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Role of Reverse Logistics in Solid Waste Management: A Systematic Review

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Abstract This systematic review aims to identify factors and practices related to reverse logistics applicable to solid waste management. The review covers 58 peer-reviewed studies published between 2010 and 2025, sourced using the PRISMA framework. This review reveals that academic interest in reverse logistics in solid waste management has been growing, especially since 2016, with the highest concentration of studies originating from Asia and the Americas. The thematic analysis identifies seven main categories of influencing factors, including organizational, economic, regulatory, technological, infrastructure, stakeholder collaboration, public awareness and participation. In addition, the integration of digital tools such as the Internet of Things, artificial intelligence, and tracking systems emerges as a key enabler of reverse logistics effectiveness. The review further describes the key challenges in adopting digital tools and technology solutions, including financial constraints, limited digital infrastructure, interoperability issues, shortage of skilled human capital. This review addresses a significant gap by systematically synthesizing current knowledge on strategies, practices, and influencing factors, and providing a foundational understanding for researchers, policymakers, and businesses aiming to improve the circularity and sustainability of solid waste systems.

Keywords: Factors, Practices, Reverse logistics, Solid waste management, Sustainability

Introduction

The increase in global solid waste generation presents a significant crisis with adverse impacts on the environment, human health, and the economy (Zielińska, 2020). Global waste volume was 2.3 billion tons in 2023 and is estimated to increase to 3.8 billion tons by 2050 (Rodrigues et al., 2025). Annually, approximately 2.01 billion tons of municipal solid waste are produced worldwide, often without environmentally friendly management practices (Alshaikh and Abdelfatah, 2024). This high level of waste contributes to climate change, poses risks to human health, and creates a significant economic burden, underscoring the urgent need for effective and sustainable management solutions. Traditional linear "take-make-dispose" models of production and consumption have proven unsustainable due to their inherent limitations in addressing resource depletion and environmental pollution (Julianelli et al., 2020).

A circular economy emphasizes maintaining the value of products, materials, and resources for as long as possible. It minimizes the generation of waste for long-term sustainability (Scrioșteanu and Criveanu, 2023). Reverse logistics (RL) has emerged as a crucial strategy for minimizing environmental impacts and enabling a circular flow of resources within solid waste management (SWM) (Julianelli et al., 2020). It plays an important role in addressing the challenges of solid waste by facilitating the collection, sorting, recycling, and remanufacturing of materials, while also improving both environmental protection and resilience of supply chains (Rodrigues et al., 2025). The key difference between RL and traditional waste management is that while waste management mainly focuses on the collection and treatment of waste that has no further use, RL focuses on recovering value from end-of-life products and waste for reintegrating into future supply chains (Budak and Ustundag, 2016).

This systematic literature review focuses on exploring the role of RL in SWM, with a specific focus on practices, influencing the factors that affect the efficiency and effectiveness of RL processes. The objectives of this review can be divided into two parts. Firstly, to conduct a descriptive analysis to identify the publication trends, geographical distribution, and research methodologies used in the literature on RL in SWM. Secondly, to identify and classify the RL practices and key influencing factors that contribute to effective and efficient SWM systems.

To achieve these objectives, this review is guided by the following research questions:

- RQ1: What are the publication trends and patterns in reverse logistics in SWM from 2010 to 2025?
- RQ2: What key factors influence the effectiveness and efficiency of reverse logistics in SWM?
- RQ3: What are the most significant RL practices commonly applied in SWM?

Methodology

This systematic literature review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework, ensuring transparent and reproducible methodology. A literature search was performed using multiple academic databases to maximize coverage and minimize publication bias. The databases selected included Google Scholar, Emerald Insight, IEEE Xplore, and PubMed. These databases were chosen for their broad coverage of social science, environmental science, business, and public health literature, all of which are relevant to the interdisciplinary nature of RL and waste management. The search was conducted using a combination of keywords with boolean operators, including "reverse logistics" OR “reverse supply chain” AND "solid waste management" OR "solid waste disposal" AND "practices" OR "factors" OR “determinants” OR “drivers" OR "barriers".

The search was limited to peer-reviewed index journal articles published between 2010 and 2025, written in English, and available as open-access content. The 2010-2025 timeframe was chosen to capture developments following major global sustainability initiatives and technological shifts. The period after 2010 marked the introduction of significant international commitments, such as the United Nations Sustainable Development Goals (2015) and the Paris Agreement (2015), which emphasized waste reduction, resource efficiency, and circular economy principles. Moreover, this period witnessed the rise of Industry 4.0 technologies such as digitalization, Internet of Things, artificial intelligence, and big data analytics that have increasingly impacted RL systems and SWM practices. The inclusion criteria required that selected articles specifically address RL in the context of SWM. Publications were excluded if they were non-English, unrelated to RL and waste management, not openly accessible, or not formally peer-reviewed, such as blogs, reports, conference abstracts, and news articles.

Initially, a total of approximately 1053 records were given from the comprehensive search across the four databases. All identified records were imported into the Zotero reference management tool and systematically de-duplicated. These unique records were screened for titles and abstracts against predefined inclusion and exclusion criteria. During this phase, articles were excluded, primarily due to not focusing on RL in SWM, being general logistics, lacking a clear discussion of RL factors and practices, and focusing only on waste collection without reverse flow. Following these criteria, a final set of 58 papers were eligible and included for qualitative synthesis in this systematic review. The PRISMA flow diagram in Figure 1 visually represents this entire selection process, detailing the number of records identified, screened, and included at each stage.

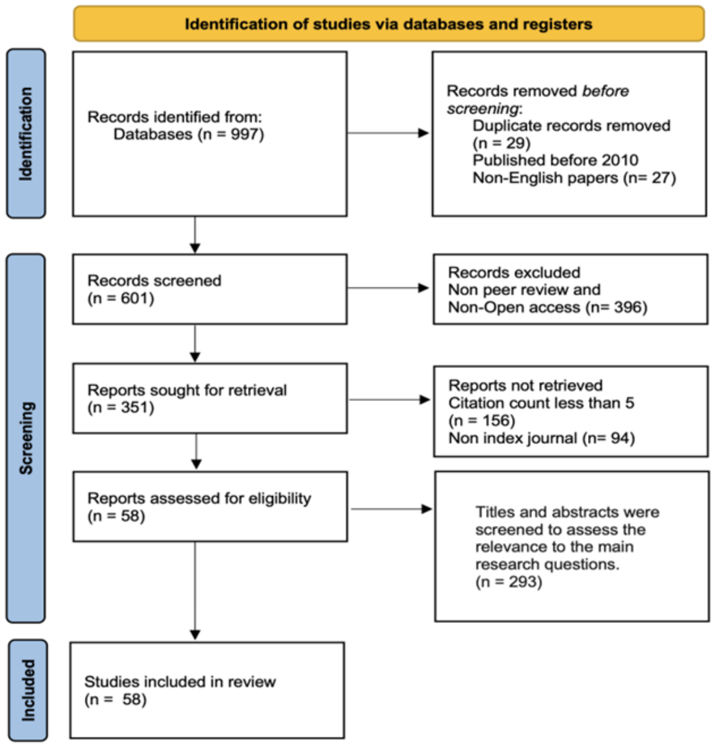

Figure 1: The PRISMA flow diagram

The selected papers were then carefully and systematically analyzed. A descriptive analysis of the included literature was conducted, highlighting publication trends, geographical distribution, and methodologies used in the studies. Subsequently, a thematic analysis was conducted to categorize the identified logistics practices and the key factors affecting the efficiency and effectiveness of RL in SWM.

