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Review

Forward and reverse logistics for circular economy in construction: A systematic literature review

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A R T I C L E I N F O

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A B S T R A C T

To close the loop for the circular economy (CE) transition in the construction industry, forward logistics (FL) and reverse logistics (RL), as enabling operations for CE, are important topics to be addressed. However, current research mainly focuses on either FL or RL, with a lack of synthesis that presents an overview of the bi-directional logistics system integrating FL and RL and related mechanisms to close the loop. This review, therefore, explores the current cases of FL and RL in the construction arena through a systematic literature review (SLR) process. A review framework to synthesize and compare both FL and RL operations in various phases of the construction project life cycle (CPLC) has been established for this purpose. The phases include - in FL: design, manufacturing, construction, and operations; and in RL: deconstruction, product reuse, waste distribution, and material reprocessing. The review concludes that while similar methods and CE strategies are used in FL and RL, RL operations require more integration between supply chain actors to close the loop for CE in construction. The findings also indicate that more lateral integration between FL and RL phases beyond the life cycle and industrial boundaries is necessary for CE-driven construction projects, instead of only direct vertical integration with up- and down-stream partners. This review proposes a new conceptual framework of circular logistics integration (CLI) that consists of channel creation, network integration, and inventory management to guide and inspire future research in tackling the systematic barriers that hinder materials and resource flow from RL to FL in construction life cycles.

1. Introduction

The construction industry is recognized as one of the biggest consumers of energy and resources, as well as a significant source of carbon emissions globally (Bajželj et al., 2013). The circular economy (CE) transition has been a trending topic for the construction industry, which envisions a new growth model that minimizes environmental and material footprint while still pursuing economic prosperity (Joensuu et al., 2020). CE is believed to be a promising alternative to the traditional 'take, make, disposal' model to treat material and resource flows in production (González-Sánchez et al., 2020). Both the academic and practical domains took CE as a more constructive and pragmatic pathway to the already much discussed sustainable development (Kirchherr et al., 2017). The CE development model seeks to sustain the value of materials and products at the highest level possible throughout the whole life cycle, by incorporating a sequence of R strategies, i.e. recover, recycle, repurpose, remanufacture, refurbish, repair, re-use, reduce, rethink, refuse (Bocken et al., 2017; Campbell-Johnston et al., 2020; Joensuu et al., 2020; Morseletto, 2020).

One of the most ambitious goals of CE is "closing the loop" in material and resource flows throughout product life cycles (Bocken et al., 2017; Kirchherr et al., 2017), which evokes the already well-established term "closed-loop" in green logistics and green supply chain management (GSCM) (Calmon and Graves, 2017; Cannella et al., 2016). Thus, CE and logistics management are closely interrelated, as argued by several authors (e.g. Charef et al., 2021; Mojumder and Singh, 2021), since logistics is often a key barrier and bottleneck in transforming the traditional construction industry towards CE. Seroka-Stolka and Ociepa-Kubicka (2019) also argued that developing greener logistics systems is an inherent requisite and valuable tool to realize CE.

Logistics, in its narrowest sense, describes the process of moving goods from the point of origin to customers. This narrow conceptualization has since been expanded to include planning, executing, and controlling the efficient flow of products, services, and information through an economic system (Christopher, 2016, p. 2; Lummus et al., 2001). One important concept of logistics in CE is the bi-directional framework that consists of forward logistics (FL) and reverse logistics

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Glossary

SLR	Systematic Literature Review
CE	Circular Economy
FL	Forward Logistics
RL	Reverse Logistics
CPLC	Construction Project Life Cycle
(G)SCM	(Green) Supply Chain Management
LCA	Life Cycle Analysis
CLI	Circular Logistics Integration

(RL). RL is a term that has evolved since the 1980s in the retail and manufacturing industry, which has been defined by Rogers and Tibben-Lembke (2001, p. 130) as "The process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal". RL is recognized as an important counterpart of FL that constitutes a closed-loop logistics system in CE (Seroka-Stolka, and Ociepa-Kubicka, 2019). By definition, the FL and RL combination aligns with CE in the goal to minimize the leak of resources from the system by diverting waste flows back to the original point (Bernon et al., 2018; Bocken et al., 2017), this notion of flowing backward also strongly coincides with the 'butterfly diagram' by Ellen MacArthur Foundation (2013).

