkish manufacturing industry. Based on the literature review, solutions to cope with these critical barriers have been discussed. Issues such as providing the support of the top management, cooperation between the members of the supply chain on RL, training, and motivation of the employees were emphasized.

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Tersine Lojistik Uygulamalarının Önündeki Engeller: Metodolojik Bir Yaklaşım Olarak Delfi Tekniği

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Öz

Ters lojistik, hammadde veya yarı mamul ürünlerin yeniden üretilmesi veya bakım ve tamirinin yapılması yoluyla geri dönüştürülerek döngüsel ekonomi anlayışıyla ürünün yaşam ömrünü uzatmaktadır. Tersine lojistik faaliyetleri son zamanlarda araştırmacıların büyük ilgisini çekmiş olsa da, gerçek hayatta tersine lojistik uygulamaları oldukça yetersizdir. Literatürde, tersine lojistik uygulamalarının önündeki engeller birçok ülke bağlamında ve farklı sektörlerde araştırılmıştır. Fakat ilgili alanda, Türk imalat sanayi bağlamında hangi engellerin var olduğunu ortaya koyan bir çalışma eksikliği vardır. Bu çalışmanın amacı, pratik yaşama dayanarak Türk imalat sanayinde tersine lojistik uygulamalarının önündeki engelleri belirlemektir. Araştırma amacını gerçekleştirmek için üç aşamadan oluşan Delfi süreci yürütülmüştür. İlk aşamada Literatür incelemeleri yapılarak uzman görüşleri alınmış ve yönetimle ilişkili engeller, altyapı ve teknolojiyle ilgili engeller, sosyal ve kültürel engeller, kanun ve mevzuat ile ilgili engeller, mali ve ekonomik engeller ve bilgi ve yetenekle ilişkili engeller olmak üzere 6 ana başlık halinde engeller sıralanmıştır. Daha sonra alanında yetkin yirmi yönetici ile anket yöntemi kullanılarak Delfi çalışmasının 2. ve 3. aşamaları gerçekleştirilmiştir. Araştırmanın sonucu, Türk imalat sanayisinde yönetim kaynaklı engeller ile (tedarik zinciri üyelerinin ters lojistiğe karşı isteksizliği, üst yönetimin ters lojistiğe kendisini adamaması, yenilikçi yöntemlere karşı direnç gibi) altyapı ve teknoloji kaynaklı engellerin (ters lojistiği kolaylaştıracak yeni bilgi sistemlerinin ve teknolojinin eksikliği, insan kaynağı eksikliği, sınırlı tahmin ve planlama imkânları gibi) çoğunlukla yaygın bir şekilde görülen engeller olduğunu göstermektedir. Ayrıca çalışmada, literatür taramasına dayanarak bu kritik engellerin üstesinden gelmek için çözümler tartışılmıştır. Üst yönetimin desteğinin sağlanması, tedarik zinciri üyeleri arasında ters lojistik üzerine işbirliği yapılması, çalışanların eğitimi ve motivasyonu gibi konular üzerinde durulmuştur.

Anahtar Kelimeler: Ters Lojistik, Sürdürülebilirlik, Döngüsel Ekonomi, Delfi Süreci, Ters Lojistik Engelleri

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Introduction

 The accretionary relevancy for sustainability is arousing the manufacturers to insert "green initiatives" into their operations. Reverse logistics (RL) is evaluated as a critical ingredient of the circularity notion that comprises many advantages such as enhancing proper waste disposal alternatives, attracting the public attention to the firm's green preference, and reducing carbon footprints (U-Dominic et al., 2021, p.1). Yet, in practical life, the adoption and implementation of RL strategically, operationally, and regionally still face critical obstacles to overcome (Zhu et al., 2014, p.103) because of the following reasons: lack of top administration involvement, changes in functional priorities among SC partners, cost of RL, and undervalued of the high potential advantages of unifying operations (Abdulrahman et al., 2014, p.460; Zhu et al., 2014, p.103).

Researchers recommended future research to investigate the inhibitors related to implementing RL activities (Mathiyazhagan et al., 2020, p.880). Because the adoption and implementation of RL are still at their early phases in emerging economies (Naseem et al., 2021, p.1), the investigation of the barriers in these countries has been more needed. Although many studies in the literature shed light on this issue in developed economies such as Australia (e.g. Chileshe et al., 2015) and Germany (e.g. Münch et al., 2021), there is scant attention in developing countries to elucidate the obstacles to performing RL (e.g. U-Dominic et al., 2021; Abdulrahman et al., 2014). Especially, Turkiye is an unexplored area for researchers to investigate the inhibitors of RL. Of the few studies in Turkiye, Kazancoglu et al. (2020) investigated policy-related barriers in the circular economy (CE). In another study, Ayçin and Kaya (2021) determined the potential inhibitors which have a significant role in zero waste management implementations. Erol et al. (2022) investigated the true potential of the blockchain to unveil the CE adoption inhibitors. However, these studies related to CE instead of particularly focusing on RL practice. Therefore, from the side of Turkiye, a holistic approach that encapsulates RL barriers is still an exigence.

Barriers to implementing RL practices have been broadly examined in the industrial context such as the automotive industry (González-Torre et al., 2010; Kaviani et al., 2020), the pharmaceutical industry (de Campos et al., 2021; Khan and Ali, 2022), the construction industry (Chileshe et al., 2015; Rameezdeen et al., 2016), electrical and electronics industry (Bouzon et al., 2016; Kiatcharoenpol and Sirisawat, 2020; Prakash and Barua, 2016; Prakash and Barua 2015; Sirisawat and Kiatcharoenpol, 2018), steel industry (Pourmehdi et al., 2022), palm oil industry (Phochanikorn et al., 2020), defense industry (Hall et al., 2013), leather footwear sector (Moktadir et al., 2020), and food sector (Münch et al., 2021). Most of the researchers (e.g. U-Dominic et al., 2021, p.20; Lamba et al., 2020, p.399) acknowledged limitations in the aspect of their studies as well as hearten proper future investigations across various sectors, especially in the manufacturing industry (Chileshe et al., 2015, p.196).

Without any differences in diverse industries, many sectors have witnessed similar barriers in implementing RL. In Kiatcharoenpol and Sirisawat (2020), the authors have identified several criteria like legal barriers, infrastructural barriers, technological barriers, and management barriers in the electronics industry. Phochanikorn et al. (2020) have categorized the barriers similar way to investigate these barriers in the palm oil industry. Similar classifications have been discovered in the leather footwear industry (Moktadir et al., 2020), the authors have defined inhibitors like deficiency of advanced

technology, lack of awareness of environmental regulations, and lack of interest as well as support from top administration to adopt RL. Although studies have identical classifications, the findings of the research have diversity in the context of the country. The reason is that each country faces different barriers in its own circumstances.

It is incontestable fact that Turkiye is the path-breaking economy in the Middle East as well as Southeastern Europe. It has been one of the G20 member countries owing to the critical significance of its economy to the world's financial markets. Furthermore, beyond Turkiye being a developing economy, environmental apprehensions are the top priority of the Turkish government. For instance, Turkiye has presented policies and strategies to lead firms toward more environmentally sustainable implementations (Bouguerra et al., 2021, p.7). Interestingly, despite the importance of location and given importance to implement RL by the government, there are limited practices of RL in real life. Therefore, the investigation of inhibitors to perform RL in the context of Turkiye is needed. This study endeavors to fulfill this gap by expanding scarce research in this area. In line with the approach of Bouzon et al. (2018), Waqas et al. (2018), and Abdulrahman et al. (2014), we select the manufacturing industry in the research context to enable more generalize the result of the study and respond to the future research directions of extant studies.