Results and discussion

Publication trends

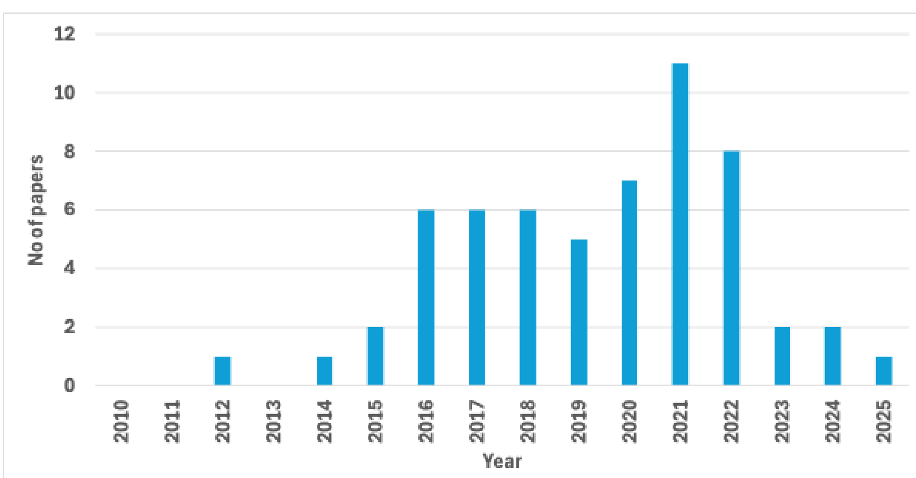

Figure 2: Number of publications by year

Figure 2 showcases the number of publications related to RL in SWM across the period 2010 to 2025. The data reveals a clear upward trend in scholarly interest over the years, especially from 2016 onwards. From 2010 to 2015, publication activity remained minimal, with only one or two papers published per year, indicating limited academic focus on this specific area during the early part of the decade. From 2016 onwards, publications increased steadily, averaging 6-7 papers annually through 2020, suggesting growing recognition of RL's role in sustainable waste management.

There is a significant increase in 2021, with 11 papers published. This peak may correlate with the global acceleration of sustainability initiatives and the emphasis on circular economy practices following the COVID-19 pandemic (Shadkam, 2021). The subsequent years show a moderate decline, with 8 papers in 2022 and fewer studies in 2023-2025. This recent drop may reflect a saturation in specific subtopics or delays in research dissemination, or a shift in academic focus. The chart demonstrates a positive long-term trend in research interest, highlighting the growing importance of RL in addressing solid waste challenges over the last 15 years.

The distribution of the selected studies across various academic journals reflects the interdisciplinary nature of research on RL in SWM. Among all journals, the journal "Waste Management and Research" stands out as the leading outlet, contributing 10 articles to the review, while "Sustainability" contributed 9 articles. This indicates the growing academic alignment between RL practices and the broader goals of sustainable development and the circular economy.

Several other journals contributed one to four articles each, such as Waste Management, Applied Sciences, Environmental Science and Pollution Research, Resources Conservation & Recycling, Environment International, Journal of Industrial Engineering and Management, Supply Chain Management, and Logistics. This expansion reflects the multidisciplinary relevance of RL in the context of SWM. The diversity of publication sources emphasizes the importance of RL not only in operations management research but also in the fields of environmental, public health, industrial engineering, and social responsibility. It suggests that solutions to solid waste challenges are explored from multiple academic lenses, promoting a more integrated and holistic understanding of the problem.

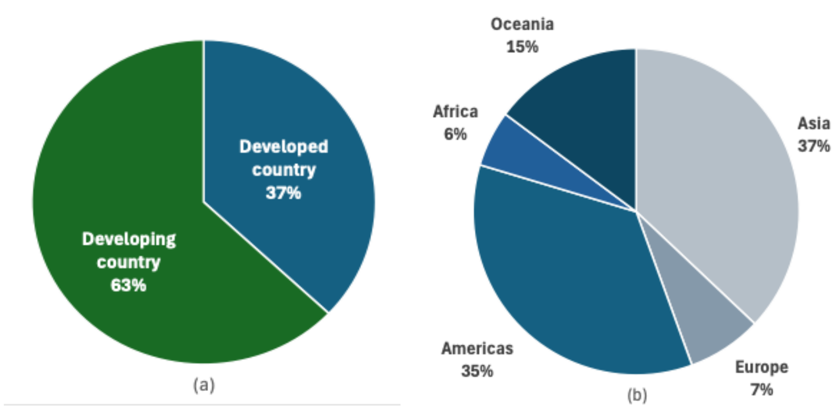

Figure 3: Publication trend based on geographical focus

The included papers originated from various parts of the world, with a significant concentration of research in certain regions and economic classifications. Figure 3(a) shows that a substantial 63% of the included studies originated from developing countries, while 37% came from developed countries. This indicates a higher volume of research on RL in SWM emerging from developing nations.

Figure 3(b) further breaks down this geographical distribution, showing that Asia (37%) and the Americas (35%) collectively represent a significant 72% of the reviewed literature. This indicates a strong research focus on RL within these continents, potentially driven by factors such as rapid urbanization, increasing waste generation rates, evolving regulatory frameworks, and growing industrial activities in these regions (Waqas et al., 2018). Europe (7%) and Africa (6%) show comparatively lower representation in the dataset. While Europe has well-established waste management systems and circular economy initiatives (Zielińska, 2020). The lower percentage might suggest that fewer studies from Europe met the specific inclusion criteria of this review, or that research is published in non-English sources. The low percentage in Africa indicates a potential research gap or emerging interest in formal RL systems in many countries within the continent.

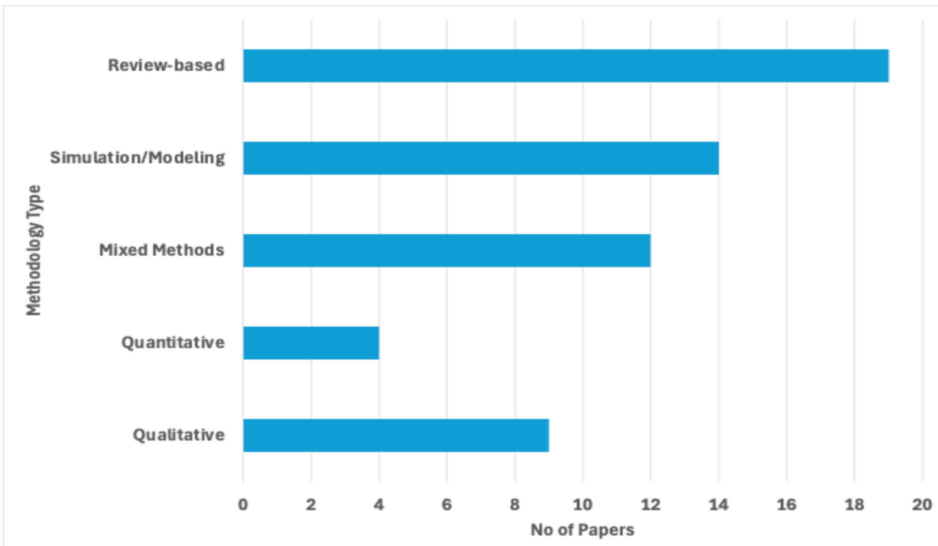

Figure 4: Number of papers based on the used methodology type

The papers included in this review utilized a range of methodologies, as shown in Figure 4. There is a significant portion of the literature, with approximately 19 papers. This indicates a strong emphasis on synthesizing existing knowledge, identifying research gaps, and providing conceptual frameworks within the field of RL in SWM. "Simulation/Modeling" approaches are notably prominent, accounting for approximately 13 papers. This highlights the importance of quantitative tools for optimizing RL networks and predicting system behavior. While less frequent than review or mixed methods studies, Qualitative and Quantitative research methodologies are also represented, with 9 and 4 papers, respectively. Qualitative studies often delve into deep case studies, policy analysis, or stakeholder perceptions, providing rich contextual understanding. Quantitative studies typically rely on surveys, empirical data analysis, or statistical modeling to test hypotheses and generalize findings.