However, in the current discussion of CE in construction, there are two strands of literature that do not overlap much with each other, with literature on FL focusing on green supply chain management (GSCM) in construction project delivery until the operational phase, and studies on RL attending to deconstruction and waste management in the post-end-of-use phase (Table 1). This leads to a rather segmented and inconsistent discussion about logistics in construction. Previous reviews on FL often considered logistics as part of the bigger concept of "construction supply chain management", which is often oriented to construction project life cycle (CPLC) phases. For example, Badi and Murtagh (2019) and Chen et al. (2022) synthesized CE strategies in different phases of the construction supply chain and suggested that logistics optimization could help reduce the environmental impact of construction projects. In contrast, studies that tackled RL in construction considered RL more as an improved practice of waste management. For example, Hosseini et al. (2015), Pushpamali et al. (2019), and Wijewickrama et al. (2021a) reviewed different aspects of RL in the construction context, highlighting the coordination between demolition contractors, waste collectors, and municipal waste treatment entities, etc. Despite growing attention on both FL and RL in CE, the juxtaposition of FL and RL has been seldom addressed. To date, there is no review study in the construction context that presents a holistic overview of FL/RL as a pair of distinct, yet inter-dependent operations.

Table 1
Literature reviews on logistics for circular economy in the construction industry.

Author	Description	FL or RL focused	Focused Topic
Hosseini et al. (2015)	Synthesized the research trends in RL, while also identifying the advantages and barriers.	RL	Deconstruction and material recovery
Badi and Murtagh (2019)	Synthesized different operations in GSCM in construction.	FL, partially RL	Supply chain actors and inter-firm perspectives
Chen et al. (2022)	Summarized which CE strategies are adopted in construction supply chain management, and what drivers support the strategies.	FL	Construction phases, manufacturing, and sociotechnical drivers
Wijewickrama et al. (2021a)	Identified barriers to information sharing by RL actors.	RL	Information sharing and waste management
Pushpamali et al. (2019)	Compared RL studies in construction and other industries.	RL	Waste management

For the CE transition to take place in the construction industry, a more synthesized framework that aligns FL and RL operations in more comparative positions is highly desired for a few reasons. First, both FL and RL have been given much higher priority in CE compared to the linear economy as CE business models are more sensitive to financial and environmental costs. Therefore, logistics processes such as transport and delivery matter more in the calculation of life cycle cost and waste in CE compared to traditional construction projects (Charef et al., 2021; Ghisellini et al., 2018). Second, CE has also driven the construction industry to adopt new business model innovations from other industries. For example, product-service systems of manufactured products (Guerra et al., 2021). Such business cases require the construction industry to think beyond the traditional project delivery processes and get involved in the FL and RL processes together with manufacturers and service providers. Third, CE requires the construction industry to track material and resource flows throughout the extremely long life cycle of buildings and facilities, normally beyond the systematic boundaries of the construction projects. This means that FL and RL must be seen no more as only temporary events, but as planned and controlled operations in an integrated system (Guerra et al., 2021; Munaro and Tavares, 2021; Wibowo et al., 2022).

This review, therefore, explores the current cases of FL and RL operations in the construction realm by aligning the review frameworks in both forward and reverse directions, to synthesize, elaborate, and clarify the different aspects of FL and RL, furthermore, to create a new conceptual framework to analyze the relationship between FL and RL operations and potentially support the improvement and integration of FL and RL operations in achieving more substantial CE goals in the construction context. The systematic review process is designed to answer the following research questions (RQs). RQ1: What is the relationship between FL and RL operations in the CPLC under CE strategies? RQ2: What are the (potential) mechanisms of integration of FL and RL?

This review critically analyzes evidence in CE-related literature that tackled specific FL or RL operations in the CPLC. An analytical framework based on FL and RL phases in the holistic CPLC is used to compare and understand the relationship between FL and RL operations in CE-driven construction projects and related organizations. For RQ1, the literature is categorized based on which FL or RL phase the studied case mainly tackles, as well as which method and CE strategies are involved in the cases. Then the corresponding phases and operations in FL and RL are compared to analyze the similarities and differences regarding the FL and RL approaches to CE. For RQ2, the integration mechanisms in logistics operations are identified, by observing how logistics issues are coordinated internally, between upstream/downstream supply chain actors, or across different industries for closing the resource loops in CE. By understanding the relationships and integration mechanisms, the framework is also intended to guide construction organizations and local authorities with a set of methods to possibly improve the FL and RL operations for more collective CE goals.

The rest of the paper is structured as in the following sections: Section 2 provides a narrative of the current understanding of the FL and RL operations in CPLC under the CE transition, and the scope this review is structured within. This background and scope definition helps to define an analysis framework that is followed for the analysis. Section 3 outlines the systematic review method. Section 4 presents the results of the review, and categorized CE-driven logistics approaches by different FL and RL phases. Section 5 constructs a synthesized framework to explore the relationship between FL and RL as well as the potential integration mechanisms and discusses the future research aspects and questions derived from the findings. And finally, section 6 concludes the review and implicates future work.