The purpose of this research is to

(1) investigate the literature review articles which aim to determine the barriers to reverse logistics

(2) determine prevalently mentioned barriers in the literature

(3) unveil the barriers from the context of Turkiye in the manufacturing industry based on the Delphi technique

The contribution of this study is three-fold. Firstly, to date, several studies on RL barriers have been conducted both in developing and developed countries. However, to the best of our knowledge, the inhibitors of RL in the context of Turkiye have not been carried out specifically. To this end, we conduct the Delphi techniques to identify the barriers of RL in Turkiye, which is an unexplored important area. Secondly, although researchers specify the limitation of their study to industries that performed and highlight the need to conduct different industries, especially the manufacturing industry, there is limited attention on manufacturing firms in developing countries. To obtain more generalizable results, this study aims at manufacturing industries. Finally, to capture holistic knowledge, the barriers both in developing and developed countries have been investigated and scrutinized.

Literature Review

Reverse logistics

The linear economy is based on "take, produce, consume, and waste", without consideration of sustainability. On the other hand, the circular economy is a sustainable economic model that is renovator or restorative of a kind (Kazancoglu et al., 2020, p.591). Reverse logistics has a critical role in implementing circular economy principles (Azadnia et al., 2021, p.2). In the 1990s, the concept of RL was first introduced in the logistics sector by Rogers and Tibben-Lembke (1999, p.2), who defined RL as "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 or creating value for proper disposal". Advancing RL and supply chain systems has a significant role in performing circular economy principles as well as closing the supply chain loop (Azadnia et al., 2021, p.2).

Various RL practices include such as remanufacturing, managing waste, re-design, recycling, repairs, re-use, and recovery (Saruchera and Asante-Darko, 2021, p.327). RL has been closely associated with many sustainable supply chain elements (Morgan et al., 2018, p.165). Moreover, RL has been certified to be a requirement in capturing the satisfaction of customers, it has been labeled as a "key determinant of consumer loyalty" (Saruchera and Asante-Darko, 2021, p.327). Because customers typically are the beginning point and therefore a crucial link of RL (Mallick et al., 2023, p.10). According to another definition, RL is the process of collecting used products and materials from the first customers in a way that they can be reused, recycled, or converted into other products (Yıldız and Çavdar, 2020, p.2331). For consumers or clients, organizations that recycle with the purpose of being environmentally friendly are more legal and legitimate. Therefore, they are more eager to purchase organizations' product that endeavors to be environmentally friendly (Saruchera and Asante-Darko, 2021, p.330).

Nowadays, RL is seen as basic to achieving the sustainable administration of materials while opening the way for novel advantages and contributing to the competitiveness of firms (Pimentel et al., 2022, p.3). In addition, RL is mainly applied to gain value from the feasible waste as well as it may assure environmental, economic, and social acquisitions to the utilizers. Despite the fact that there have been various prompting determinants like revenue maximization, cost savings, and improved customer satisfaction, the practice of RL may occasionally be a tiresome as well as risky action for the business. It necessitates accurate planning as well as intimate studying with parties, suppliers, and designers to recycle the waste constituted in the manufacturing process (Ambekar et al., 2021, p.2881). Beiler et al. (2020) indicate that recycling proportion, storage costs, employment percentage, and parallel metrics assist to enhance RL functioning. RL can enhance environmental efficiency thanks to the planning as well as application of efficient cost control, providing an effective influx of raw materials, finished outputs, inventory processing, and associated information and knowledge necessitated to recollect value or convenient waste elimination. Moreover, it can facilitate the administration of waste and the utilization of recovered materials, reinforcing accountable and sustainable action (Correia et al., 2021, p.1).

Despite the great advantages of RL, the implementation of it is stay in the background due to some obstacles. There are different economic difficulties while establishing RL network. These comprise primary investments in collection and transportation point setup, impacting the firm's bottom line. Cost limitations are critical perspectives of a decision taken by businesses, especially in emerging economies (Dutta et al., 2021, p.4). Many stakeholders are connected along the RL and appropriate coordination as well as collaboration should be provided for the successful implementation of RL (Lamba et al., 2020, p.384). Nevertheless, because of concerns respecting the safety of the information and knowledge shared, it poses an obstacle to horizontal and vertical unification for assisting coordination as well as collaboration across the supply chain (Dutta et al., 2021, p.4). According to Lamba et al. (2020, p.384), efficient RL implementation requires

financial support from the government. Based on Interpretive Structural Modelling and MICMAC approach, Pimentel et al. (2022) found that a lack of financial incentives to incorporate recycled materials and lack of technical support, and standard codes hinder the implementation of RL. By applying the fuzzy analytical hierarchy process, Naseem et al. (2021) studied 14 barriers in performing effective RL and found that infrastructure and policy-related barriers are the top obstacles to RL practices. In another study, Wu et al. (2022) reveal the three most significant inhibitors negatively influencing RL as follows: (1) lack of trust among stakeholders, (2) lack of certainty in the market environment, (3) and lack of government support. Lastly, Azadnia et al. (2021) revealed that market and social and policy and regulation related barriers are the two most influencing inhibitors to the implementation of RL of electric vehicles' lithium-ion batteries.

Research methodology

Delphi study characteristics

The aim of the Delphi process is to "obtain the most reliable opinion consensus of a group of experts by subjecting them to a series of questionnaires in-depth interspersed with controlled opinion feedback". It is a convenient research tool for decision-making and forecasting and for analyzing sophisticated problems via a round of questions among investigators as well as practitioners, it was improved in the late 1940s (Durugbo et al., 2020, p.552).

In this study, the Delphi method was selected for various reasons. Firstly, the Delphi studies facilitate and structure the transaction exchange of notions as well as information in a group of specialists via a written and multi-phase survey process. Secondly, anonymized group discussions were guaranteed in the Delphi approach. It assists in obstacle group inefficiencies like halo effects and bandwagon. Therefore, it is especially convenient for socially desirable research areas like sustainability, where participants may sense pressured to award favorable ratings when being identifiable (Gebhardt et al., 2022, p.6). Thirdly, this technique provides a highly convenient foreseeing tool in an area in which many uncertainties and a lack of knowledge, are extensive (Münch et al., 2021, p.265). Accordingly, when considering this research aims, which is an unexplored subject in the context of Turkiye, the Delphi method is the most convenient technique to achieve the research purpose. Figure 1 exhibits the flow chart of the research methodology.
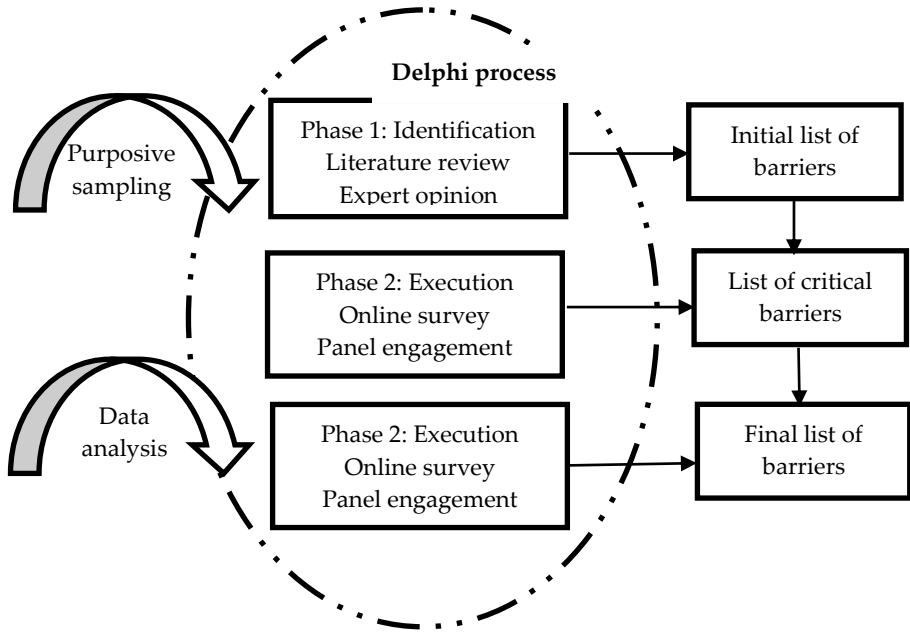
Figure 1. Flow chart of the research methodology