Several general models of reverse and inverse logistics for SWM have been proposed in the literature. A common framework includes four basic steps such as gatekeeping, collection, sorting, and disposal (Banguera et al., 2017). This model provides a basic structure for RL. Gatekeeping manages the entry of products into the system, determining which items are allowed to enter.

Various mathematical modeling approaches have been used to optimize RL networks. These include mixed integer linear programming, which has been used for facility location problems (Budak and Ustundag, 2016). Other techniques include hybrid methods that combine approaches such as linear programming, mixed integer programming, genetic and heuristic algorithms, analytical hierarchy process, and fuzzy modelling. Simulation and network models have also been used to analyze and improve the efficiency of RL operations in this domain (Banguera et al., 2017). Conceptual frameworks have been developed to suit specific waste streams. For instance, a reverse supply chain model for construction and demolition waste has been proposed to better understand and manage the unique challenges associated with this type of waste (Brandão et al., 2021).

Furthermore, a theoretical framework has been developed to link Industry 4.0 solutions to RL activities in SWM. This framework categorizes the applications of these technologies at operational, tactical, and strategic levels and provides a structured way to understand their impact and potential benefits (Rodrigues et al., 2025).

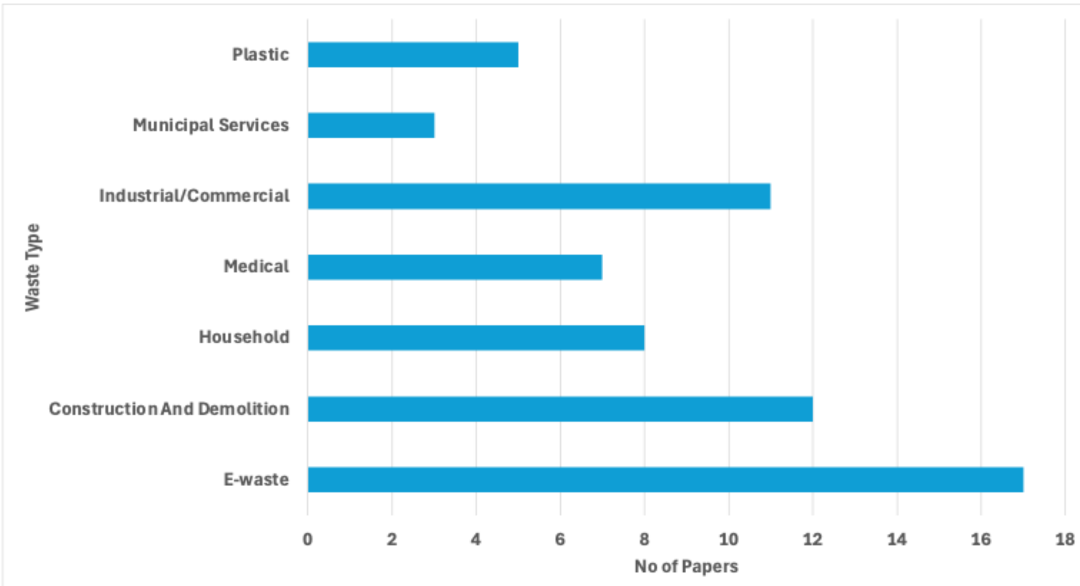

Figure 5: Publication trend based on the focus waste type

The publication trend based on focus waste type, as shown in Figure 5, reveals a significant variation in RL research across these categories. Electronic waste stands out as the most extensively researched waste stream. This high level of focus is likely due to several factors, such as the rapid growth in e-waste generation, its complex composition containing both valuable and hazardous materials, stringent regulatory frameworks, and the significant potential for resource recovery through RL processes (De Souza et al., 2016).

Construction and demolition waste and industrial/commercial waste also receive significant research attention. These waste streams are characterized by large volumes, potential for high material recovery, such as concrete, metals, wood, and the need for efficient logistics due to their bulk (Huang et al., 2022). Research into household waste often tackles challenges such as collection logistics, source separation, and citizen participation (Singh and Agrawal, 2018). While medical waste studies typically focus on hazardous medical material handling, safe disposal, and specialized collection networks (Kargar et al., 2020).

Plastic waste and municipal services waste appear to have comparatively less dedicated research in RL within this dataset. While plastic waste is a globally critical issue, its RL research might be more diffuse or integrated into broader recycling studies (Scrioșteanu and Criveanu, 2023). The lower count for municipal services waste could indicate that this is a very broad category, and researchers often specify subtypes such as household waste or commercial waste more precisely (Bing et al., 2016).

Factors influencing the adoption and effectiveness of RL in SWM

Several factors influence the adoption and effectiveness of RL in SWM, among which economic considerations play a crucial role. Collection costs, which include the expenses associated with gathering waste from various sources such as households, businesses, and institutions (Pourmohammadi et al., 2015). The efficiency of these collection systems directly impacts the overall cost-effectiveness of RL operations (Pumpinyo and Nitivattananon, 2014). The availability and quality of transport infrastructure, including road networks and logistics services, as well as the cost of transporting waste to processing facilities, also have a significant impact (Q. Chen and Liao, 2022). In regions with poor infrastructure, high transportation costs can hinder the viability of RL. Organizations are often motivated by the potential for cost savings through reduced raw material use, lower disposal costs, and revenue generation from recovered materials (Le, 2023). This potential for cost savings and new revenue streams, such as secondary markets, is crucial for the widespread use and sustainability of RL. The economic viability of waste recycling is heavily dependent on the value of recovered materials such as metals, plastics, and glass (Tesfaye & Kitaw, 2020; Tennakoon et al., 2022).

Government incentives and subsidies are encouraging investment and participation in RL operations. Financial incentives, tax breaks, and subsidies can help offset initial investment costs and make RL more attractive to businesses and consumers (Pumpinyo and Nitivattananon, 2014). The core purpose of RL is resource optimization and environmental protection, providing a strategy for economically reducing and reusing waste (Alshaikh and Abdelfatah, 2024). With increasing environmental awareness, strict legislation, and a strong need to reduce landfill waste and promote overall sustainability, organizations are being pushed to adopt RL practices, thereby supporting this core objective (Chileshe et al., 2018).

The presence and effectiveness of regulatory and policy frameworks significantly influence the success of RL in SWM. These regulations should clearly define responsibilities for waste management, set standards for collection, treatment, and disposal, and mandate environmentally sound practices (Valenzuela et al., 2021). Effective implementation of these regulations is equally important to ensure compliance and the prevention of illegal activities (Bakhiyi et al., 2018). Extended Producer Responsibility (EPR) policies play a key role by holding producers accountable for the collection and recycling of their products at the end of their lifecycle. Well-designed EPR schemes can encourage manufacturers to design more recyclable products and finance the development of RL infrastructure. Government regulations that motivate sustainability-based waste management programs in promoting RL practices (Herat and Agamuthu, 2012).

Technological factors include the availability and adoption of digital technologies and the infrastructure needed to support RL operations. Improving transparency in the supply chain is crucial, and it can be achieved through the implementation of real-time monitoring and digital tracking tools (Rodrigues et al., 2025). These technologies provide businesses with accurate insights into product returns, damaged inventory, and end-of-life materials, enabling them to make better decisions and identify inefficiencies (Scrioșteanu and Criveanu, 2023). Implementing structured systems for sorting, assessing, and determining the best course of action for each returned or discarded item ensures that materials are handled efficiently and directed to the most appropriate path, whether it be refurbishment, reuse, recycling, or responsible disposal (Gorji et al., 2020).