2. The scope and analysis framework

2.1. CE in construction and its implications for logistics

The construction industry is quickly building its awareness of CE in recent years, with many pilot cases to test new products and business models. For example, the initiative of design for deconstruction/disassembly attempts to initiate the circular life cycle from the beginning of building projects with the end-of-use scenarios already in plan (Akinade et al., 2020; Marzouk and Elmaraghy, 2021). In business innovation, several cases demonstrated the product as a service model for building elements, challenging the current models of ownership and risk transfer to facilitate the reuse and recovery of products by service providers (Azcarate-Aguerre et al., 2018; Fargnoli et al., 2019). A major challenge lies in the existing stock of the built environment that is inherited from the linear economy; the European BAMB – building as material bank project is amongst the set of initiatives that endorsed the potential of implementing material passports and information tracking for the life cycle management of existing building components, those trials are in the infancy of developing generalized applications (Copeland and Bilec, 2020; Honic et al., 2021; Munaro and Tavares, 2021; Sanchez et al., 2021).

In general, the CE goals are still far from reach for the construction industry, as construction and demolition waste alone still leads to 46% of total waste generation globally (Gálvez-Martos et al., 2018). Despite many pilot cases, the lack of incentives transiting current linear supply chains into circular ones is still hindering the achievement of CE resource loops. Several studies have identified logistics as a key barrier to CE in the construction industry (Charef et al., 2021; Mojumder and Singh, 2021). Especially, there is a lack of holistic approaches in the construction supply chain to coordinate logistics operations by different actors (Adams et al., 2017). There also still exist information and organizational barriers between different phases of construction, particularly at the moment of end-of-use which separates FL and RL (Joensuu et al., 2020; Wijewickrama et al., 2021b). Ultimately, the CE transition still requires radical changes to the traditional materials and waste flows of the construction industry, which requires more innovative logistics systems that work efficiently in both forward and reverse directions.

Although logistics has been used almost interchangeably with supply chain management (SCM) by many studies, we argue that it is still important to distinguish the term from SCM as logistics management tackles more practical aspects that determine the movement of material and product flows in a supply chain system (Lummus et al., 2001). The broadening and redefining of SCM has led to new research foci that tend to focus much on general business performances but may lose sight of the specific logistics operations performed by different organizational roles to determine the actual material flows, such as sellers, distributers, warehouses, logistics service providers, etc.

In the construction context, there also lacks a common definition of logistics and its two embranchments: FL and RL. To be able to further explore FL and RL operations as part of the CE transition in construction, we propose to provide the definition based on previous various definitions from the construction and other industries (Christopher, 2016, p. 2; Hosseini et al., 2015; Lummus et al., 2001; Rogers and Tibben-Lembke, 2001). In the context of this research, logistics is defined as the process of planning, executing, and controlling efficient material and product flows, as well as relevant information through the CPLC, in both directions: FL, from the point of material extraction to the in-use phase of construction projects, and RL, from the end-of-use of projects or products to the point of resource value recapturing or proper disposal.

2.2. FL and RL phases in the CE-driven CPLC

Most studies that analyzed the supply chain and logistics in the construction industry referred to the CPLC framework defined with five phases: design, manufacturing, construction, operation, and end-of-use phases (Benachio et al., 2019; Chen et al., 2022; Wijewickrama et al., 2021b). Although this framework is understandable for construction professionals, it is FL-centric and missing the post-end-of-use operations. To make the adaptation to the CE principle of 'closing the loop', the end-of-use phase shall not only be seen as the end-game of FL, but also as the beginning of RL. Ideally, a framework of logistics in CE should consist of phases in RL operations that correspond to FL. Nevertheless, RL is a relatively new concept to the construction industry, and the phases in the post-end-of-use phases are not clearly defined.

Previous studies from the manufacturing and retail sectors have identified several key operations in RL: source reduction, product returns, waste management, remanufacturing, and material substitution (Olorunniwo and Li, 2010; Rogers and Tibben-Lembke, 2001). In construction literature, studies by Wijewickrama et al. (2021b) and Chileshe et al. (2019) defined the phases in the RL network of the construction industry according to the sequence of four locations: collection points, salvaging yards, reprocessing centers, and secondary markets. Based on the frameworks from the previous studies and requirements of CE strategies, we adapted the terms to create a framework of five phases for the post-end-of-use RL phases: deconstruction, product reuse, waste distribution, material reprocessing, and loop regeneration. The result of the new definition of phases in FL and RL is thereby presented in Table 2, which coded the phases in the forward direction as F1 to F4 and the reverse direction as R1 to R4. The above-mentioned fifth phase of FL and RL, namely the end-of-use phase and loop regeneration are recognized as transitional phases between FL/RL life cycle boundaries and are thus not used as codes for the literature review to reduce confusion.

3. Review process

To select the relevant literature for the research questions, understand the body of literature in more detail, and critically evaluate them,

Table 2
Coding of FL and RL phases and implications for CE.

