Reverse logistics of construction and demolition waste: a bibliometric analysis of the literature and perspectives for future research

Logística reversa de resíduos de construção e demolição: uma análise bibliométrica da literatura e perspectivas para pesquisas futuras

Logística inversa de residuos de construcción y demolición: un análisis bibliométrico de la literatura y perspectivas para investigaciones futuras

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Abstract

The Civil Construction industry is one of the largest generators of waste, which when improperly disposed of, lead to irreversible environmental implications. Effective management of these materials can recycle about 90% of the waste, minimizing environmental impacts. In this sense, the research aimed to provide an overview of the implementation of reverse logistics in Construction and Demolition Waste, highlighting the main gaps in the research scenario. For the selection of the analyzed articles, a string was

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defined and searched in the Web of Science journal database. The search resulted in 45 articles from 20 journals, which were analyzed using the VOSviewer software. The results revealed a significant concentration of studies in journals such as "Journal of Cleaner Production", "Waste Management & Research" and "Sustainability", and highlighted the most relevant keywords, such as "reverse logistics", "construction and demolition waste" and "waste management". However, emerging research trends were evidenced, such as the challenges of implementing reverse logistics in C&D waste and the importance of recycling for circular economy and environmental sustainability. The conclusions emphasize the importance of a multidisciplinary approach in C&D waste management, highlighting challenges from the construction process to waste recycling and recovery. Additionally, the need for models and systems to improve performance in reverse logistics implementation is emphasized. Finally, the importance of exploring advanced technologies and public-private partnerships to promote the effectiveness of reverse logistics in C&D waste is emphasized.


Resumo

A indústria de Construção Civil é uma das maiores geradoras de resíduos que, ao serem descartados incorretamente, ocasionam implicações ambientais irreversíveis. A gestão eficaz destes materiais pode reciclar cerca de 90% dos resíduos, minimizando impactos ambientais. Neste sentido, o objetivo da pesquisa foi elaborar um panorama da implementação da logística reversa em Resíduos de Construção e Demolição, destacando as principais lacunas no cenário de pesquisas. Para a seleção dos artigos analisados, foi definida uma string que foi pesquisada na base de periódicos Web of Science. A busca resultou em 45 artigos de 20 revistas, que foram analisados no software VOSviewer. Os resultados revelaram uma concentração significativa de estudos nas revistas “Journal of Cleaner Production”, “Waste Management & Research” e “Sustainability”, e destacou as palavras-chaves mais relevantes, como “logística reversa”, “resíduos de construção e demolição” e “gestão de resíduos”. Entretanto, evidenciou-se tendências de pesquisas emergentes, como os desafios da implementação da LR em RCD e a importância da reciclagem para a economia circular e a sustentabilidade ambiental. As conclusões destacam a importância da abordagem multidisciplinar na gestão de RCD, evidenciando os desafios desde o processo construtivo até a reciclagem e recuperação dos resíduos. Além disso, ressalta-se a necessidade de modelos e sistemas que melhorem o desempenho na implementação de LR. Por fim, enfatizou-se a importância de explorar...
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Introduction

Construction and demolition waste (CDW) is a consequence of the life cycle of buildings, emerging from construction to demolition and representing a significant environmental challenge in the construction industry management. However, the majority of tecnologias avanzadas e parcerias público-privadas para promover a eficácia da LR em RCD. 


Resumen

La industria de la Construcción Civil es una de las mayores generadoras de residuos que, al ser descartados incorrectamente, ocasionan implicaciones ambientales irreversibles. La gestión eficaz de estos materiales puede reciclar cerca del 90% de los residuos, minimizando los impactos ambientales. En este sentido, el objetivo de la investigación fue elaborar un panorama de la implementación de la logística inversa en Residuos de Construcción y Demolición, destacando las principales lagunas en el escenario de investigaciones. Para la selección de los artículos analizados, se definió una cadena de búsqueda que fue consultada en la base de revistas Web of Science. La búsqueda resultó en 45 artículos de 20 revistas, que fueron analizados en el software VOSviewer. Los resultados revelaron una concentración significativa de estudios en las revistas "Journal of Cleaner Production", "Waste Management & Research" y "Sustainability", y destacaron las palabras clave más relevantes, como "logística inversa", "residuos de construcción y demolición" y "gestión de residuos". Sin embargo, se evidenciaron tendencias de investigaciones emergentes, como los desafíos de la implementación de la logística inversa en RCD y la importancia del reciclaje para la economía circular y la sostenibilidad ambiental. Las conclusiones destacan la importancia del enfoque multidisciplinario en la gestión de RCD, evidenciando los desafíos desde el proceso constructivo hasta el reciclaje y recuperación de los residuos. Además, se resalta la necesidad de modelos y sistemas que mejoren el rendimiento en la implementación de la logística inversa. Finalmente, se enfatizó la importancia de explorar tecnologías avanzadas y asociaciones público-privadas para promover la eficacia de la logística inversa en RCD. 