Selection of the participants

The choosing and attendance of Delphi panel specialists is an important characteristic of the process and it is recommended attentive selection of panels along with anonymity (Durugbo et al., 2020, p.552) due to the fact that it directly impacts the quality of findings (Gebhardt et al., 2022, p.7). The choosing of participants followed the three-phase process as recommended by Roubelat (2000, p.110):

(1) Determination of potential specialists
(2) Assessment of determined
(3) Experts and invitation of specialists

Firstly, potential specialist criteria were determined to reach satisfactory information congruent with the research aim. According to Gebhardt et al. (2022, p.7), "the integration of cross-functional and interdisciplinary subject matter experts increases the information processing capability of the panel as a whole". Therefore, as opposed to limiting the expert panel to circular economy professionals, different supply chain management functions like operations, and marketing should be included. By following Gebhardt et al. (2022) recommendation', we determined the expert criteria not only circular economy professionals but also other supply chain managers who are involved in supply chain activities in their daily work routines. To reach the inhibitors of RL in the manufacturing sector, the other criterion was determined as each specialist had to possess at least 5 years of experience in the manufacturing industry (Azadnia et al., 2021, p.6).

We utilized the social media called "LinkedIn", which is a social network including many experts who focus on professional networking and career enhancement (Johnson,

2019). Using purposive sampling (Durugbo et al., 2020), we invited 35 managers who meet the research criteria to participate in the study via LinkedIn in March 2022. Nonetheless, 15 of these declined or could not otherwise participate, making it a total of 20 specialists accepting to attend the research. In the second phase of the Delphi, one manager could not participate the study, whereas 19 managers took part. To achieve reliable results, the previous studies recommend a minimum number of at least 10–15 participants (Zielske and Held, 2021, p.7). Table 1 demonstrates the features of the participants.

Table 1. The features of the participants

Respondent's position	Age	Experience	Industry sector	Education
Export operations manager	35	7	Steel	Master degree
Supply chain manager	32	8	Automotive	Doctoral degree
Integrated planning manager	37	6	Steel	Bachelor's degree
General manager	44	13	Energy	Master degree
Business development and investment manager	44	10	Chemical	Master degree
General manager	44	10	Construction	Doctoral degree
Supply chain manager	35	8	Ship construction	Doctoral degree
Supply chain manager	47	15	Automotive	Master degree
Supply chain manager	33	9	Chemical	Master degree
General manager	44	12	Textile	Master degree
General manager	36	6	Food	Bachelor's degree
Foreign trade and logistics manager	39	9	Steel	Bachelor's degree
Logistics manager	44	9	Glass	Master degree
Logistics manager	54	15	Textile	Bachelor's degree
General manager	50	16	Food	Bachelor's degree
Quality assurance manager	40	15	Electronic	Doctoral degree
General manager	32	6	Chemical	Master degree
General manager	35	7	Food	Master degree
Logistics specialist	42	6	Chemical	Bachelor's degree
Operation manager	61	20	Leather	Bachelor's degree

Phase 1: Identification of the barriers for implementing RL through literature review as well as specialist opinion

In this study, the critical various inhibitors to implementing RL have been determined from an extensive literature review performed not only seen in Turkiye but also in other countries to capture deeper comprehension. Web of Science and Scopus were selected as a database because they are extensively utilized in literature review investigations as well as comprise a wide range of quality articles (Lima et al., 2021). The process barrier determination comprises of the searching article title, abstracts, and keywords applied

to particular search words such as "reverse logistics barriers", "reverse logistics challenges", "obstacles", "Closed-loop supply chain", and "Turkiye" without any time period. In the initial stage, 38 inhibitors to the practice of RL were determined based on the examination of studies which were performed in both developed and developing countries and then improved a set of questionnaires to identify the academics' and industry experts' views. These inhibitors were then analyzed to elucidate how relevant they are in the aspect of Turkiye by four academicians who are experts in supply chain management field. Then 7 previously determined barriers were eliminated because of their similar meanings. Table 2 presents the final 31 barriers, main categories, and sources identified after the initial assessment by experts. Details about definitions and explanations of 31 barriers are described in Table 3.

Table 2. Initial listed barriers to implement RL and sources

Code	Barriers	Sources
	Financial & Economic Barriers	
B1	Higher expenditures of implementing RL	Waqas et al., (2018); Naseem et al., (2021); Kaviani et al., (2020)
B2	High ventures and less return-on-ventures	Waqas et al., (2018); Dutta et al. (2021); Kiatcharoenpol and Sirisawat (2020); Sirisawat & Kiatcharoenpol (2018)
B3	Scarcity of finance from the company	Govindan & Bouzon (2018); Ambekar et al. (2021); Correia et al. (2021)
B4	Cost of cumulating utilized products and storage of used products	Waqas et al., (2018); Sirisawat & Kiatcharoenpol (2018); Naseem et al., (2021); Kiatcharoenpol and Sirisawat (2020)
	Law & Regulation Barriers	
B5	Deficiency of government supportive attitudes for RL	Waqas et al., (2018); Ambekar et al., (2021); Münch et al. (2021); Chileshe et al., (2015); U-Dominic et al. (2021); Lamba et al. (2020)
B6	Deficiency of regulatory restrictions	Waqas et al., (2018); Correia et al. (2021)
	Knowledge & Capability Barriers	
B7	Product design difficulties to render remanufacturing & reuse	Dutta et al. (2021)
B8	Difficulty in segregating waste/ returns at the source	Dutta et al. (2021)
B9	Deficiency of knowledge, experience, and education in RL	Ambekar et al., (2021); U-Dominic et al. (2021); Kaviani et al., (2020); Lamba et al. (2020); Kiatcharoenpol and Sirisawat (2020)
B10	Deficiency of awareness regarding the potential advantages of reverse logistics	Ambekar et al., (2021); Münch et al. (2021); Chileshe et al., (2015); Kaviani et al., (2020); Waqas et al., (2018); Bouzon et al. (2016)
	Management Barriers	
B11	Lack of responsibility and commitment from top administration	Sirisawat & Kiatcharoenpol (2018); Naseem et al., (2021); Lamba et al. (2020); Phochanikorn et al. (2020)
B12	Deficiency of collaboration with RL professionals and SC partners	Phochanikorn et al. (2020); Waqas et al., (2018)
B13	Deficiency of enthusiasm towards	Ambekar et al., (2021); Bouzon et al. (2016)

	RL by stakeholders	
B14	Resistance to transition from conventional ways	Chileshe et al., (2015); Waqas et al., (2018); Prakash & Barua (2015)
B15	Deficiency of strategic planning for enhancing RL implementations	Prakash & Barua (2015)
B16	The demanding and time-consuming nature of RL	Chileshe et al., (2015)
	Social & Cultural barriers	
B17	The attitude of customers about the lower quality of used and salvaged commodities	Chileshe et al., (2015); Govindan & Bouzon (2018); Bouzon et al. (2016)
B18	Uncertainties, risks, and potential liabilities for utilizing the recovered item	Chileshe et al., (2015); U-Dominic et al. (2021); Kiatcharoenpol and Sirisawat (2020)
B19	Poor organizational culture	Naseem et al., (2021); U-Dominic et al. (2021)
B20	Deficiency of public consciousness on RL adaptation	U-Dominic et al. (2021)
	Infrastructure & Technology barriers	
B21	Deficiency of new information systems and technology to facilitate RL	Sirisawat & Kiatcharoenpol (2018); Naseem et al., (2021); U-Dominic et al. (2021); Lamba et al. (2020); Phochanikorn et al. (2020)
B22	Lack of human resources	Kaviani et al., (2020); Prakash and Barua (2016)
B23	Deficiency of flexibility to alter from a conventional system to a new system	Sirisawat & Kiatcharoenpol (2018); Phochanikorn et al. (2020)
B24	Deficiency of efficient systems to pursue returns	Ambekar et al., (2021); Correia et al. (2021)
B25	Deficiency of technical support (such as constructing guidelines and standards) in favor of utilizing recovered materials	Chileshe et al., (2015); Lamba et al. (2020)
B26	Higher precedence is given to other topics in the supply chain	Dutta et al., (2021); Govindan & Bouzon (2018); Bouzon et al. (2016)
B27	Limited forecasting and planning	Kaviani et al., (2020); Phochanikorn et al. (2020)
	Market-related Barriers	
B28	Market uncertainty and fierce competition	U-Dominic et al. (2021); Waqas et al., (2018)
B29	Marketing of remanufactured product	Waqas et al., (2018); Prakash and Barua, (2016); Prakash & Barua (2015)
B30	Uncertain quality and quantity of return	U-Dominic et al. (2021)
B31	Restricted market availability of reuse products	Dutta et al., (2021)