Code	Phases	Other associated terms in CE	Sources
FL			
F1	Design	Sustainable design, project planning, and decision making, green procurement	Chen et al. (2022); Geldermans et al. (2019)
F2	Manufacturing	Parts production, off-site construction	Benachio et al. (2019); Chen et al. (2022)
F3	Construction	On-site waste reduction, green construction logistics	Benachio et al. (2019); Chen et al. (2022)
F4	Operations	Predictive maintenance, service life planning, integrated logistics support	Benachio et al. (2019); Chen et al. (2022)
RL			
R1	Deconstruction	Deconstruction planning, on-site waste collection	Chileshe et al. (2019); van den Berg et al. (2020a)
R2	Product reuse	Product returns, reusing reclaimed building components, repair, refurbishing	Bertin et al. (2019); van den Berg et al. (2020a)
R3	Waste distribution	Waste management, sorting, and segregation, waste transportation, salvage yards	Chileshe et al. (2019); Wijewickrama et al. (2021b)
R4	Material reprocessing	Remanufacturing, recycling of building materials, industrial symbiosis	Chileshe et al. (2019); Wijewickrama et al. (2021b)

the Systematic Literature Review (SLR) approach has been chosen. The SLR is mainly based on the PRISMA method (Pushpamali et al., 2019). The search queries were determined together with experts in the field/co-researchers/co-authors. The literature selection process is illustrated in Fig. 1. The initial search retrieved journal publications from two databases: Scopus and Web of Science (backed to June 13th, 2022). We referred to previous SLRs in the field to consider the two databases as a comprehensive source of mature scientific results (journal papers) (Chen et al., 2022; Wijewickrama et al., 2021a). Three sets of keywords were defined. The first set of keywords only has one word: logistic*. The second keyword set assures more general perspectives of CE are covered, including several R strategies (reus*, reduc*, recycle*, remanufacture*, etc.) that are commonly used by construction scholars (e.g. Chen et al., 2022; Gebhardt et al., 2021; Hossain et al., 2020). Also, by expanding the third keyword set to different built environment-related keywords, more industrial insights, and building project cases were included. The * represents wildcard entries regardless of tense or plural form. Given the longstanding interest in the concept of logistics, the search was not restricted to any timeframe.

The search conducted on search engines returned in total more than 4000 journal articles after removing the duplicates. Other sources such as conferences are not included to improve the reliability of the cases for comparison. After screening the titles and abstract, articles clearly not related to the construction were excluded. This selection procedure also did not include other literature reviews, only original academic studies and practical cases in the English language were analyzed. It is worth noting that a few economic modeling studies which used ‘logistic regression’ as part of the method, not in solving logistics and circularity-related issues, were also excluded. Finally, 205 papers were left after this round of screening.

In the following stage, the first author screened the full text of the papers and excluded more entries based on their relevance to CE principles. First, a few papers that incorporated purely technical solutions from material science perspectives, which did not contain logistics management insights, were excluded. Studies that only tackle logistics from a linear economy perspective, although expressing some interest in time and cost reduction in construction projects, were also taken out due to the lack of ecological and material life cycle concerns. Likewise, one article that focused on the logistics warehouses but not on the logistics operation in the construction industry was also not included (Son et al., 2021). Afterward, we screened the articles based on the review framework of different FL and RL phases (Table 2), articles that do not tackle specific CPLC operations, but only investigate the general drivers and barriers to CE and FL/RL were not selected for the SLR process, but used as back-up sources for the discussion of concepts. And finally, the authors carried out a snowball sampling with other experts to ensure more comprehensive data collection with the consideration of more up-to-date CE concepts and practices, which added 5 more entries to the pool of literature. The screening process has left a total of 81 articles for content analysis.

The 81 publications were first summarized to the main research topics and logistics operations, the main methods used, and the important findings in regard to CE and logistics operations. Then, the sources were categorized and coded in the dimension of CPLC phases. More dimensions of coding have been applied to gather review data to answer the two RQs, including the CE strategies applied, the indication of integration mechanisms with other phases/actors, and whether the integration is already established supply chain or only presented as pilot cases. The coding process has been partially inspired by the work of Chen et al. (2022) which utilizes a phase-specific framework to understand CPLC; and the SLR by Gebhardt et al. (2021), which elaborates integration and collaborative mechanisms.