Implementing tracking systems such as RFID, GPS, and online platforms will enable better monitoring of solid waste movement throughout the reverse supply chain, improving transparency and accountability (Q. Chen and Liao, 2022). This allows for better inventory management and helps prevent valuable materials from leaking into informal or illegal channels. Efficient disassembly processes are critical for the safe and effective separation of components and materials from end-of-life products. This can involve optimized manual techniques that are more suitable for labor-intensive environments, or semi-automated processes to increase throughput (De Campos et al., 2017).

Social and ethical considerations, such as increasing public awareness, demand for sustainable practices, and corporate social responsibility, also contribute to the adoption of RL (Kianpour et al., 2017). A higher level of awareness and education among the general public about the environmental and health risks associated with improper waste disposal can increase consumer participation in formal waste collection programs and create a greater willingness to adopt responsible disposal practices (Azevedo et al., 2017).

Organizational factors, including strong management commitment, effective collaboration among various stakeholders, and the availability of necessary knowledge and expertise, are critical for the successful implementation and effectiveness of RL systems (De Campos et al., 2021). Integrating organizational learning capabilities with RL practices has been shown to improve RL performance (Banguera et al., 2017). Similar to this, organizational learning facilitates knowledge sharing and promotes collaboration across different functional areas within the organization, which helps to better position the organization to adapt and effectively utilize RL for process enhancement and value creation (Tennakoon et al., 2021).

Partnering with experts in waste management and RL, using specialized infrastructure and software solutions can significantly improve the effectiveness of these operations. Professional waste management partners can help businesses to develop customized solutions for waste recovery, recycling, and disposal, while specialized software can streamline operations by automating tasks, improving visibility, and providing valuable analytics (Abdissa et al., 2022). Reviewing the terms and conditions established with suppliers for handling returns is essential to optimizing the entire RL process. Implementing ethical standards and company policy is critical to supporting the RL system (Singh and Agrawal, 2018). Finally, designing products with end-of-life management, for instance by making them easier to disassemble and recycle, can significantly facilitate the RL process and contribute to a more circular economy (Tesfaye and Kitaw, 2020).

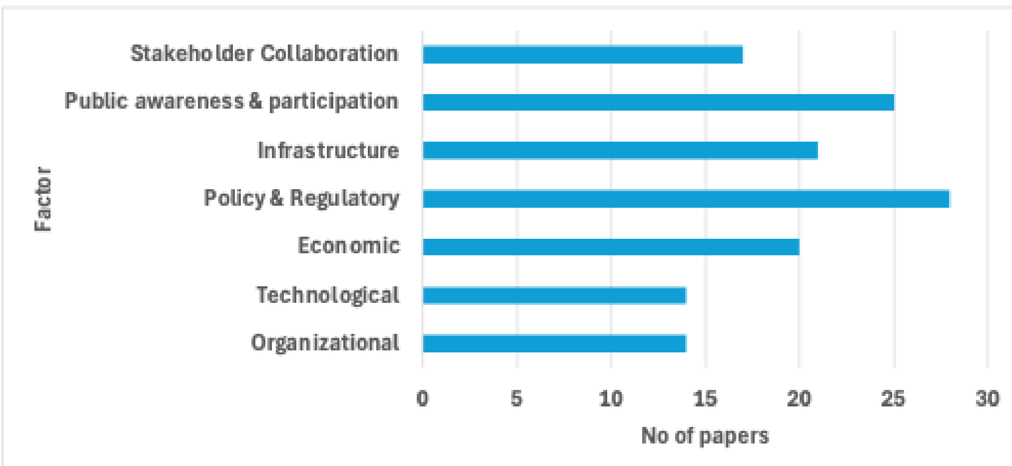

Figure 6: Distribution of key factors affecting RL effectiveness

Table 1 provides a deeper understanding of the thematic focus of the reviewed literature, and a content analysis was performed to identify the key factors addressed in each paper. For a complete list of sources supporting each factor, including individual references, see Table A1 in the Appendix. As shown in Figure 6, the factor receiving the most significant attention in the literature is policy & regulatory, which was highlighted by 28 papers reviewed. This prominence suggests that government regulations, environmental policies, and legislative frameworks are widely considered to be key drivers and challenges for the implementation of RL strategies (Azevedo et al., 2017). The second most studied factor is public awareness and participation, which appeared in 25 papers, emphasizing the critical role of consumer behavior and public participation in the success of waste management and resource recovery programs.

Furthermore, factors such as organizational and technological appear to be less frequently studied. This finding is particularly noteworthy as internal organizational structures, operational processes, and the role of advanced technologies are often cited as critical enablers for effective RL systems. This discrepancy indicates a potential gap in the current research, suggesting that while the external drivers (policy and public awareness) are well-documented, the internal, firm-specific mechanisms that facilitate or hinder the implementation of RL remain underexplored.

Table 1. Factors affecting RL in SWM identified from the literature

Type	Factor	Frequency
Organizational	Commitment and involvement of top-level management	5
	Employee training on RL systems and proper knowledge	5
	Implement ethical standards/ company policy to support RL	1
	Employee incentives for engaging in recycling and returns	3
Technological	Data management tools for tracking collection, sorting, and processing	4
	Availability of modern equipment and methods for recycling and recovery installations	6
	Product Design for recyclability/disassembly	4
Economic	Cost efficiency of operations such as collection, transport, sorting, and disposal	7
	Government or private sector financial support via incentives/subsidies	7
	Demand and pricing (Market value) of recyclable materials	6
Policy & Regulatory	Comprehensive and enforced legislation (e.g., waste laws, recycling mandates, and penalties)	8
	Policies promoting the reuse and reduction of non-recyclable products	8
	EPR, which obliges producers to manage post-consumer waste	6
	Government support for monitoring and ensuring adherence to rules	7
Infrastructure	Availability and accessibility of collection points	7
	Availability of suitable locations for waste storage, sorting, and processing facilities	5
	Optimal vehicle usage	5
	Efficiency and coverage of transportation routes	4
Public awareness & participation	Knowledge and attitude of the public toward waste separation and return	7
	Awareness of the harmful effects of improper disposal of hazardous waste into the environment	6
	Habits and willingness to comply with waste rules	5
	Participating in waste collection programs	7
Stakeholder Collaboration	Public-private partnership and shared responsibility	8
	Informal sector integration with waste pickers and recyclers	6
	Collaboration with third-party logistics providers in reverse operations, waste collection & recycling	4

RL practices influencing the adoption and effectiveness in SWM

RL practices are applied differently across various solid waste streams, each reflecting the unique characteristics and challenges. For Municipal solid waste, a significant focus is on leveraging digital technologies for enhancing collection, sorting, and processing efficiency (Bing et al., 2016). This includes implementing smart bins equipped with sensors and deploying proper vehicles for optimal waste collection (Q. Chen & Liao, 2022). Artificial Intelligence (AI) and Internet of Things (IoT) play a crucial role in enabling intelligent waste classification and segregation, improving the quality of recovered materials (Rodrigues et al., 2025).

In the industrial waste sector, the primary focus is on value recovery through practices such as reuse, recycling, and material substitution. Business-to-business networks are developing to facilitate the exchange of waste and by-products between different industries, creating opportunities for resource efficiency and cost reduction (Pourmohammadi et al., 2015). Implementing hierarchical RL principles that prioritize waste minimization, reuse, and recycling before incineration or landfilling and guide the management of industrial waste streams (Banguera et al., 2017).

Due to the risks to public health and the environment, RL of hazardous waste places a strong emphasis on ensuring its safe transportation, handling, and disposal (De Oliveira et al., 2021). Specific RL activities include careful network location planning, efficient collection methods, optimized vehicle routing, specialized processing techniques, secure packaging and storage, and distribution to designated treatment facilities (Kargar et al., 2020). Risk assessment and analysis are critical factors in managing the reverse flow of hazardous waste to prevent accidents and environmental pollution (Xu and Yang, 2022).