Palabras clave: Logística Inversa. Industria de la Construcción. Residuos de Construcción y Demolición. Gestión de Residuos de C&D.
its waste consists of materials such as steel which, through the use of Reverse Logistics, can be managed more actively and controlled (BRANDAO et al., 2023; SEA-LIM et al., 2018). Reverse Logistics can be defined as a set of important procedures for the recovery of materials already used by consumers; however, despite numerous organizations using RL to gain advantages, few employ it with a focus on material recycling and reutilization (SEA-LIM et al., 2018; WIJEWICKRAMA et al., 2021).

In this sense, reverse logistics is a strategic process in waste management, consisting of methods that allow for the collection, sorting, and reuse of discarded materials that return to the production system. However, in many countries, the predominant method of CDW disposal is landfilling due to its low cost, although this results in severe environmental impacts, generating various forms of pollution (JAHANGIRI et al., 2022).

Therefore, reverse logistics in CDW management is crucial in recycling and reducing these discarded materials, decreasing the volume of waste in landfills, thus preserving resources and generating economic opportunities. Its importance lies primarily in reducing environmental impact, promoting sustainability. This activity favors a circular economy, creates opportunities for new businesses, and stimulates innovation in waste management. By enabling the recycling of discarded materials and products, reverse logistics emerges as a component for a more efficient and responsible approach to waste management.

In this context, the construction industry requires significant resources as it ends up generating large volumes of waste that, if not properly disposed of, result in environmental pollution. Therefore, it is important to conduct research to develop a more effective reverse logistics for CDW from this perspective (SANTOS & MARCHESINI, 2018). Thus, the phenomenon of applying efficient management systems arises due to consumers' concern for excellence and environmental care (DÍAZ et al., 2023).

However, despite the importance of reverse logistics in C&D waste management, and despite the existence of studies related to the topic, systematic literature reviews focusing on the application of this issue in the construction industry are almost nonexistent. Thus, the greatest deficiency persists in quantitative studies that investigate and reveal in detail the barriers of the theme (HOSSEINI et al., 2015; WU et al., 2022).

The lack of in-depth investigations into practical and logistical barriers in the application of reverse logistics (RL) for construction and demolition waste (CDW) highlights a critical knowledge gap. Given the relevance of this scenario, the following question emerges: What is the landscape of RL implementation in CDW? Based on this guiding question, the
research objective was to develop an overview, understand, and identify gaps in the research landscape in the application of reverse logistics for CDW.

This article is structured into five main sections. In addition to this introductory section, section two presents a theoretical framework addressing the concepts of RL for CDW and CDW management, followed by the methodology adopted for the research. Subsequently, the results obtained through bibliometric analysis and associated discussions are presented, followed by perspectives for future research. Finally, conclusions will be presented based on the discussions presented.

Theoretical Framework

In this section, the topics of Reverse Logistics for CDW and CDW Management are addressed, discussing their respective concepts and contexts.

2.1 Reverse Logistics for CDW

Zaratrochova et al (2021) refer to Reverse Logistics as the practice of returning goods to their initial locations with the aim of transporting, reusing, recycling, or disposing of these materials correctly. Additionally, the term Reverse Logistics can be defined as the process of recycling objects that have been used, are no longer in use, or are defective. Therefore, given the environmental consequences generated by CDW, efficient treatment of these wastes is of utmost global necessity (CHEN & LIAO, 2022; HUANG et al., 2018).

According to Chen & Liao (2022), reverse logistics and traditional direct logistics are terms often confused but have their distinctions. While traditional direct logistics relates to the transportation of goods from the manufacturing point to the end consumer, reverse logistics is the system for returning these goods to their origin. Although resulting in numerous benefits and proving to be a sustainable approach, RL has not been fully explored in practical settings (HOSSEINI et al., 2015).