4. Results

4.1. Overview of the literature studied

The distribution of selected literature by year and source of journals

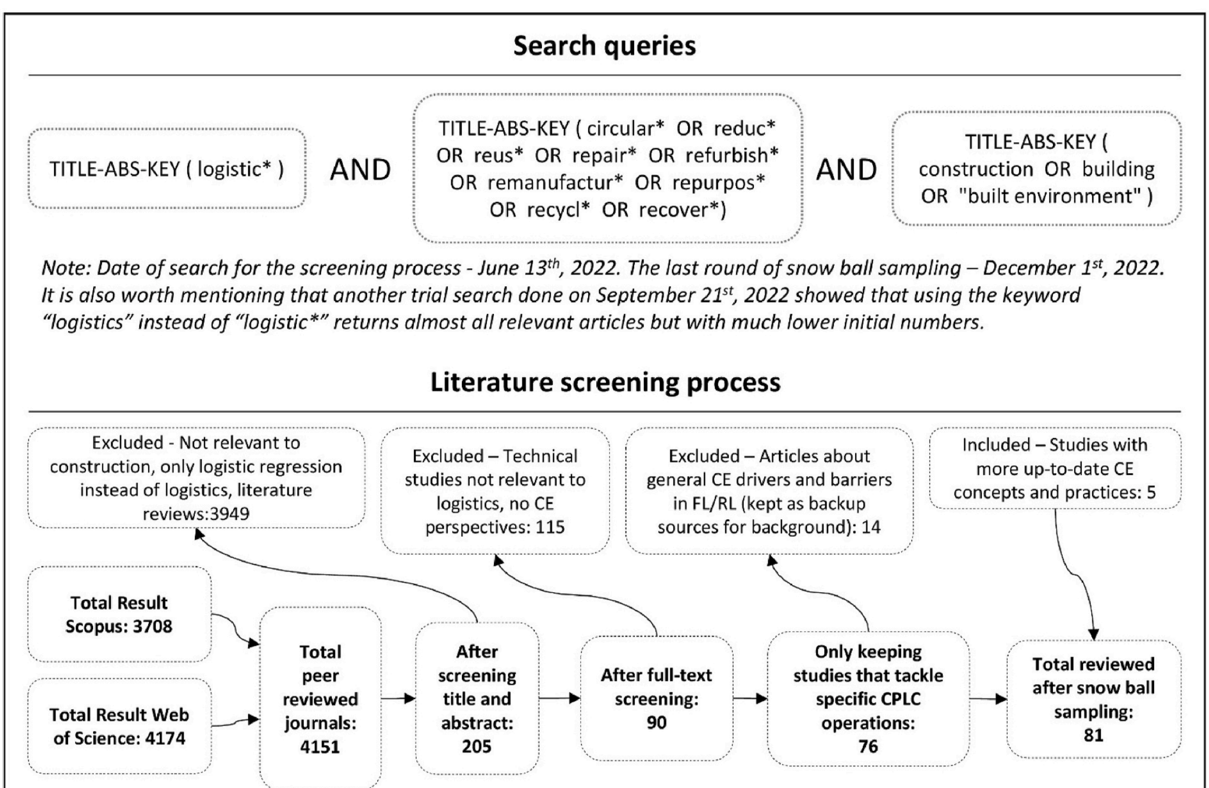

Fig. 1. Literature selection process.

are presented in Figs. 2 and 3.

4.2. FL operations

Table 3 presents the summary of the CE-driven logistics study approaches in FL phases.

4.2.1. Design

- LCA-based design for logistics planning

Compared to some previous studies that included the biggest portion of literature in the design phase (Chen et al., 2022), this review finds that in the domain of logistics, only a few pieces of literature have explicitly mentioned the relationship between product/building design and logistics, all of which have been based on an LCA informed approach. Several cases have focused on the selection of specific construction methods or manufacturing options (e.g., timber and prefab components) to potentially improve logistics performance in construction, such as reducing transportation and overall life cycle environmental impact of logistics operations (Chen et al., 2022; El-Aghoury et al., 2021; Geldermans et al., 2019; Liu et al., 2021).

- Green procurement by construction organizations

Adjacent to building and product design, another important CE-relevant operation in the early phase of construction projects is procurement. In FL, this operation includes the key decision-making procedures by construction organizations to manage the supply channels of materials. One empirical study by Ajayi et al. (2017a,b) highlighted the importance of procurement in construction waste reduction and identified the key strategies employed by organizations. This concept is further solidified by several other studies that tackled more specific building materials such as steel and timber (El-Aghoury et al., 2021; Kar and Jha, 2020; Zhu et al., 2021; Zuo et al., 2009). These studies took various field studies or modeling approaches to prove the influence of supply channel selection and supplier management from the demand side upon the life-cycle performance and waste reduction of construction projects.

4.2.2. Manufacturing: logistics management in offsite construction

Another key phase in FL is the manufacturing phase. In this part, almost all reviewed papers focus on logistic improvements on off-site/modular construction. This is possibly due to the search being limited to the construction industry, which did not reveal strong integration with other manufacturers outside the prefabrication discussion. It is interesting to observe that by engaging industrialized construction methods, research in the construction industry can tackle logistics-related topics from the manufacturer's perspective by using supply chain modeling techniques. For example, Ma et al. (2021) used a hierarchical fuzzy comprehensive evaluation method to test the possibility of process improvement in prefabrication to reduce waste, emissions, and energy consumption. Li et al. (2017) and Zhai et al. (2020) took modeling methods to evaluate schedule risks and coordinate spatial-temporal hedging, to reduce waste in production networks. Studies by Bataglin et al. (2020) and Li et al. (2018) introduced Lean principles in the supply chain of prefabricated housing production by implementing BIM. Both studies revealed a growing concern about more efficient and green logistics operations in the delivery of pre-fabricated building projects. Lastly, Kothman and Faber (2016) explored the disruption of 3D printing as a new manufacturing technique in the construction supply chain and analyzed its potential influence on logistics such as shortened lead time and reduced material demand.