Over the course of time, various barriers to perform RL have been identified in the

literature on developed and developing economies across various sectors such as manufacturing, construction, and textile. In Chileshe et al. (2015), the authors have identified diverse internal barriers like the initial cost of adopting RL and potential liabilities for using recovered items. Lamba et al. (2020) have presented that the deficiency of commitment on the part of top management, and deficiency of education, and training among partners about RL also plays a critical role in hindering the performing RL by businesses. Managers usually opt for focusing on the forward part of the supply chain and disregard the RL, since they consider it to be an extra encumbrance on the firm, and the value addition is less (Dutta et al., 2021). Parallel discussions have been seen in U-Dominic et al. (2021), this research has determined inhibitors like poor organizational culture, absence of public awareness of RL implementation, and uncertainty of consumers' behavior.

Many authors highlighted the role of economic and financial challenges in RL adoption (Dutta et al., 2021; Waqas et al., 2018; Kiatcharoenpol and Sirisawat, 2020; Sirisawat and Kiatcharoenpol, 2018). These comprise expenditures such as the initial cost of collection point setup, collecting used products, and storage of used products (Naseem et al., 2021, p.5). Cost restrictions are critical sides of a decision taken by any business, especially in emerging economies (Dutta et al., 2021, p.4). In their research, Moktadir et al. (2020, p.720) emphasize this issue as the top consideration for RL practices in Bangladesh.

The barriers external to firms comprise deficiency of regulatory restrictions, market uncertainty, fierce competition, and other industry-specific obstacles (Waqas et al., 2018, p.9). Phochanikorn et al. (2020, p.423) have identified various other inhibitors like the absence of information systems and technology, the exiguity of a system to monitor returns. The existence of a quality returns-handling system might be a source of important cost savings and even function as a capital center. There against, a deficiency of RL infrastructure will restrain a firm's capability to efficiently and quickly cope with returns and any attempt at handling returns will be a fiscal encumbrance with the costs going beyond the benefits (Abdulrahman et al., 2014, p.464).

Phase 2: Delphi survey

Based on outputs from Phase 1, barriers were compiled in a structured questionnaire. The specialists were asked to rate each barrier based on its importance in the Turkish manufacturing industry along a five-point Likert scale (very low = 1,…, very high = 5). At the end of the survey, we asked managers to add if any other barriers exist in practical life. Moreover, the attendants enucleated their assessment of each barrier through qualitative comments. Thereby, this research design provided an understanding to what degree previously determined barriers from literature are related to practical life and facilitated decreased uncertainty concerning the specialists' evaluations (Tapio et al., 2011, p.1626; Gebhardt et al., 2022, p.6).

After the second Delphi phase, we calculated the mean values, standard deviations, and interquartile range (IQR) for each barrier. Because a survey-based investigation with a response rate < 20% poses a non-response bias risk (Gebhardt et al., 2022, p.8), non-response bias was tested. It was presumed that late participants indicate characteristics of non-responders (Can Saglam et al., 2021, p.1232) and contrasted the evaluations of early participants (first 10) to the ones of later participants (final 10) during both phases. A Wilcoxon-Mann-Whitney-Test was performed to contrast both groups and it could be

seen that any important differences ($p < 0.05$) between early and late responders did not exist. So, a non-response bias was rejected.

Furthermore, the participants' comments and suggestions were evaluated by two academicians. It was seen that several participants pointed out the importance of some barriers in the list. Furthermore, a supply chain manager recommended a different barrier which not included in the list called "uncertainty of return on investment". In the third phase of the Delphi, a new barrier suggested by participants was added to the survey. As the mean impact of barriers on performing RL activities is expected to be >3 (Roßmann et al., 2018, p.141), the results signify an estimated non-negligible effect of all 31 barriers on RL. Therefore, none of the barriers was eliminated.

Phase 3: Delphi survey

After the second assessment stage, the managers received monitored feedback from the other experts' evaluations. The information was comprised of boxplots with statistical data as well as a new barrier recommended by the supply chain manager. Based on this supplement information, the participants can re-assess their ratings and offer more remarks in the second phase (Gebhardt et al., 2022, p.8). Table 3 demonstrates the quantitative results from the final Delphi survey.

Table 3. The quantitative results from the final Delphi survey

	Mean	Mod	Median	1. IQR	3.IQR	R1.IQR−3.IQR)
B1.Higher costs of implementing RL	*4.31*	*4*	*4*	*4*	*5*	*1*
B2.High investments and less return-on-investments	*4*	*4*	*4*	*4*	*4.75*	*0.75*
B3.Scarcity of finance from the company	3.93	4	4	3.25	4	0.75
B4.Expenditure on collecting used products and storage of used products	3.68	4	4	3	4	1
B5. Lack of government supportive policies for RL	*4.18*	*4*	*4*	*4*	*5*	*1*
B6.Lack of regulatory restrictions	3.62	3	3.5	3	4	1
B7. Product design difficulties to render remanufacturing & reuse	3.87	5	4	3	5	2
B8. Difficulty in segregating waste/ returns at the source	*4.37*	*5*	*5*	*4*	*5*	*1*
B9. Deficiency of knowledge, experience, and education in RL	*4.62*	*5*	*5*	*4*	*5*	*1*
B10. Deficiency of awareness regarding the potential advantages of reverse logistics	*4.68*	*5*	*5*	*4*	*5*	*1*
B11.Lack of responsibility and commitment from top management	*4.18*	*5*	*4*	*3.25*	*5*	*1.75*
B12.Lack of cooperation with RL professionals and SC partners	*4,25*	*4*	*4*	*4*	*5*	*1*
B13.Lack of enthusiasm towards RL by stakeholders	*4,5*	*4*	*4,5*	*4*	*5*	*1*
B14.Resistance to transition from	*4.06*	*4*	*4*	*4*	*4*	*0*

conventional ways

B15. Deficiency of strategic planning for enhancing RL implementations	**4.75**	**5**	**5**	**4.25**	**5**	**0.75**
B16. The demanding and time-consuming nature of RL	**4.37**	**4**	**4**	**4**	**5**	**1**
B17. The attitude of customers about the lower quality of used and salvaged commodities	3.75	3	4	3	4	1
B18. Uncertainties, risks, and potential liabilities for utilizing the recovered item	3.5	4	3.5	3	4	1
B19.Poor organizational culture	**4.5**	**5**	**5**	**4**	**5**	**1**
B20. Deficiency of public consciousness on RL adaptation	**4.62**	**5**	**5**	**4**	**5**	**1**
B21.Lack of new technology and information systems to facilitate RL	**4**	**4**	**4**	**4**	**5**	**1**
B22.Lack of human resources	**4.31**	**4**	**4**	**4**	**5**	**1**
B23. Deficiency of flexibility to alter from a conventional system to a new system	3.75	4	4	3	4	1
B24. Deficiency of efficient systems to pursue returns	**4**	**4**	**4**	**4**	**4.75**	**0.75**
B25. Deficiency of technical support (such as constructing guidelines and standards) in favor of utilizing recovered materials	3.68	4	4	3	4	1
B26. Higher precedence is given to other topics in the supply chain	**4.37**	**5**	**4.5**	**4**	**5**	**1**
B27.Limited forecasting and planning	**4.06**	**4**	**4**	**4**	**5**	**1**
B28.Market uncertainty and fierce competition	3.5	4	4	3	4	1
B29.Marketing of remanufactured product	3.43	4	4	3	4	1
B30.Uncertain quality and quantity of return	3.5	3	3.5	3	4	1
B31. Restricted market availability of reuse products	3.56	3	3	3	4	1
B32. Uncertainty of return on investment	**4.2**	**4**	**4**	**4**	**5**	**1**