Currently, RL accounts for a considerable portion of organizational logistics processes. Therefore, it is essential to have monitoring and control mechanisms that manage these operations since efficient recycling can minimize factors such as production costs, which would reduce the exploitation of natural resources, and waste disposal in landfills, which generates CO2 emissions (CHEN & LIAO, 2022; ZIELIŃSKA, 2021). However, various
variables have been obstacles to the successful implementation of RL, negatively impacting results and the effectiveness of the system as a whole.

The transportation of CDW, while crucial due to its relevance to waste management systems, has faced challenges as there are no adequate transport routes, and this component is the main cause of increased environmental impacts of goods that use this resource (CHEN & LIAO, 2022; TAZI et al., 2020). Therefore, it becomes essential to conduct research that develops solution strategies for the addressed problem, an issue that was debated by Chen & Liao (2022) who, based on their studies on reverse logistics for CDW recycling, proposed a scheme for sustainable and economically viable transportation, aiming to optimize resources.

In this context, RL employs techniques aimed at reducing the effects caused by poor CDW management. Among these practices, the concept of 3R is prominent, comprising three terms: 1) reducing waste disposal (reduce) – seen as the primary priority for establishing CDW management plans; 2) reusing materials either by reusing the product with the same function or an alternative function (reuse); 3) collecting, processing, and transforming these wastes into new products (recycle) (ELLY et al., 2018; HUANG et al., 2018).

In this perspective, Schamne & Nagalli (2016) conducted a literature review to explore publications related to RL in the construction industry. The authors noted that despite incentives for recycling CDW around the world, professionals in the field show little interest in working with recycled materials. Therefore, to stimulate Reverse Logistics, certain alternatives were proposed, such as: defining reverse channel objectives, waste characterization, and implementing mediation and information systems to monitor reverse channel operations. The relevance of this approach lies in promoting sustainability in the construction industry, serving as an example, especially for new research seeking other means to manage RL for CDW.

2.2 Management of C&D Waste

Construction and Demolition Waste (CDW) can be defined as a set of materials that may or may not contain properties harmful to human health and the environment, such as asphalt, steel, tiles, batteries, concrete, and nuclear waste (ELLY et al., 2018; KABIRIFAR et al., 2020; PRAIRIE VILLAGE, 1998). The management of Construction and Demolition Waste (CDW) is a crucial issue today, given the continuous growth of construction activities and their environmental implications. The industrial waste refers to leftovers generated from constructions, renovations, and/or demolitions carried out in the construction sector that do
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According to ABRECON (2020), Brazil produces approximately 100 million tons of CDW annually. This large quantity can be directly related to the size of the population and the economy of the country. Thus, the main global generators of CDW are countries with large economies, and despite being mostly developed countries, there is no efficient management for these materials, which are often directed to landfills and disposed of inadequately, causing widespread environmental impacts (KABIRIFAR et al., 2020; YACTAYO-ORMENO et al., 2023).

In light of this, CDW management has been driven by the possibility of recycling almost 90% of these materials, aiming to reduce waste production and environmental risks, and to dispose of those that pose no risk to society properly and quickly (HYVÄRINEN et al., 2020; ZHAO et al., 2022). However, the implementation of effective CDW management presents certain barriers due to divergent stakeholder concerns, among which stand out the group composed of authorities prioritizing the reduction of waste quantity in landfills and another group formed by construction stakeholders focusing on waste economy and revenue, not giving due attention to the environmental impacts for which CDW is responsible (ELSHABOURY et al., 2022).

The responsibility for the proper management of these materials falls on both the government and the private sector, as they are responsible for constructions (CUNHA et al., 2023). Thus, public policies that incentivize and regulate the reuse of construction and demolition waste must be created, developing models that are more environmentally compatible (LIMA et al., 2024).

CDW represents a significant portion of urban solid waste, constituting a global challenge. Therefore, an effective approach to CDW management encompasses everything from minimizing resource use, reusing and recycling products, to proper final disposal, emphasizing the importance of integrated strategies and public policies to enhance the management of these wastes, highlighting the need for sustainable practices to mitigate their impacts (SANTOS & MARCHESINI, 2018).