4.2.3. Construction

- On-site logistics for waste reduction

Traditional construction organizations are interested in waste reduction because it is often associated with cost minimization. The on-site waste reduction could be improved by properly organizing the logistic operations in the delivery of materials and products. A few researchers conducted field studies, interviews, or surveys to determine the key factors influencing on-site waste minimization and environmental impact reduction. They concluded that logistic optimization is among the most important operations (Ajayi et al., 2017a,b; Dixit et al., 2022; Gharehbaghi et al., 2019). One case study by Teizer et al. (2020) demonstrated the possibility of using long-range material tracking with advanced internet of things (IoT) devices to enhance logistic coordination compared to more traditional technologies such as RFID.

- Green urban construction logistics networks

On a bigger scale, the optimization of construction logistics networks could also contribute to green performance such as reducing transportation emissions and facility resources. Studies by Brusselaers et al. (2021) and Sezer and Fredriksson (2021) took actor-centric case studies to explore the complex systems that determine the impact of urban construction logistics, which involved decision-making in multiple dimensions such as site selection and green building certification. Shakantu et al. (2008a,b) evaluated the phenomenon of empty running trucks between construction sites and suggested that emissions could be reduced by combining forward logistic truck rides with waste collection. Another heated discussion is the introduction of construction logistic centers (CLCs) to formulate consolidation points for construction sites in a region, to replace more traditional forms of construction freights that

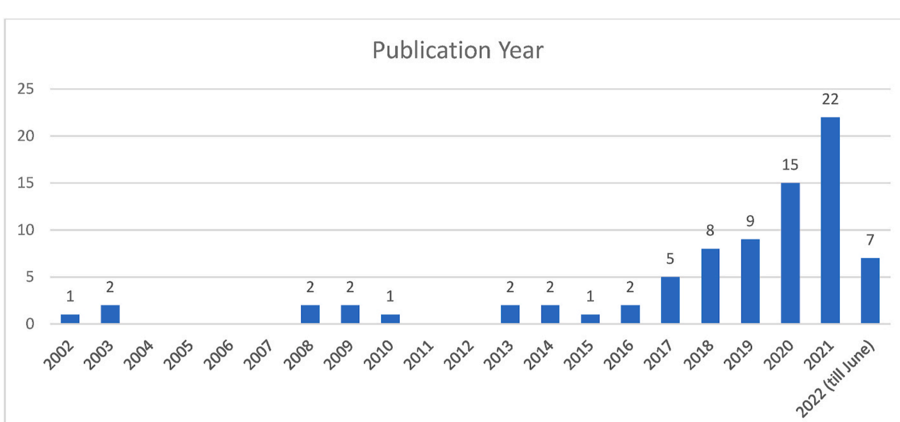

Fig. 2. Distribution of selected articles by year of publication.