Although some researchers suggest that the mean of the factor is expected to be >3 to be assessed as significant (Roßmann et al., 2018, p.141), this study expected the factor is exceeding to >4. The reason to determine this criterion is for research purposes which intends to find out the most critical barriers to implementing RL barriers. Also, according to Chileshe et al. (2015, p.188), when discussing the general evaluation of the inhibitors in the various classifications, the approach assumed is that of opting solely for the top-ranked inhibitors. As highlighted in the study by Chileshe et al. (2015, p.188), the logic for this approach of choosing solely the top-ranked barriers is to provide a more detailed discussion of the advocated solutions. Therefore, the barriers scored as "high importance =4 and very high importance =5" by participants were determined as the significant barriers to the practice of RL in the context of the Turkish manufacturing industry. These critical barriers are highlighted in bold in Table 3.

According to the findings of the study, in the aspect of the Turkish manufacturing industry, management-related inhibitors are mostly confirmed as critical barriers, as can be seen in Figure 2. Infrastructure and Technology related barriers are the second groups that are mostly evaluated as critical importance barriers. Then, the barriers with the most points are as follows: Knowledge and capability barriers, financial and economic related barriers, social and cultural barriers, and law and regulation barriers.
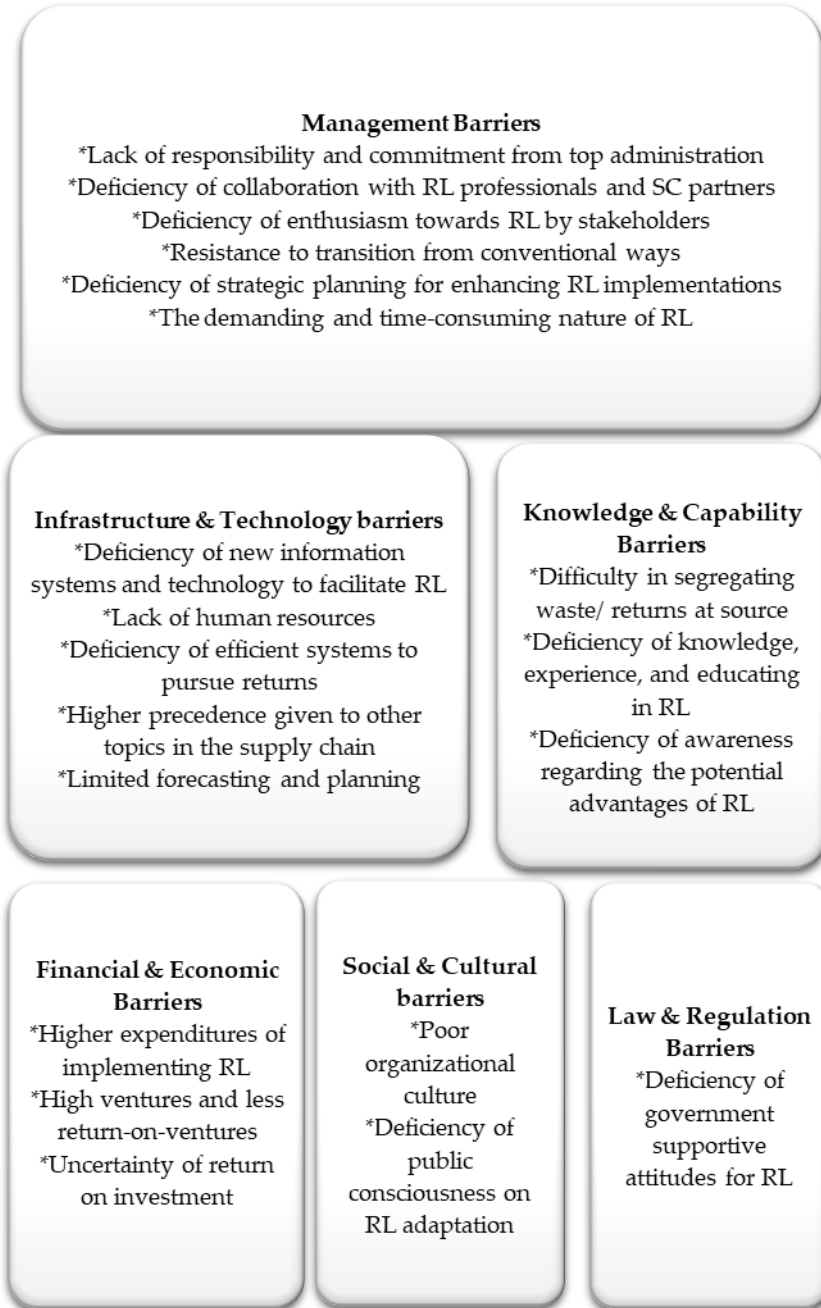
Management Barriers
*Lack of responsibility and commitment from top administration
*Deficiency of collaboration with RL professionals and SC partners
*Deficiency of enthusiasm towards RL by stakeholders
*Resistance to transition from conventional ways
*Deficiency of strategic planning for enhancing RL implementations
*The demanding and time-consuming nature of RL

Infrastructure & Technology barriers
*Deficiency of new information systems and technology to facilitate RL
*Lack of human resources
*Deficiency of efficient systems to pursue returns
*Higher precedence given to other topics in the supply chain
*Limited forecasting and planning

Knowledge & Capability Barriers
*Difficulty in segregating waste/ returns at source
*Deficiency of knowledge, experience, and educating in RL
*Deficiency of awareness regarding the potential advantages of RL

Financial & Economic Barriers
*Higher expenditures of implementing RL
*High ventures and less return-on-ventures
*Uncertainty of return on investment

Social & Cultural barriers
*Poor organizational culture
*Deficiency of public consciousness on RL adaptation

Law & Regulation Barriers
*Deficiency of government supportive attitudes for RL

Figure 2. Final list of RL implementation barriers from the Delphi study
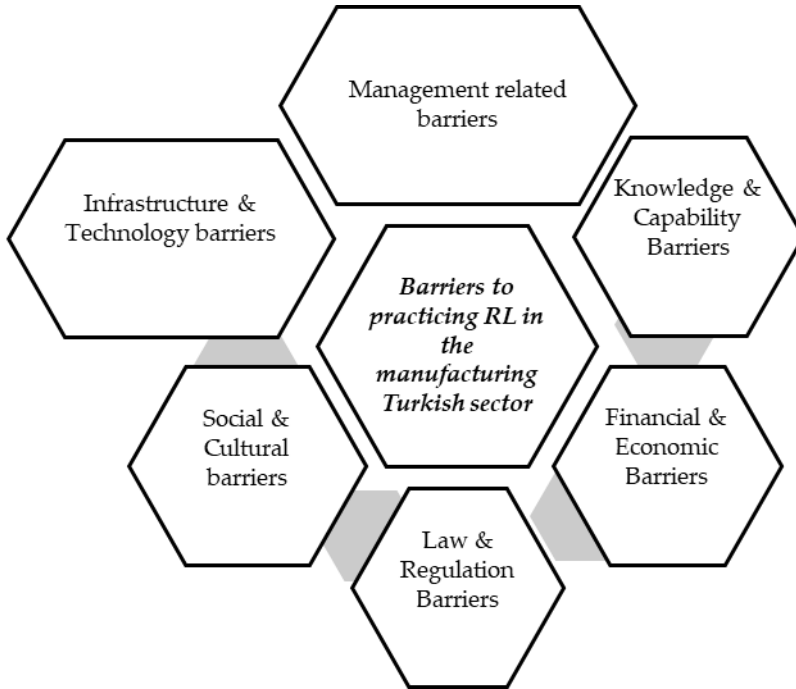
Figure 3. Groups of barriers to RL practice in the manufacturing Turkish sector

Solutions to barriers

After determining the barriers of RL based on Delphi studies, managerial implications for managers to overcome the barriers to the practice of RL are developed in this section as a result of the literature review. Table 4 exhibits solutions to overcome RL implementation barriers and related studies.