For construction and demolition waste (CDW), RL practices focus on reusing, recycling, and downcycling materials such as concrete, metal, brick, and wood (Huang et al., 2022). RL networks and optimization models are being developed to enhance CDW management, aiming to divert this large amount of waste from landfills (Q. Chen and Liao, 2022). The RL of electronic waste emphasizes collection, sorting, refurbishment, disassembly, material recovery, and proper disposal of hazardous components (Le, 2023). RL plays a crucial role in enabling a circular supply chain for electronics, ensuring the recovery and reuse of valuable materials (Bakhiyi et al., 2018). Several successful programs and initiatives have been implemented by companies, such as Apple, Motorola, and Sony, focusing on efficient collection systems, advanced recycling technologies, and the recovery of valuable metals and rare earth elements (Azevedo et al., 2017).

RL models have been developed specifically for the collection and recycling of plastic waste. The aim of these efforts is to reduce the use of raw materials by plastic manufacturers and contribute to environmental protection and sustainable development (Valenzuela et al., 2021). Strategies for sustainable packaging, including the use of reusable, recyclable, and biodegradable materials to reduce the environmental footprint of packaging (Scrioșteanu & Criveanu, 2023).

Implementing smart waste segmentation based on the potential for reuse, recycling, or responsible disposal is also vital. By properly categorizing waste materials, businesses can reduce the volume sent to landfills and identify opportunities for value recovery through resale, refurbishment, or recycling of certain products (Mesjasz-Lech, 2019). Leveraging data-driven decision-making is another effective strategy. Analyzing return and disposal patterns can provide valuable insights for process optimization, helping companies to identify inefficiencies and make informed decisions to improve their waste management processes (Alshaikh and Abdelfatah, 2024). Ensuring efficient transportation is crucial to minimizing both costs and environmental impact. This can be achieved through optimal routing, load balancing, and the potential establishment of localized return centers to reduce transportation distances and emissions (Q. Chen and Liao, 2022).

Establishing clear and well-defined guidelines and procedures for waste collection, transportation, and environmentally sound disposal is fundamental to ensuring the effectiveness of RL operations (Azevedo et al., 2017). Educating employees about specific requirements and best practices for SWM and RL, and providing training, directly impacts the efficiency and environmental outcomes of these processes (De Campos et al., 2021). It is essential to regularly monitor and measure the success of RL programs using relevant performance indicators to identify areas for improvement and ensure continuous optimization (Kargar et al., 2020).

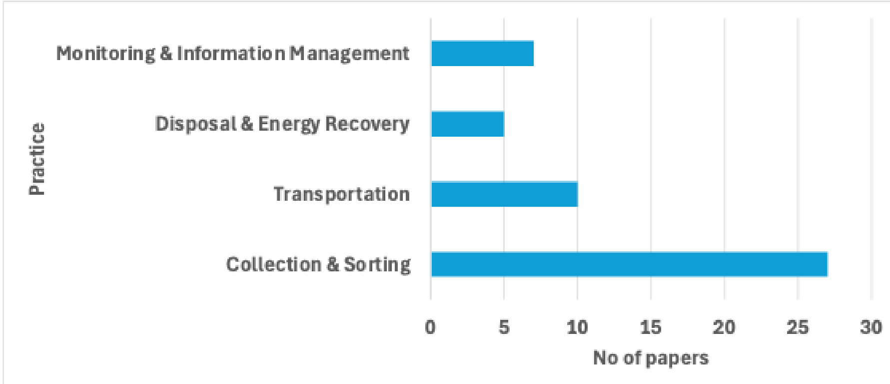

Figure 7: Distribution of key practices affecting RL effectiveness

Figure 7 illustrates the distribution of SWM practices discussed across the selected papers in this literature review and summarized in Table 2. For a complete list of sources supporting each practice, including individual references, see Table A2 in the Appendix. Collection and sorting is the most frequently cited practice, with a significant number of papers addressing this aspect. This highlights the primary concern of researchers and practitioners in establishing efficient and effective systems to collect and sort waste from its sources. Following this, the solid waste transportation is discussed in a notable number of papers. This indicates that the logistical challenges and strategies for moving collected waste to treatment facilities are also a key focus.

In contrast, monitoring and information management, disposal, and energy recovery are addressed in a smaller number of papers. The low frequency of these topics suggests that they are less mature areas of research or that they are often considered as part of broader collection and sorting, or transportation practices, rather than distinct phases. The limited focus on disposal and energy recovery is particularly noteworthy, as it suggests a potential gap in the literature regarding the final stages of the waste life cycle and the implementation of sustainable end-of-life solutions.

Table 2. RL practices that influence SWM identified from the literature

Type	Practice	Frequency
Collection & Sorting	Separate waste at the point of consumption (e.g., bio, recyclable, hazardous)	8
	Use color-coded bins for different waste types (e.g., green for organic, orange for plastics)	1
	Use door-to-door collection systems	4
	Establish drop-off centers	2
	Use the gatekeeping method (It involves deciding which products are authorized to enter the system)	2
	Organize waste collection programs/ temporary stations in high-density areas	4
	Establish waste consolidation centers/ intermediate locations to gather and sort waste	3
	Conduct incentive-based collection programs like rewards for returning recyclables (e.g., glass/plastic bottle deposit schemes)	4
Transportation	Plan and use optimized RL routes	3
	Train drivers and handlers in safe handling protocols for hazardous components	5

	Use RL fleet integration with forward logistics	2
	Use suitable vehicles for waste transport	3
Disposal & Energy Recovery	Generate energy in waste-to-energy plants	2
	Do sanitary landfilling considering engineered disposal for non-recyclables with leachate/gas control	1
	Use anaerobic digestion of organic waste for biogas production and composting	2
Monitoring and Information Management	Use of waste tracking software and IoT to monitor collection, sorting, and processing	2
	Use data management tools to identify bottlenecks and optimize the process	6
	Use mobile waste apps for reporting, education, and scheduling collections	1
	Using GPS and route optimization software to minimize fuel consumption and collection time	2

Challenges in the adoption of digital tools and technological solutions in RL for SWM

While the integration of digital tools such as IoT, AI, and advanced tracking systems is recognized as a key enabler of effectiveness in RL for SWM, the pathway to digitalization is not a simple one. Adopting digital solutions is not only a technical upgrade but a profound organizational and systemic transformation (Julianelli et al., 2020). It requires overcoming significant economic barriers, deep-rooted technological and infrastructure limitations, and addressing organizational human-related factors.

The economic and financial barriers associated with adopting digital technologies represent one of the most formidable obstacles for many organizations and municipalities. Moving to a smart SWM system requires significant initial capital expenditure. The costs for the required hardware, software, and infrastructure are significant (Rodrigues et al., 2025). The financial commitment doesn't end with the initial purchase. A comprehensive analysis reveals significant ongoing lifecycle costs, including recurring expenses for software licenses, data storage fees, regular system maintenance, and periodic technology upgrades to prevent obsolescence (Julianelli et al., 2020). Without a strong, long-term financial strategy, many organizations and municipalities struggle to obtain necessary initial funding, manage ongoing operating costs, and build a resilient case for investment, ultimately leading to technical failure (Santos and Ogunseitan, 2022).

One of the most critical technical challenges is the lack of interoperability between different digital systems. Many companies operate on a patchwork of outdated IT systems that were never designed to communicate with modern platforms (Zielińska, 2020). Although they can perform their specific function, unable to share data or collaborate with other parts of the ecosystem. For example, data from a smart sensor network may not be able to seamlessly integrate with the materials recovery facility's inventory management system (Rodrigues et al., 2025). This fragmentation is a major barrier to achieving a data-driven view of the entire waste management lifecycle.