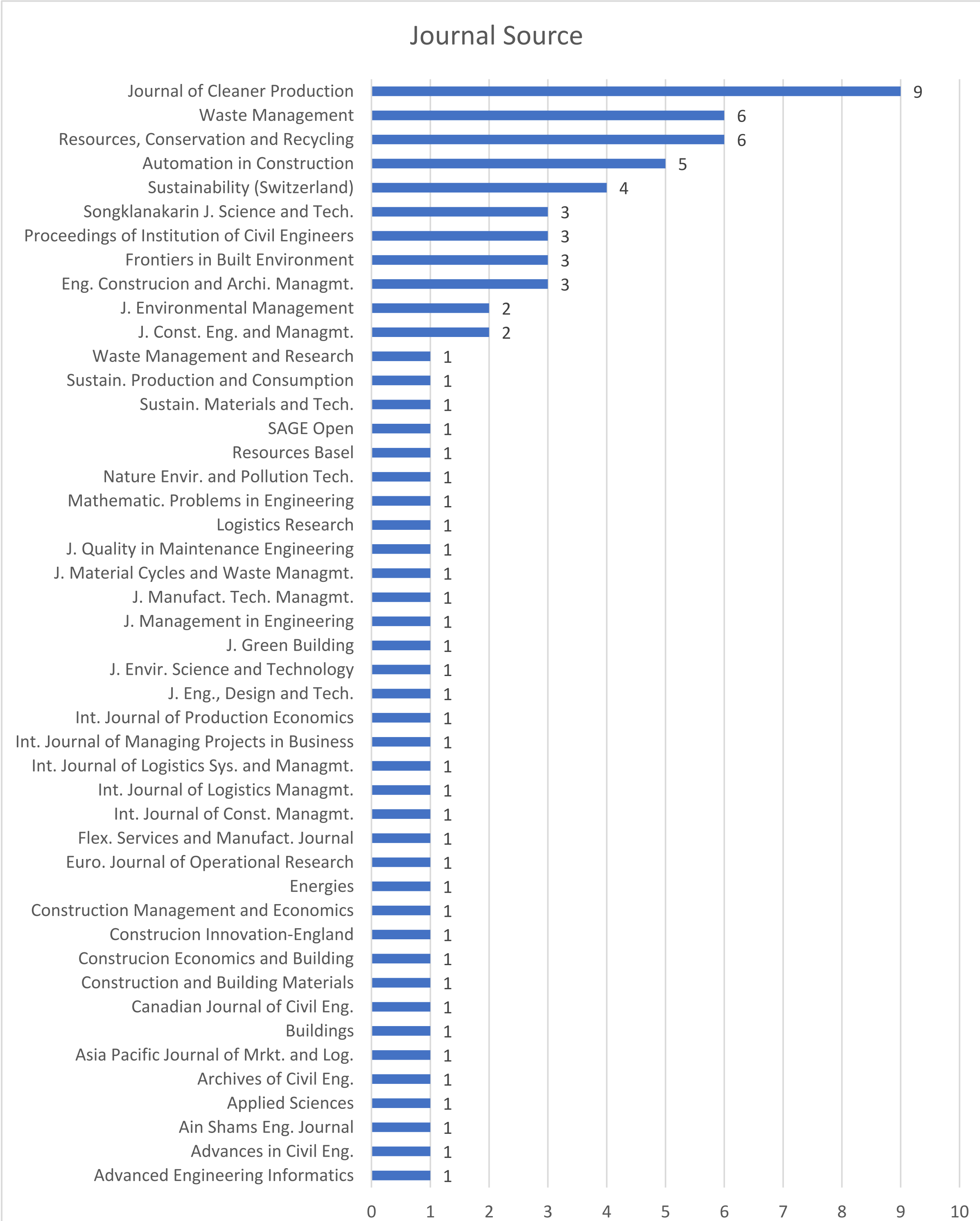

Fig. 3. Distribution of the selected articles by journal source.

run between fragmented spots. Guerlain et al. (2019) conducted case studies that showed the positive influence of CLCs on waste reduction. On the contrary, Janné and Fredriksson (2021) and Nolz (2021) discussed the trade-offs of consolidation and just-in-time (JIT) methods while employing CLCs, highlighting that the balance between the two methods is key to solving inventory routine problems in construction.

4.2.4. *Operations and maintenance: logistics coordination in operations*

In current studies, the in-use phase of the built environment is rather under-examined compared to other construction phases. Few studies have mentioned logistics operations in the maintenance of built assets. Two articles used the term Integrated logistics support (El-Haram and Horner, 2002, 2003), which refers to a management system evolved from the military and the oil industry, that focuses on whole-life-cycle cost minimization and optimization in maintenance strategies.

Table 3
FL phases and CE-driven logistics operations.

Phases of key FL operations	Major CE-driven logistics approaches	References
F1	Life cycle analysis (LCA) based design for logistics planning	Banks et al. (2018); Chen et al. (2022); Geldermans et al. (2019); Liu et al. (2021); Xu et al. (2021)
	Green procurement by construction organizations	Ajayi et al. (2017); El-Aghoury et al. (2021); Kar and Jha (2020); Tsai et al. (2014); Zhu et al. (2021); Zuo et al. (2009)
F2	Logistics management in off-site construction	Almashaqbeh and El-Rayes (2021); Bataglin et al. (2020); Kothman and Faber (2016); Li et al. (2017, 2018); Ma et al. (2021); Zhai et al. (2020)
F3	On-site logistics for waste reduction	Ajayi et al. (2017); Dixit et al. (2022); Gharehbaghi et al. (2019); Teizer et al. (2020)
	Green urban construction logistics networks	Brusselaers et al. (2021); Fang et al. (2018); Guerlain et al. (2019); Janné and Fredriksson (2021); Nolz (2021); Sezer and Fredriksson (2021); Winans et al. (2017); Tischer et al. (2013)
F4	Logistics coordination in operations	Azcarate-Aguerre et al. (2022); El-Haram and Horner (2002, 2003)

However, the concept refers to military jargon and its applicability in construction has not been further validated. It was not until the product-as-a-service (PaaS) model was introduced to the construction industry, that logistics has been again discussed as a prioritized topic in the operational phase of built assets (Azcarate-Aguerre et al., 2022). CE business and ownership models require asset management practices to also consider logistics issues after projects and products are delivered; for example, the delivery and storage of replaced/repaired building elements.

4.3. RL operations

Table 4 presents the summary of the CE-driven logistics study approaches in RL phases.