Customers play an essential role in waste management in the construction industry. By preferring more sustainable practices, they influence organizations to adopt strategies that meet consumer expectations and are more efficient, stimulating transparent communication among stakeholders (KABIRIFAR et al., 2020). However, one of the biggest challenges is the cost of implementing efficient CDW management, given that the investment is very high and

(POLÍTICA NACIONAL DE RESÍDUOS SÓLIDOS LEI N. 12.305, 2010)
involves various factors (YUAN et al., 2016). This hinders better management since many companies are not interested in dealing with these costs, preferring to continue generating and improperly disposing of these wastes.

Considering the vast array of concepts related to the subject at hand, the methodology presented in the subsequent section aims to study the barriers to the implementation of RL and CDW management.

Methodological Procedures

This research was conducted following four main steps: a) literature review, b) definition of search strings, and c) bibliometric analysis using VOSviewer software.

Initially, a literature review was conducted, with a focus on critically analyzing Reverse Logistics and Construction and Demolition Waste, aiming to establish a theoretical foundation for the analyses related to the addressed topic. The outcome of this stage is presented in section two of this article.

In the second stage, articles were searched using the following strings: 1) "Construction and Demolition Waste" OR "Demolition Waste" OR "C&D Waste" OR "Building Waste" OR "Demolition Debris"; 2) "Reverse Logistic" OR "Reverse Supply Chain"; 3) "C&D Waste" OR "Barrier" OR "Difficult*" OR "Obstacle*" OR "Limitation*" OR "Impediment" as topics in the WEB of Science database. To obtain more specific results, a combination of these words was made, resulting in the final string used for data search: "Construction and Demolition Waste Reverse Logistics Challenges" OR "Demolition Waste Reverse Logistics Barrier". The search was conducted on October 25, 2023, considering a period of 10 years (2012-2022), resulting in 45 documents.

Subsequently, considering the results obtained, the articles exported in .txt format were analyzed using VOSviewer software to perform bibliometric analyses of the data, characterizing the third stage of this research. In the program, a criterion of at least 3 co-occurrences per keyword was used.

Finally, after an initial screening of the data in VOSviewer to list words to be considered in the analysis, a "Thesaurus" file was created to group similar terms. Among the grouped terms, "Construction" and "Demolition Waste" were grouped with the term "Construction and Demolition Waste"; "End-of-Life" and "Life" were grouped with "Life-Cycle"; "Construction-Industry" was grouped with "Construction Industry"; and "Demolition Waste Management", "Management" were grouped with "Waste Management", and
"systematic literature review" was removed. With this screening, 36 keywords were kept for analysis.

Using the "Thesaurus" file, a series of analyses were conducted, making use of the options provided by the software, such as: 1) Co-occurrence network of publications; 2) Co-occurrence network based on publication averages; 3) Co-occurrence network considering term density analysis; 4) Country network.

In the last analysis, a "Thesaurus" file was again used to rename the country "China," which was also listed as "peoples r china." After the modification, using the new "Thesaurus" file and including the criterion of at least 1 document and 1 citation per country, a graph was generated for analysis. It was observed that the countries with the highest co-authorship in this context are: Australia, England, China, the Netherlands, and Belgium.

The analysis of the maps produced by VOSviewer revealed a series of important themes addressing the intersection of reverse logistics with construction and demolition waste, providing a more comprehensive and in-depth view of this specific field. These findings are presented in detail in the Results and Associated Discussions section.

**Results and Associated Discussions**

This section consists of four distinct subsections. The first one explores the results of bibliometric mapping, along with the discussions that emerged from this process. The following subsection provides a detailed analysis of the comprehensive landscape of Reverse Logistics in the context of Construction and Demolition Waste, highlighting its interconnections. Next, the third subsection focuses on the theoretical and practical implications arising from the previous discussions. Finally, the fourth subsection highlights perspectives for future research on the subject matter.

**4.1 Bibliometric Analysis**

As mentioned in the methodological stage, 45 articles were used for bibliometric analysis. The documents were distributed across 20 journals. The data presented in Figure 1 reveal that the "Journal of Cleaner Production" stood out with 10 documents, followed by the "Waste Management & Research" and "Sustainability" journals, with 7 and 6 documents, respectively. Additionally, the journals "Sustainable Production and Consumption" and "Engineering Construction and Architectural Management" recorded 3 documents each, while...
"Waste Management" presented 2 documents. The remaining journals shown in the graph had only one publication each.