The success of smart SWM solutions fundamentally depends on the quality of the underlying physical and digital infrastructure. Smart devices, from sensors in bins to GPS trackers on trucks, rely on a stable and reliable network connection to transmit data (Xu & Yang, 2022). In many regions, especially in rural areas or developing countries, the necessary digital infrastructure is underdeveloped or completely nonexistent. Without this basic connectivity, the implementation of smart waste solutions is not feasible (Le, 2023).

The successful adoption of digital technologies ultimately depends on the readiness of the organization and its people to embrace them. Organizational culture can create significant organizational inertia, making the adoption of new, technology-driven workflows a slow and challenging effort (Tesfaye and Kitaw, 2020). Resistance can manifest itself at all levels of the organization. Employees resist new technologies for a variety of reasons, including fear that automation will make their jobs redundant, doubt about the expected benefits of new systems, or the difficulty and stress of learning new processes (Waqas et al., 2018; Z. Xu et al., 2021). For example, collection drivers who are accustomed to fixed, familiar routes may initially be resistant to route optimization software that changes their daily tasks, even if it gives greater efficiency (Huang et al., 2022).

Furthermore, a critical challenge to the effective use of digital tools is the widespread shortage of human capital with the skills needed to properly install, operate, maintain, and analyze the data generated by modern SWM systems. Even for existing workforces, organizations often fail to invest in adequate and ongoing training programs (Bakhiyi et al., 2018). Delivering new digital tools without providing the necessary support to ensure employees are proficient and comfortable is a common mistake that leads to frustration, user error, and even abandonment of new systems (De Campos et al., 2021).

The findings of this systematic review emphasize the growing recognition of RL as a transformative component of SWM. Establishing an integrated and resilient SWM system requires coordinated efforts among government, private enterprises, waste management professionals, and the public. To improve RL practices in SWM, several recommendations can be made.

Governments: The development and implementation of comprehensive and consistent national and international waste management regulations, including clearly defined scopes, ambitious collection targets, and strict standards for environmentally sound treatment and disposal. It is crucial to expand and strengthen the implementation of EPR schemes across all relevant waste categories to ensure that manufacturers take greater responsibility for the entire life cycle of their products, especially for their end-of-life management. Governments should also consider introducing and enhancing both financial incentives, such as tax credits, subsidies, deposit refund systems, and non-financial incentives, such as public recognition, awareness campaigns, to encourage active participation from both consumers and businesses in solid waste recycling and responsible disposal initiatives. Furthermore, strategic and sustained investment in developing national waste management infrastructure, which includes accessible and conveniently located collection points, efficient and environmentally friendly transportation networks, and modern recycling facilities equipped with advanced technologies. Continued support and funding for research and development efforts focused on creating innovative and environmentally friendly waste recycling technologies, including AI-powered sorting, advanced material recovery processes, and safe methods for handling and disposing of hazardous components, are vital for advancing the field.

Businesses**:** Circular design principles should be adopted early on for long life, ease of disassembly for repair and recycling, and with minimal use of hazardous materials. It is essential for businesses to establish and actively promote take-back programs, ensuring that consumers are given convenient and easily accessible options for returning their end-of-life products. By establishing strategic collaborations and partnerships with specialized third-party RL providers and certified waste recycling companies, they can significantly improve the efficiency and environmental performance of their waste management efforts by leveraging the expertise and established infrastructure of these specialists. Businesses handling returned IT equipment must implement strict data protection protocols to ensure that any sensitive information is completely and irreversibly deleted before the equipment is considered for reuse, refurbishment, or recycling.

Consumers: Proactive steps should be taken to improve awareness and understanding of the significant environmental and public health consequences associated with improper waste disposal and recognize the critical importance of participating in recycling efforts. It is essential that consumers actively participate in available waste recycling programs and make full use of established collection infrastructure, such as manufacturers' take-back schemes, community drop-off centers, and scheduled collection events, while ensuring that their end-of-life products are managed responsibly. Whenever possible, consumers should consider donating or selling their used products if they are still in good or functional condition, as this can extend their useful life and contribute to reducing overall waste generation.

While the existing literature provides a comprehensive understanding of many aspects of RL in SWM, several gaps and future research directions need to be addressed. Future research should focus on quantitatively assessing the environmental, economic, and social impacts of RL practices across different waste streams to provide a strong evidence base for policymakers and professionals. Regional and sectoral disparities also highlight the need for deep studies in underrepresented regions such as Africa and South Asia, which receive relatively less attention. As digitalization transforms supply chains, it is essential to further explore Industry 4.0 technologies, including AI, RFID, and IoT, to enable real-time tracking, process automation, and smarter decision-making within RL systems. Moreover, the review effectively identifies key external drivers for reverse logistics, and it highlights a research gap on internal, firm-specific mechanisms. Finally, empirical evaluations of policy tools, such as EPR, are needed to assess their practical impact on the adoption of RL and inform the design of more effective regulatory frameworks based on waste streams. Continued research and innovation in this field are essential for addressing the growing complexities of waste management and ensuring a sustainable future.

Conclusion

This systematic review has highlighted the critical role of RL in addressing the growing global challenge of SWM. The analysis shows that RL is simply not a waste disposal mechanism but a strategic approach that integrates economic, environmental, and social considerations. Key findings reveal the transformative potential of digital technologies associated barriers in optimizing RL operations, the importance of models and frameworks created for different solid waste streams, and the many factors and practices that influence the adoption and effectiveness of RL. The effectiveness of RL in SWM is a multifaceted issue influenced by a complex interaction of regulatory frameworks, consumer behaviour, technological advances, infrastructure development, economic considerations, and organizational support. Government regulations and policies, particularly EPR, establish the crucial framework for responsible waste management. Active participation of consumers, driven by awareness, convenience, and incentives, is essential for the success of collection programs. Technological advancements in recycling processes, IoT applications, and waste tracking systems continue to improve the efficiency and sustainability of SWM, though their adoption is frequently hindered by major economic and organizational barriers. Well-established infrastructure for collection, transportation, and processing provides the foundation for effective RL. Selecting and implementing appropriate RL strategies, according to the unique characteristics of different types of waste, is key to maximizing collection rates and ensuring environmentally sound management.

This systematic review has several limitations that should be considered. The methodology was limited to peer-reviewed, open-access journal articles published in English. This exclusion criterion may have led to an underrepresentation of relevant research published in other languages or non-open-access journals, particularly from regions such as Europe and Africa. Although efforts were made to ensure a comprehensive search across multiple databases, relying on four databases may still limit the breadth of included literature. Another limitation of this review is that it primarily relies on secondary data synthesis without expert validation or incorporating stakeholder perspectives. While thematic analysis identified factors and practices that influence RL in SWM, the lack of triangulation with industry professionals, policymakers, or community stakeholders may limit the real-world applicability of the findings. These gaps suggest directions for future research.

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Conflicts of interest

The authors declare that there are no conflicts of interest.

Author Contributions

Conceptualization, methodology design, literature search, data collection, analysis, and writing of the manuscript were carried out by N.T.D.T. Sandamini. Supervision, review, and critical feedback were provided by C.A. Kavirathna and A.S. Withanaarachchi. All authors read and approved the final manuscript.