Table 4. Solutions to overcome RL implementation and related studies

Codes	Solutions	References
S1	Top administration consciousness and support	Sirisawat & Kiatcharoenpol (2018); Naseem et al., (2021); Sellitto et al. (2021); de Campos et al. (2021); Phochanikorn et al. (2020); Correia et al. (2021)
S2	Standardized reverse logistics processes	Sirisawat & Kiatcharoenpol (2018); Naseem et al., (2021); Phochanikorn et al. (2020); Sirisawat & Kiatcharoenpol (2018)
S3	Strategic collaboration with RL partners	Sirisawat & Kiatcharoenpol (2018); Sellitto et al. (2021); de Campos et al. (2021); Phochanikorn et al. (2020)
S4	Improve and invest in infrastructure and technology for supporting reverse logistics activities	Sirisawat & Kiatcharoenpol (2018); Naseem et al., (2021); Phochanikorn et al. (2020); Govindan & Bouzon (2018); (20) Sirisawat & Kiatcharoenpol (2018)
S5	Strengthen environmental	Münch et al. (2021); Dutta et al., (2021);

	regulations, legislation, and directives	Phochanikorn et al. (2020); (20) Sirisawat & Kiatcharoenpol (2018); Kazancoglu et al. (2021)
S6	Determine clear policies and processes	Naseem et al., (2021); Govindan & Bouzon (2018); (20) Sirisawat & Kiatcharoenpol (2018)
S7	Improve quality issues with customer coordination	Naseem et al., (2021)
S8	Consumer education	Dutta et al., (2021); Chileshe et al. (2015)
S9	Employees' education and motivation	Sellitto et al. (2021)
S10	Generate public consciousness on environmental topics	Govindan & Bouzon (2018); Prakash and Barua, (2015); Kazancoglu et al. (2021)
S11	Improve outsourcing tactics to collect and recover of end of life products	Prakash and Barua, (2015)

As a result of the analysis of South Australian construction organizations, Chileshe et al. (2015, p.194) recommended to designers be more proactive in training customers concerning the long-run advantages of performing RL for the design and construction industries. According to de Borba et al. (2021, p.137), to cope with difficulties, the supply chains must be flexible, principally to meet the requirements of clients. Also, the return processes should be administrated tactically by comprehending the intentions and behaviors of clients to diminish expenditures, develop predictions, and optimize return operations. Azadnia et al. (2021, p.14) stress the significance of top management support and alignment in RL implementation. Managers must present strategic tactics with regard to the RLs programs and action plans to accomplished perform their strategic tactics.

Discussion and Conclusion

Adopting RL practices emerges as environmental relevancies ascend and green production, green logistics, and waste management accrue (Naseem et al., 2021, p.17). Consequently, it is crucial for the Turkish manufacturing sector to contemplate the significance of RL practices and should move towards adopting them. In line with the highlighted need for and scarcity of study in the aspect of emerging economies, to elucidate from the side of practical life perspective on barriers to RL practice (Mathiyazhagan et al., 2020; Naseem et al., 2021), this study is a pioneer study to empirical apprehension the sector practitioners' perspective on the notion in the context of the Turkish manufacturing industry. Contextually, it is also unique as there is limited knowledge of incorporating the barriers that exist in both developed and developing economies. In particular, based on the Delphi approach, this study contributes to discovering the barriers to practicing RL in the Turkish manufacturing sector which is an unexplored area on this subject.

According to the findings of the research, discussions were improved based on the most significant critical barriers determined by managerial insight. The management issue in the supply chain is gaining a significant role as it becomes more critical for sustainability within business environmental administration. The barriers which included management-related main categories are unveiled as the most significant inhibitor since the majority of the barriers in this category have been selected among

managers as critical. This is in parallel with the findings of Naseem et al. (2021) who recommended a solution as top management support and awareness in the case study of Pakistan's E-commerce sector. Especially, deficiency of collaboration among supply chain partners and lack of enthusiasm towards RL by stakeholders can be the main barriers to perform RL. According to Mallick et al. (2023, p.9), different stakeholders accomplish distinct roles in RL comprising transactions, operations, or coordination. In addition, the forward supply chain members like the distributors, suppliers, and retailers can also be required. Top administration consciousness and support (Sellitto et al., 2021) and strategic collaboration with RL partners (de Campos et al., 2021) can aid in solving management-related barriers which will eliminate resistance to transition from conventional ways, enhance commitment from top administration, and provide collaboration with SC partners.

After the management-related barriers, participants selected mostly the barriers related to infrastructure and technology barriers. While such systems and technologies are not extensively available for the Turkish manufacturing industry, managers are facing many problems already at the start of RL practice and it triggers a discouraging position. In their study, Wollenburg et al. (2018, p.540) emphasized the significance of mastering technology topics, especially information systems, for the accomplished administration of Omni channel retail. The deficiency of new information systems and technology (such as the Internet of Things and Blockchain technology) to facilitate RL can be a critical barrier to perform RL. The Internet of Things provides considerable advances where conventional waste administration strategies for gathering, transporting, and recycling have stayed complicated as well as time-consuming. Blockchain technology can make possible traceability, transparency, and trust in transactions in the RL (Mallick et al., 2023, p.11). Improvement and investment in infrastructure and technology for supporting RL activities will assist arrange as well as track the nodes of the supply chain better, providing delays are minimized, and the supply chain transforms more responsive than before (Dutta et al., 2021, p.14).

In the third category, the same percentage of barriers related to knowledge & capability and financial & economic were selected as critical barriers by respondents. Marked deficiency of education as well as training is an important obstacle in front of the RL implementation. There is no big chance to obtain experts and competent employees in this field because of the lack of training and education. Furthermore, these findings are paralleled with Starostka-Patyk et al. (2013) results. They highlighted that it is the problem to organize the training for all organization stages. Without education about RL processes, the investment into RL implementation may induce lost advantages as a consequence of its incorrect maintenance (Starostka-Patyk et al., 2013, p.508). In addition, the deficiency of knowledge and the uncertainties encompassing the return processes amplify the problem of administering RL (de Borba et al., 2021, p.132). Improvement outsourcing tactics to collect and recover of end of life products (Phochanikorn et al., 2020), education and motivation of employees (Sellitto et al., 2021), standardized reverse logistics processes, and determination of clear policies and processes (Naseem et al., 2021) can be a strategy to cope with knowledge and capability and financial and economic related barriers.

Lastly, Social & Cultural, and Law & Regulation Barriers have been assessed by managers as critical barriers, respectively. According to Münch et al. (2021, p.272), if

governments supplied the infrastructure for RL and rendered support, the supply chain would be heartened to adapt their daily activities as well as strategies, and customer mindsets would probably modify. Identical standpoints can be found in the literature, with taxing strategies, governments can utilize that income to invest in further required consciousness campaigns (Hartley et al., 2020, p.6). With proper regulations, taxation, and legislation, manufacturers can be motivated for performing RL (Azadnia et al., 2021, p.1). Yıldız and Çavdar (2020, p. 2344) highlighted that environmental responsibility has become a necessity due to the constant pressure many companies face to develop environmentally benign products and use less harmful operations. In addition, the deficiency of public consciousness of RL makes it difficult to implementation of RL activities. This finding corroborates the studies of Correia et al. (2021) who demonstrated the need to encourage alterations in attitudes related to the use of recovered materials among the public. Consumer education and the constitution of public consciousness on environmental topics can be utilized to overcome social and cultural barriers, which encourage organizations to perform RL. In addition, strengthening environmental regulations, legislation, and directives facilitates to implementation of RL practice from the side of businesses. Wu et al. (2022, p.9) stressed that more support from the government should be given for setting up administrative regulations.