**Figure 1**

*Number of documents per journal*

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As mentioned earlier, the analysis considered a minimum occurrence of 3 for the terms. Initially, a co-occurrence network of words from the sample was created, and the result was generated by the VOSviewer software, as presented in figure 2. As expected, the terms "reverse logistics," "construction and demolition waste," "barriers," and "waste management" emerged as the most important central terms and were connected to all other words in the figure. Figure 2 reveals the presence of four distinct clusters of themes, whose understanding is facilitated by observing the heat map in figure 3.
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**Figure 2**

*Co-occurrence Network*

Source: Data generated by VOSviewer

**Figure 3**

*Co-occurrence Network considering term density analysis*

Source: Data generated by VOSviewer
4.2 Associated Debates

The thermal map presents a clustering of four sets of words characterized in separate clusters by the colors green, red, blue, and yellow. The green cluster contains the words "construction and demolition waste," "implementation," "barriers," "industry," "performance," "system," "model," "uncertainty," "minimization," "supply chain," and "recycling." In the current context, (MARTINS & RIBEIRO, 2021) state that ecological collapse has a strong potential to trigger a global conflict; thus, there is a greater concern in establishing actions to minimize the effects generated by improper waste disposal, as advocated by (ZHAO et al., 2022). Consequently, there is an increase in literary productions addressing the barriers and difficulties present in C&D waste management, simultaneously discussing means to address them using efficient models that facilitate this management.

The red cluster "reverse logistics" is associated with terms such as "design," "product," "buildings," "reuse," "supply chain management," "built environment," "construction industry," "recovery," "waste," "strategies," and "framework." The correlation between the words suggests an interdependence between the concepts of reverse logistics and construction and demolition waste, which stand out in the context of the construction industry and the built environment. This clustering confirms the conclusions of authors such as Pan et al. (2020), who attest that sustainable management for construction and demolition waste has a significant and beneficial effect on promoting the reuse rate of these materials.

Thus, it reflects the effectiveness of implementing reverse logistics in the construction industry, from the initial stages - such as project conception and production - to the disposal and recycling of these waste materials. This comprehensive approach highlights the breadth and effectiveness of reverse logistics as a broad strategy to optimize waste management in the construction industry, aiming not only to reduce environmental impacts but also to maximize material reuse.

The authors Freitas & Mezech (2021), highlight that the implementation of policies aimed at recycling construction waste is essential for society's sustainability, as it is intrinsically linked to reducing the environmental impact caused by the sector and the costs associated with managing this waste. From this perspective, it is understood that by adopting reverse logistics for construction and demolition waste (CDW) and encouraging material reuse, it not only promotes the reduction of environmental impacts but also provides an adequate space for the adoption of sustainable and economically viable practices. This approach, besides reflecting environmental benefits, also resonates as an economically
efficient alternative, in line with promoting sustainability in the realm of building waste management.

Next, in the blue cluster, with the words "generation," "optimization," "BIM," "challenges," "circular economy," "decision-making," "drivers," and "structural-steel reuse." Within the current scenario of construction and demolition waste management, the application of strategies aimed at recycling and waste minimization, especially steel, emerges as a resource to address the challenges inherent in the barriers represented by uncertainty and technological constraints, which in turn hinder managers' decision-making.

According to Spadotto & Nagalli (2022), the development of innovative models and systems, such as the Deconstruction Project (PpD), is a method used to reuse and recycle construction materials and components. This process significantly contributes to promoting more sustainable practices in waste management and provides greater effectiveness and efficiency to initiatives implemented in the sector.

Finally, the yellow cluster, containing the words "economy" and "steel reuse," reinforces the conclusions presented in the blue cluster, highlighting the importance of steel recycling for the global economy. The reuse of steel not only provides direct economic benefits but also helps reduce the environmental impacts associated with production. Given that steel production is one of the most energy-consuming activities and emits greenhouse gases, the introduction of recycling practices for this material is not only beneficial for environmental sustainability but also for sustainable economic growth (OLIVEIRA et al., 2015).