References

Abdissa, G., Ayalew, A., Dunay, A., & Illés, C. B., (2022). Role of reverse logistics activities in the recycling of used plastic bottled water waste management. *Sustainability*, *14*(13), 7650. https://doi.org/10.3390/su14137650

Agrawal, S., & Singh, R. K., (2019). Analyzing disposition decisions for sustainable reverse logistics: Triple Bottom Line approach. *Resources Conservation and Recycling*, *150*, 104448. https://doi.org/10.1016/j.resconrec.2019.104448

Alshaikh, R., & Abdelfatah, A., (2024). Optimization Techniques in Municipal Solid Waste Management: A Systematic Review. *Sustainability*, *16*(15), 6585. https://doi.org/10.3390/su16156585

Azevedo, L. P., Da Silva Araújo, F. G., Lagarinhos, C. a. F., Tenório, J. a. S., & Espinosa, D. C. R., (2017). E-waste management and sustainability: a case study in Brazil. *Environmental Science and Pollution Research*, *24*(32), 25221–25232. https://doi.org/10.1007/s11356-017-0099-7

Bakhiyi, B., Gravel, S., Ceballos, D., Flynn, M. A., & Zayed, J., (2018). Has the question of e-waste opened a Pandora's box? An overview of unpredictable issues and challenges. *Environment International*, *110*, 173–192. https://doi.org/10.1016/j.envint.2017.10.021

Banguera, L., Sepulveda, J. M., Fuertes, G., Carrasco, R., & Vargas, M., (2017). Reverse and inverse logistic models for solid waste management. *The South African Journal of Industrial Engineering*, *28*(4), 120–132. https://doi.org/10.7166/28-4-1701

Bing, X., Bloemhof, J. M., Ramos, T. R. P., Barbosa-Povoa, A. P., Wong, C. Y., & Van Der Vorst, J. G., (2016). Research challenges in municipal solid waste logistics management. *Waste Management*, *48*, 584–592. https://doi.org/10.1016/j.wasman.2015.11.025

Brandão, R., Edwards, D. J., Hosseini, M. R., Melo, A. C. S., & Macêdo, A. N., (2021). Reverse supply chain conceptual model for construction and demolition waste. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *39*(11), 1341–1355. https://doi.org/10.1177/0734242x21998730

Budak, A., & Ustundag, A., (2016). Reverse logistics optimisation for waste collection and disposal in health institutions: the case of Turkey. *International Journal of Logistics Research and Applications*, *20*(4), 322–341. https://doi.org/10.1080/13675567.2016.1234595

Chen, Q., & Liao, W., (2022). Collaborative Routing Optimization Model for Reverse Logistics of Construction and Demolition Waste from Sustainable Perspective. *International Journal of Environmental Research and Public Health*, *19*(12), 7366. https://doi.org/10.3390/ijerph19127366

Chen, X., Qiu, D., & Chen, Y., (2024). Reverse logistics in the construction industry: status quo, challenges and opportunities. *Buildings*, 14(6), 1850. https://doi.org/10.3390/buildings14061850

Chileshe, N., Rameezdeen, R., Hosseini, M. R., Lehmann, S., & Udeaja, C., (2016). Analysis of reverse logistics implementation practices by South Australian construction organisations. *International Journal of Operations & Production Management*, *36*(3), 332–356. https://doi.org/10.1108/ijopm-01-2014-0024

Chileshe, N., Rameezdeen, R., Hosseini, M. R., Martek, I., Li, H. X., & Panjehbashi-Aghdam, P., (2018). Factors driving the implementation of reverse logistics: A quantified model for the construction industry. *Waste Management*, *79*, 48–57. https://doi.org/10.1016/j.wasman.2018.07.013

Da Silva, R. C., De Azevedo, A. R., Cecchin, D., Carmo, D. D., Marvila, M. T., & Adesina, A., (2022). Study on the implementation of reverse logistics in medicines from health centers in Brazil. *Cleaner Waste Systems*, *2*, 100015. https://doi.org/10.1016/j.clwas.2022.100015

De Campos, E. a. R., Caten, C. S. T., & De Paula, I. C., (2021). End-of-use and end-of-life medicines—insights from pharmaceutical care process into waste medicines management. *Environmental Science and Pollution Research*, *28*(41), 58170–58188. https://doi.org/10.1007/s11356-021-14661-4

De Campos, E. a. R., De Paula, I. C., Pagani, R. N., & Guarnieri, P., (2017). Reverse logistics for the end-of-life and end-of-use products in the pharmaceutical industry: a systematic literature review. *Supply Chain Management an International Journal*, *22*(4), 375–392. https://doi.org/10.1108/scm-01-2017-0040

De Oliveira, U. R., Neto, L. A., Abreu, P. A. F., & Fernandes, V. A., (2021). Risk management applied to the reverse logistics of solid waste. *Journal of Cleaner Production*, *296*, 126517. https://doi.org/10.1016/j.jclepro.2021.126517

De Souza, R. G., Clímaco, J. C. N., Sant'Anna, A. P., Rocha, T. B., De Aragão Bastos Do Valle, R., & Quelhas, O. L. G. (2016). Sustainability assessment and prioritisation of e-waste management options in Brazil. *Waste Management*, *57*, 46–56. https://doi.org/10.1016/j.wasman.2016.01.034

Doan, L. T. T., Amer, Y., Lee, S., Phuc, P. N. K., & Dat, L. Q., (2019). E-Waste Reverse Supply Chain: A review and future perspectives. *Applied Sciences*, *9*(23), 5195. https://doi.org/10.3390/app9235195

Ferri, G. L., De Lorena Diniz Chaves, G., & Ribeiro, G. M., (2015). Reverse logistics network for municipal solid waste management: The inclusion of waste pickers as a Brazilian legal requirement. *Waste Management*, 40, 173–191. https://doi.org/10.1016/j.wasman.2015.02.036

Gonçalves, A. T. T., Fagundes, L. D., De Carvalho Miranda, R., & Da Silva Lima, R., (2019). Discrete event simulation as a decision-making tool for end-of-life tire reverse logistics in a Brazilian city consortium. *Environmental Science and Pollution Research*, *26*(23), 23994–24009. https://doi.org/10.1007/s11356-019-05559-3

Gorji, M., Jamali, M., & Iranpoor, M., (2020). A game-theoretic approach for decision analysis in end-of-life vehicle reverse supply chain regarding government subsidy. *Waste Management*, *120*, 734–747. https://doi.org/10.1016/j.wasman.2020.10.043

Guarnieri, P., Silva, L. C. E., & Levino, N. A., (2016). Analysis of electronic waste reverse logistics decisions using Strategic Options Development Analysis methodology: A Brazilian case. *Journal of Cleaner Production*, *133*, 1105–1117. https://doi.org/10.1016/j.jclepro.2016.06.025

Herat, S., & Agamuthu, P., (2012). E-waste: a problem or an opportunity? Review of issues, challenges and solutions in Asian countries. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *30*(11), 1113–1129. https://doi.org/10.1177/0734242x12453378

Hosseini, M. R., Rameezdeen, R., Chileshe, N., & Lehmann, S., (2015). Reverse logistics in the construction industry. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *33*(6), 499–514. https://doi.org/10.1177/0734242x15584842

Huang, Y., Pan, L., He, Y., Xie, Z., & Zheng, X., (2022). A BIM–WMS management tool for the reverse logistics supply chain of demolition waste. *Sustainability*, *14*(23), 16053. https://doi.org/10.3390/su142316053

Islam, M. T., & Huda, N., (2018). Reverse logistics and closed-loop supply chain of Waste Electrical and Electronic Equipment (WEEE)/E-waste: A comprehensive literature review. *Resources Conservation and Recycling*, *137*, 48–75. https://doi.org/10.1016/j.resconrec.2018.05.026

Julianelli, V., Caiado, R. G. G., Scavarda, L. F., & De Mesquita Ferreira Cruz, S. P.. (2020). Interplay between reverse logistics and circular economy: Critical success factors-based taxonomy and framework. *Resources Conservation and Recycling*, *158*, 104784. https://doi.org/10.1016/j.resconrec.2020.104784

Kargar, S., Paydar, M. M., & Safaei, A. S., (2020). A reverse supply chain for medical waste: A case study in Babol healthcare sector. *Waste Management*, *113*, 197–209. https://doi.org/10.1016/j.wasman.2020.05.052

Kianpour, K., Jusoh, A., Mardani, A., Streimikiene, D., Cavallaro, F., Nor, K. M., & Zavadskas, E., (2017). Factors Influencing Consumers' Intention to Return the End of Life Electronic Products through Reverse Supply Chain Management for Reuse, Repair and Recycling.