The integration of quantitative and qualitative approaches in data collection and analysis provides to constitute a deeper understanding of unexplored topics, which may be more illuminating and exciting than those obtained through using solely one type of material. Nonetheless, obtaining such data could be time-consuming from the side of both participants and the researchers. There can be also some pitfalls that may hinder reality (Tapio et al., 2011). Therefore, the generalizability of the research findings could be considered somewhat limited. Our study determined the critical practice barriers for the RL, yet did not examine their relations with each other as well as potential solutions to overcome them. Future research in this field is especially significant for managers by indicating how can managers overcome these obstacles.

Analyzing the degree of the severity of inhibitors to performing RL is evaluated as a type of multi-criteria decision-making (MCDM) problem, as it comprises more than one criterion as well as usually with more than one conflicting purpose to be contemplated concomitantly to arrive at the most rational decision (U-Dominic et al., 2021). In recent studies, various types of MCDM methods and hybrid methods of MCDM have been prevalently utilized to facilitate decision-makers concerning ranking criteria of connected alternatives such as the Fuzzy AHP-TOPSIS Approach, Grey-DEMATEL (Naseem et al., 2021; Dutta et al., 2021; de Campos et al., 2021) in different regions like Pakistan, Nigerian, and Indıa. Future research should perform different MCDM approach on RL implementation barriers in the aspect of Turkiye.

Değerlendirme	İki Dış Hakem / Çift Taraflı Körleme
Etik Beyan	It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.
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Etik Bildirim	itobiad@itobiad.com
Çıkar Çatışması	Çıkar çatışması beyan edilmemiştir.
Finansman	Bu araştırmayı desteklemek için dış fon kullanılmamıştır.

Peer-Review	Double anonymized - Two External
Ethical Statement	Bu çalışmanın hazırlanma sürecinde bilimsel ve etik ilkelere uyulduğu ve yararlanılan tüm çalışmaların kaynakçada belirtildiği beyan olunur.
Plagiarism Checks	Yes - Ithenticate
Conflicts of Interest	The author(s) has no conflict of interest to declare.
Complaints	itobiad@itobiad.com
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References / Kaynakça

Abdulrahman, M. D., Gunasekaran, A., & Subramanian, N. (2014). Critical barriers in implementing reverse logistics in the Chinese manufacturing sectors. *International journal of production economics*, 147, 460-471.

Ali, S. M., Arafin, A., Moktadir, M., Rahman, T., & Zahan, N. (2018). Barriers to reverse logistics in the computer supply chain using interpretive structural model. *Global journal of flexible systems management*, 19(1), 53-68.

Ambekar, S., Roy, D., Hiray, A., Prakash, A. and Patyal, V.S. (2021). Barriers to adoption of reverse logistics: a case of construction, real estate, infrastructure and project (CRIP) sectors, *Engineering, Construction and Architectural Management*, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/ECAM-02-2021-0112

Azadnia, A. H., Onofrei, G., & Ghadimi, P. (2021). Electric vehicles lithium-ion batteries reverse logistics implementation barriers analysis: A TISM-MICMAC approach. *Resources, Conservation and Recycling*, 174, 105751.

Ayçin, E., & Kayapinar Kaya, S. (2021). Towards the circular economy: Analysis of barriers to implementation of Turkey's zero waste management using the fuzzy DEMATEL method. *Waste Management & Research*, 39(8), 1078-1089.

Beiler, B. C., de Arruda Ignácio, P. S., Júnior, A. C. P., Anholon, R., & Rampasso, I. S. (2020). Reverse logistics system analysis of a Brazilian beverage company: An exploratory study. *Journal of Cleaner Production*, 274, 122624.

Bouguerra, A., Gölgeci, İ., Gligor, D. M., & Tatoglu, E. (2021). How do agile organizations contribute to environmental collaboration? Evidence from MNEs in Turkey. *Journal of International Management*, 27(1), 100711.

Bouzon, M., Govindan, K., & Rodriguez, C. M. T. (2018). Evaluating barriers for reverse logistics implementation under a multiple stakeholders' perspective analysis using grey decision making approach. *Resources, conservation and recycling*, 128, 315-335.

Bouzon, M., Govindan, K., Rodriguez, C. M. T., & Campos, L. M. (2016). Identification and analysis of reverse logistics barriers using fuzzy Delphi method and AHP. *Resources, conservation and recycling*, 108, 182-197.

Can Saglam, Y., Yildiz Çankaya, S. and Sezen, B. (2021). Proactive risk mitigation strategies and supply chain risk management performance: an empirical analysis for manufacturing firms in Turkey, *Journal of Manufacturing Technology Management*, 32(6), 1224-1244.

Correia, J. M. F., de Oliveira Neto, G. C., Leite, R. R., & da Silva, D. (2021). Plan to overcome barriers to reverse logistics in construction and demolition waste: Survey of the construction industry. *Journal of Construction Engineering and Management*, 147(2), 04020172

Chileshe, N., Rameezdeen, R., Hosseini, M.R. and Lehmann, S. (2015). Barriers to implementing reverse logistics in South Australian construction organisations, *Supply Chain Management*, 20(2), 179-204.

de Borba, J.L.G., Magalhães, M.R.d., Filgueiras, R.S. and Bouzon, M. (2021). Barriers in omnichannel retailing returns: a conceptual framework, *International Journal of Retail & Distribution Management*, 49(1), 121-143.

de Campos, E. A. R., Tavana, M., Ten Caten, C. S., Bouzon, M., & de Paula, I. C. (2021). A grey-DEMATEL approach for analyzing factors critical to the implementation of reverse logistics in the pharmaceutical care process. *Environmental Science and Pollution Research*, 28(11), 14156-14176.

Durugbo, C.M., Al-Balushi, Z., Anouze, A. and Amoudi, O. (2020). Critical indices and model of uncertainty perception for regional supply chains: insights from a Delphi-based study, *Supply Chain Management*, 25(5), 549-564.

Dutta, P., Talaulikar, S., Xavier, V., & Kapoor, S. (2021). Fostering reverse logistics in India by prominent barrier identification and strategy implementation to promote circular economy, *Journal of Cleaner Production*, 294, 126241.

Erol, I., Ar, I. M., Peker, I., & Searcy, C. (2022). Alleviating the Impact of the Barriers to Circular Economy Adoption through Blockchain: An Investigation using an Integrated MCDM-based QFD with Hesitant Fuzzy Linguistic Term Sets. *Computers & Industrial Engineering*, 107962.

Gebhardt, M., Spieske, A., & Birkel, H. (2022). The future of the circular economy and its effect on supply chain dependencies: Empirical evidence from a Delphi study. *Transportation Research Part E: Logistics and Transportation Review*, 157, 102570.

González-Torre, P., Alvarez, M., Sarkis, J., & Adenso-Díaz, B. (2010). Barriers to the implementation of environmentally oriented reverse logistics: Evidence from the automotive industry sector. *British Journal of Management*, 21(4), 889-904.

Govindan, K., & Bouzon, M. (2018). From a literature review to a multi-perspective framework for reverse logistics barriers and drivers. *Journal of cleaner production*, 187, 318-337.

Hall, D. J., Huscroft, J. R., Hazen, B. T., & Hanna, J. B. (2013). Reverse logistics goals, metrics, and challenges: perspectives from industry. *International Journal of Physical Distribution & Logistics Management*. 43(9), 768-785.