Next, Figure 4 presents the average publication date of documents in which the terms presented in Figure 2 appear. Thus, it is possible to analyze that the theme of Reverse Logistics and Construction and Demolition Waste Management has become the focus of research involving design, recovery, supply chain management, and product. Subsequently, other research also began to relate to C&D waste LR, addressing industry, construction industry, recycling, structure, buildings, reuse, uncertainty. Finally, the last analysis revealed that in the years 2021 and 2022, terms such as economy, circular economy, optimization, steel reuse, minimization, strategies, supply chain, performance, model, implementation, waste management, decision-making, generation, drivers, system, built environment, structural steel reuse, barriers, and challenges have become objects of focus.
In the final analysis, figure 5 presents the co-authorship network concerning the countries of the analyzed documents. Australia, England, China, Belgium, and the Netherlands stand out as central countries with the highest number of publications on the subject in question.
Figure 5
Co-authorship by countries

Source: Data generated by VOSviewer

4.3 Implications for Theory and Practice

The study in question presents significant contributions from both theoretical and practical perspectives. From a theoretical standpoint, the research provides a broad understanding of the intersection between reverse logistics and construction and demolition waste, allowing, through the results of the scientific production mapping, an in-depth comprehension of the concepts related to the integration of these areas. By identifying the research trends outlined in this study, it is possible to use them as insights for subsequent research, enabling other researchers to pursue their investigations with greater precision.

From a practical standpoint, bibliometric analysis provides valuable insights that can directly influence management practice. By understanding the trends and patterns of research in Reverse Logistics of Construction and Demolition Waste, managers can make more informed and evidence-based decisions. These conclusions can guide managers in resource allocation, development of effective waste management strategies, and identification of opportunities for operational improvements. Thus, bibliometric analysis not only enriches academic knowledge but also has the potential to directly influence practices and decisions of managers in this specific area.
Conclusions

The aim of the present study was to map the scientific production on reverse logistics and the convergence of construction and demolition waste, with the objective of identifying thematic patterns and related word associations regarding the subject. Through data analysis performed with the VOSviewer software, it was possible to obtain results for the bibliometric mapping of the most important keywords related to the subject, confirming the achievement of the main objective of the study. The process identified four groups of terms related to the theme, from which valuable conclusions could be drawn for the study.

In the red cluster, the main issue can be observed in the initial phases of the construction industry, including design and production processes. The challenges of adopting sustainable practices for these materials are a reality that must be faced through a project that includes all stages of the construction process and seeks strategies to reduce losses and mitigate damages.

The Green Cluster highlights the growing concern about barriers to recycling C&D waste and links this issue to the development and implementation of models and systems that reduce process uncertainty. This approach enhances the performance of this substance.

The set of terms in the blue cluster deals with the use of two-dimensional and three-dimensional representations of building properties, known as BIM (Building Information Modelling). These presentations gather important information related to project implementation, execution, and maintenance, optimizing decision-making and, above all, reducing the challenges associated with implementing reverse logistics in construction and demolition waste. This is because BIM offers better predictability of the future consequences of construction and promotes sustainability.

Finally, the yellow cluster addresses the economic linkage between recycling and recovery of steel used in construction because the production of this material causes environmental and socio-economic effects. Thus, recycling this material reduces the damage caused by its production.

With the results of the bibliometric analysis, there has been a noticeable growth in scientific production on the topic in recent years. The research findings show that reverse logistics of C&D waste is an important issue for society as a whole, which can help reduce the environmental impact of construction. However, challenges such as inadequate collection infrastructure, transportation, and lack of interest from construction industry stakeholders in implementing reverse logistics due to high costs need to be addressed.
The research results can be used to support decision-making by stakeholders such as companies, governments, and non-governmental organizations to promote effective implementation of reverse logistics of C&D waste. Furthermore, the study contributes to advancing specialized knowledge by providing a comprehensive overview of the literature and identifying future research opportunities.

A promising area of research is the exploration of the latest technologies such as machine learning and remote sensing applications to improve the collection, sorting, and recycling processes of these materials. By exploring the integration of these technologies into existing waste management systems, significant improvements in operational efficiency and waste reduction are expected. Additionally, it is important to thoroughly analyze the impact of public-private partnerships in promoting reverse logistics of construction and demolition waste.

Well-formulated case studies and in-depth analyses of critical success factors for these partnerships can provide valuable insights for designing more effective collaborative strategies in the future. A better understanding of the dynamics and key elements of successful collaboration can lead to the development of stronger and more sustainable business models that can address the complex challenges of waste management in this constantly evolving industry.

References


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