Sustainability, *9*(9), 1657. https://doi.org/10.3390/su9091657

Kochan, C. G., Pourreza, S., Tran, H., & Prybutok, V. R., (2016). Determinants and logistics of e-waste recycling. *The International Journal of Logistics Management*, *27*(1), 52–70. https://doi.org/10.1108/ijlm-02-2014-0021

Le, S. (2023). Investigating the drivers of the reverse logistics implementation in reducing waste in Vietnam. *Environmental Health Insights*, *17*. https://doi.org/10.1177/11786302231211058

Mathiyazhagan, K., Rajak, S., Panigrahi, S. S., Agarwal, V., & Manani, D., (2021). Reverse supply chain management in manufacturing industry: a systematic review. *International Journal of Productivity and Performance Management*, *70*(4), 859–892. https://doi.org/10.1108/ijppm-06-2019-0293

Mesjasz-Lech, A., (2019). Reverse logistics of municipal solid waste – towards zero waste cities. *Transportation Research Procedia*, *39*, 320–332. https://doi.org/10.1016/j.trpro.2019.06.034

Pedram, A., Yusoff, N. B., Udoncy, O. E., Mahat, A. B., Pedram, P., & Babalola, A., (2016). Integrated forward and reverse supply chain: A tire case study. *Waste Management*, *60*, 460–470. https://doi.org/10.1016/j.wasman.2016.06.029

Peña-Montoya, C. C., Bouzon, M., Torres-Lozada, P., & Vidal-Holguin, C. J., (2020). Assessment of maturity of reverse logistics as a strategy to sustainable solid waste management. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *38*(1_suppl), 65–76. https://doi.org/10.1177/0734242x19897131

Pourmohammadi, H., Rahimi, M., & Dessouky, M., (2015). Sustainable reverse logistics for distribution of industrial Waste/Byproducts: a joint optimization of operation and environmental costs. *Supply Chain Forum an International Journal*, *9*(1), 2–17. https://doi.org/10.1080/16258312.2008.11517186

Pumpinyo, S., & Nitivattananon, V., (2014). Investigation of barriers and factors affecting the reverse logistics of waste management practice: a case study in Thailand. *Sustainability*, *6*(10), 7048–7062. https://doi.org/10.3390/su6107048

Pushpamali, N., Agdas, D., & Rose, T. M., (2019). A Review of Reverse Logistics: An Upstream Construction Supply Chain perspective. *Sustainability*, *11*(15), 4143. https://doi.org/10.3390/su11154143

Rodrigues, S. P., De Carvalho Gomes, L., Peres, F. A. P., De Faria Correa, R. G., & Baierle, I. C. (2025). A Framework for Leveraging Digital Technologies in reverse Logistics Actions: A Systematic Literature review. *Logistics*, *9*(2), 54. https://doi.org/10.3390/logistics9020054

Santos, S. M., & Ogunseitan, O. A., (2022). E-waste management in Brazil: Challenges and opportunities of a reverse logistics model. *Environmental Technology & Innovation*, *28*, 102671. https://doi.org/10.1016/j.eti.2022.102671

Scrioșteanu, A., & Criveanu, M. M., (2023). Reverse Logistics of Packaging Waste under the Conditions of a Sustainable Circular Economy at the Level of the European Union States. *Sustainability*, *15*(20), 14727. https://doi.org/10.3390/su152014727

Shadkam, E., (2021). Cuckoo optimization algorithm in reverse logistics: A network design for COVID-19 waste management. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *40*(4), 458–469. https://doi.org/10.1177/0734242x211003947

Singh, R. K., & Agrawal, S., (2018). Analyzing disposition strategies in reverse supply chains: fuzzy TOPSIS approach. *Management of Environmental Quality an International Journal*, *29*(3), 427–443. https://doi.org/10.1108/meq-12-2017-0177

Tennakoon, G. A., Rameezdeen, R., & Chileshe, N., (2022). Identifying factors affecting the low uptake of reprocessed construction materials: A systematic literature review. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *41*(4), 781–800. https://doi.org/10.1177/0734242x221135244

Tennakoon, G., Rameezdeen, R., & Chileshe, N., (2021). Diverting demolition waste toward secondary markets through integrated reverse logistics supply chains: A systematic literature review. *Waste Management & Research the*

Journal for a Sustainable Circular Economy, *40*(3), 274–293. https://doi.org/10.1177/0734242x211021478

Tesfaye, W., & Kitaw, D., (2020). Conceptualizing reverse logistics to plastics recycling system. *Social Responsibility Journal*, *17 (5): 686–702.*https://doi.org/10.1108/srj-12-2019-0411

Uriarte-Miranda, M., Caballero-Morales, S., Martinez-Flores, J., Cano-Olivos, P., & Akulova, A., (2018). Reverse Logistic Strategy for the management of tire waste in Mexico and Russia: review and Conceptual model. *Sustainability*, *10*(10), 3398. https://doi.org/10.3390/su10103398

Valenzuela, J., Alfaro, M., Fuertes, G., Vargas, M., & Sáez-Navarrete, C., (2021). Reverse logistics models for the collection of plastic waste: A literature review. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *39*(9), 1116–1134. https://doi.org/10.1177/0734242x211003948

Van Rensburg, M. L., Nkomo, S. L., & Mkhize, N. M., (2020). Life cycle and End-of-Life management options in the footwear industry: A review. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *38*(6), 599–613. https://doi.org/10.1177/0734242x20908938

Vieira, B., Guarnieri, P., Nofal, R., & Nofal, B., (2020). Multi-Criteria methods applied in the studies of barriers identified in the implementation of reverse logistics of E-Waste: A Research agenda. *Logistics*, *4*(2), 11. https://doi.org/10.3390/logistics4020011

Waqas, M., Dong, Q., 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. *Sustainability*, *10*(11), 4202. https://doi.org/10.3390/su10114202

Wardani, S. A., Handayani, N. U., & Wibowo, M. A., (2022). Barriers for implementing reverse logistics in the construction sectors. *Journal of Industrial Engineering and Management*, *15*(3), 385. https://doi.org/10.3926/jiem.3539

Wijewickrama, M., Chileshe, N., Rameezdeen, R., & Ochoa, J. J., (2021). Quality assurance in reverse logistics supply chain of demolition waste: A systematic literature review. *Waste Management & Research the Journal for a Sustainable Circular Economy*, *39*(1), 3–24. https://doi.org/10.1177/0734242x20967717

Xu, X., & Yang, Y., (2022). Municipal hazardous waste management with reverse logistics exploration. Energy Reports, 8, 4649–4660. https://doi.org/10.1016/j.egyr.2022.02.230

Xu, Z., Elomri, A., Liu, W., Liu, H., & Li, M., (2021). Robust global reverse logistics network redesign for high-grade plastic wastes recycling. *Waste Management*, *134*, 251–262. https://doi.org/10.1016/j.wasman.2021.08.024

Xu, Z., Elomri, A., Pokharel, S., Zhang, Q., Ming, X., & Liu, W., (2017). Global reverse supply chain design for solid waste recycling under uncertainties and carbon emission constraint. *Waste Management*, *64*, 358–370. https://doi.org/10.1016/j.wasman.2017.02.024

Zielińska, A., (2020). A comparative analysis of reverse logistics implementation for waste management in Poland and other European Union countries. *Journal of International Studies*, *13*(4), 171–183. https://doi.org/10.14254/2071-8330.2020/13-4/12