Hartley, K., van Santen, R. and Kirchherr, J. (2020). Policies for transitioning towards a circular economy: expectations from the European Union (EU), *Resources, Conservation and Recycling*, 155, 104634.

Johnson, D. (2019). What is LinkedIn?': A beginner's guide to the popular professional networking and career development site, retrieved from https://www.businessinsider.com/what-is-linkedin (09.03.2022)

Kaviani, M. A., Tavana, M., Kumar, A., Michnik, J., Niknam, R., & de Campos, E. A. R. (2020). An integrated framework for evaluating the barriers to successful implementation of reverse logistics in the automotive industry. *Journal of Cleaner Production*, 272, 122714.

Kazancoglu, I., Sagnak, M., Kumar Mangla, S., & Kazancoglu, Y. (2021). Circular economy and the policy: A framework for improving the corporate environmental management in supply chains. *Business Strategy and the Environment*, 30(1), 590-608.

Khan, F., & Ali, Y. (2022). Implementation of the circular supply chain management in the pharmaceutical industry. *Environment, Development and Sustainability*, 1-27.

Kiatcharoenpol, T., & Sirisawat, P. (2020). A Selection of Barrier Factors Affecting Reverse Logistics Performance of Thai Electronic Industry. *Int. J. Intell. Eng. Syst*, 13, 117-126.

Lamba, D., Yadav, D. K., Barve, A., & Panda, G. (2020). Prioritizing barriers in reverse logistics of E-commerce supply chain using fuzzy-analytic hierarchy process. *Electronic Commerce Research*, 20(2), 381-403.

Lima, P. A. B., Delgado, F. C. M., dos Santos, T. L., & Florentino, A. P. (2021). Medication reverse logistics: A systematic literature review and a new measurement system for the Brazilian case. *Cleaner Logistics and Supply Chain*, 100024.

Mathiyazhagan, K., Rajak, S., Panigrahi, S. S., Agarwal, V., & Manani, D. (2020). Reverse supply chain management in manufacturing industry: a systematic review. *International Journal of Productivity and Performance Management*.

Mallick, P. K., Salling, K. B., Pigosso, D. C., & McAloone, T. C. (2023). Closing the loop: Establishing reverse logistics for a circular economy, a systematic review. *Journal of Environmental Management*, *328*, 117017.

Moktadir, M., Rahman, T., Ali, S. M., Nahar, N., & Paul, S. K. (2020). Examining barriers to reverse logistics practices in the leather footwear industry. *Annals of Operations Research*, 293(2), 715-746.

Morgan, T. R., Tokman, M., Richey, R. G., & Defee, C. (2018). Resource commitment and sustainability: a reverse logistics performance process model. *International Journal of Physical Distribution & Logistics Management*.

Münch, C., von der Gracht, H.A. and Hartmann, E. (2021). The future role of reverse logistics as a tool for sustainability in food supply chains: a Delphi-based scenario study, Supply Chain Management, Vol. ahead-of-print No. ahead-of-print. https://doi.org/10.1108/SCM-06-2021-0291

Naseem, M. H., Yang, J., & Xiang, Z. (2021). Prioritizing the Solutions to Reverse Logistics Barriers for the E-Commerce Industry in Pakistan Based on a Fuzzy AHP-TOPSIS Approach. *Sustainability*, 13(22), 12743.

Phochanikorn, P., Tan, C., & Chen, W. (2020). Barriers analysis for reverse logistics in Thailand's palm oil industry using fuzzy multi-criteria decision-making method for prioritizing the solutions. *Granular Computing*, 5(4), 419-436.

Prakash, C., & Barua, M. K. (2015). Integration of AHP-TOPSIS method for prioritizing the solutions of reverse logistics adoption to overcome its barriers under fuzzy environment. *Journal of Manufacturing Systems*, 37, 599-615.

Prakash, C., & Barua, M. K. (2016). A multi-criteria decision-making approach for prioritizing reverse logistics adoption barriers under fuzzy environment: Case of Indian electronics industry. *Global Business Review*, 17(5), 1107-1124.

Pimentel, M., Arantes, A., & Cruz, C. O. (2022). Barriers to the Adoption of Reverse Logistics in the Construction Industry: A Combined ISM and MICMAC Approach. *Sustainability*, 14(23), 15786.

Rameezdeen, R., Chileshe, N., Hosseini, M. R., & Lehmann, S. (2016). A qualitative examination of major barriers in implementation of reverse logistics within the South Australian construction sector. *International Journal of Construction Management*, 16(3), 185-196.

Rogers, D.S., Tibben-Lembke R.S. (1999) Going Backwards: Reverse Logistics Trends and Practices, Vol. 2, *Reverse Logistics Executive Council*, Pittsburgh, PA

Roßmann, B., Canzaniello, A., von der Gracht, H., & Hartmann, E. (2018). The future and social impact of Big Data Analytics in Supply Chain Management: Results from a Delphi study. *Technological Forecasting and Social Change*, 130, 135-149.

Roubelat, F. (2000). Scenario planning as a networking process, Technological Forecasting and Social Change, 65(1), 99-112.

Saruchera, F., & Asante-Darko, D. (2021). Reverse logistics, organizational culture and firm operational performance: Some empirical evidence. *Business strategy & development*, 4(3), 326-342.

Sellitto, M. A., Murakami, F. K., Butturi, M. A., Marinelli, S., Kadel Jr, N., & Rimini, B. (2021). Barriers, drivers, and relationships in industrial symbiosis of a network of Brazilian manufacturing companies. *Sustainable Production and Consumption*, 26, 443-454.

Starostka-Patyk, M., Zawada, M., Pabian, A., & Abed, M. (2013, May). Barriers to reverse logistics implementation in enterprises. In 2013 International Conference on Advanced Logistics and Transport (pp. 506-511). IEEE.

Sirisawat, P., & Kiatcharoenpol, T. (2018). Fuzzy AHP-TOPSIS approaches to prioritizing solutions for reverse logistics barriers. *Computers & Industrial Engineering*, 117, 303-318.

Tapio, P., Paloniemi, R., Varho, V., & Vinnari, M. (2011). The unholy marriage? Integrating qualitative and quantitative information in Delphi processes. *Technological Forecasting and Social Change*, 78(9), 1616-1628.

U-Dominic, C. M., Orji, I. J., & Okwu, M. (2021). Analyzing the Barriers to Reverse Logistics (RL) Implementation: A Hybrid Model Based on IF-DEMATEL-EDAS. *Sustainability*, 13(19), 1-26.

Waqas, M., Dong, Q. L., Ahmad, N., Zhu, Y., & Nadeem, M. (2018). Critical barriers to implementation of reverse logistics in the manufacturing industry: a case study of a developing country. S*ustainability*, 10(11), 4202.

Wollenburg, J., Holzapfel, A., Hubner, A. and Kuhn, H. (2018). Configuring retail fulfillment processes for Omni-channel customer steering, International Journal of Electronic Commerce, Routledge, 22(4), 540-575.

Wu, Z., Yang, K., Xue, H., Zuo, J., & Li, S. (2022). Major barriers to information sharing in reverse logistics of construction and demolition waste. *Journal of Cleaner Production*, 350, 131331.

Yıldız, B., Çavdar, E. (2020). Yeşil Üretimin Çevresel ve Ekonomik Performans Üzerindeki Etkisinde Ters Lojistiğin Aracı Rolü. *İnsan ve Toplum Bilimleri Araştırmaları Dergisi*, 9(3), 2326-2349.

Zhu, Q., Sarkis, J., & Lai, K. H. (2014). Supply chain-based barriers for truck-engine remanufacturing in China. T*ransportation Research Part E: Logistics and Transportation Review,* 68, 103-117.

Zielske, M., & Held, T. (2021). Application of agile methods in traditional logistics companies and logistics startups: Results from a German Delphi Study. *Journal of Systems and Software,* 177, 110950.