4.3.1. Deconstruction: Waste tracking and deconstruction project planning

A key phase of RL operations is the reduction and treatment of waste sources when buildings or facilities are demolished. Through planning and managing deconstruction projects, waste materials may already be recovered, thereby reducing the waste generated for further treatment. Previous studies have focused on information availability for demolition contractors to support end-of-use decision-making, also highlighting the use of technologies such as 3D scanning and BIM to close information gaps about waste sources (van den Berg et al., 2020b; Volk et al., 2018). LCA models are also used to evaluate the environmental impact and risk of deconstruction projects before execution (Koc and Okudan, 2021; Pantini and Rigamonti, 2020). Waste prediction at a bigger scale also contributes to the planning of future RL operations in urban areas. For instance, Steins et al. (2021) analyzed waste streams of autoclaved aerated concrete in Germany with the support of geospatial data which predicted the peaking of the waste stream between 2030 and 2050. The above studies reveal the importance of life-cycle information in deconstruction planning. And bridging the data gap of material inventory in the existing built environment for future RL operations is the key practical challenge addressed by multiple studies.

4.3.2. Product reuse: reuse of reclaimed building materials

Despite being an important strategy of CE, little literature has shown awareness of logistics in reuse practices. In civil construction and the building sector, the reuse of excavated waste and by-products has been standard practice and normally involves certain logistics considerations about the allocation of vehicles and materials (Hale et al., 2021; Roth and Eklund, 2003). Van den Berg et al. (2020a) and Anastasiades et al. (2022) indicated the possibility of the reuse of demounted building components through a selective demolition and recovery process. The feasibility of RL operations is a determining factor for decisions of reusing or not, however, it is a complex issue to determine how the logistics systems, such as transportation and channel facilities need to be developed for such operations. Compared to the manufacturing and retail industries, the construction industry has little awareness about the return of products through the RL system, and the materials are normally recovered in very different manners, which makes the concept of reuse less approachable.

Table 4
RL phases and CE-driven logistics approaches.

Phases of key RL operations	Major CE-driven logistics approaches	References
R1	Waste tracking and deconstruction project planning	Jaskowska-Lemańska and Sagan (2019); Koc and Okudan (2021); Pantini and Rigamonti (2020); Steins et al. (2021); van den Berg et al. (2020b); Volk et al. (2018)
R2	Reuse of reclaimed building materials	Anastasiades et al. (2022); Hale et al. (2021); Roth and Eklund (2003); van den Berg et al. (2020a)
R3	Waste flow decision support	Ahmed and Zhang (2021); Bai and Wang (2020); Chileshe et al. (2019); Chinda and Ammarapala (2016); Pushpamali et al. (2020); Shi et al. (2020); Shi and Xu (2021); Souza et al. (2022); Xu et al. (2019)
	Waste logistics network design and optimization	Aydin (2020); Bi et al. (2022); Fu et al. (2017); Gan and Cheng (2015); Liang and Lee (2018); Lin et al. (2020); Pan et al. (2020); WM Shakantu et al. (2008); Shi et al. (2019); Zhang and Ahmed (2022)
	Waste management process improvement	Gálvez-Martos et al. (2018); Mak et al. (2019); Nikmehr et al. (2017); Nunes et al. (2009); Oliveira Neto and Correia (2019); Rabnawaz Ahmed and Zhang (2021); Rudolph Raj and Seetharaman (2013); Su et al. (2021); Tischer et al. (2013)
R4	Recycling and remanufacturing of construction products	Athira et al. (2020); de Lorena Diniz Chaves et al. (2021); NoParast et al. (2021); Rinsatitnon et al. (2018); Sea-Lim et al. (2018); Sinha et al. (2010); Superti et al. (2021); Zulcão et al. (2020)

4.3.3. Waste distribution

The practice of waste management has been a mature sector even before CE became a hot topic in the construction industry. CE goals require more predictable and controlled waste flow management that could divert waste streams to new resource channels, which post a new challenge to traditional waste distribution practices. The following three groups of CE-centric approaches are categorized about the RL operations in this phase.

- Waste flow decision support

A few studies implemented BIM to determine post-end-of-use channels of materials, demonstrating the potential of BIM for decision support in waste treatment or disposal (Chileshe et al., 2019; Shi and Xu, 2021). Several studies took among other methods mixed integer linear programming models to optimize waste treatment or recycling decisions; the models demonstrate certain capabilities to reduce the cost and environmental impact of waste treatment decisions (Ahmed and Zhang, 2021; Chinda and Ammarapala, 2016; Xu et al., 2019). The studies also revealed that such models become overly complex when multi-stakeholder interests are to be involved like green taxes (Xu et al., 2019).

- Waste logistics network design and optimization

Compared to studies on waste flows, which focused on the material properties and quantities, the study of the networks examined the spatial aspect of RL systems, for example, the scheduling and planning of waste transport routines (Gan and Cheng, 2015; Liang and Lee, 2018; Pan et al., 2020). Location selection of waste treatment plants and storage

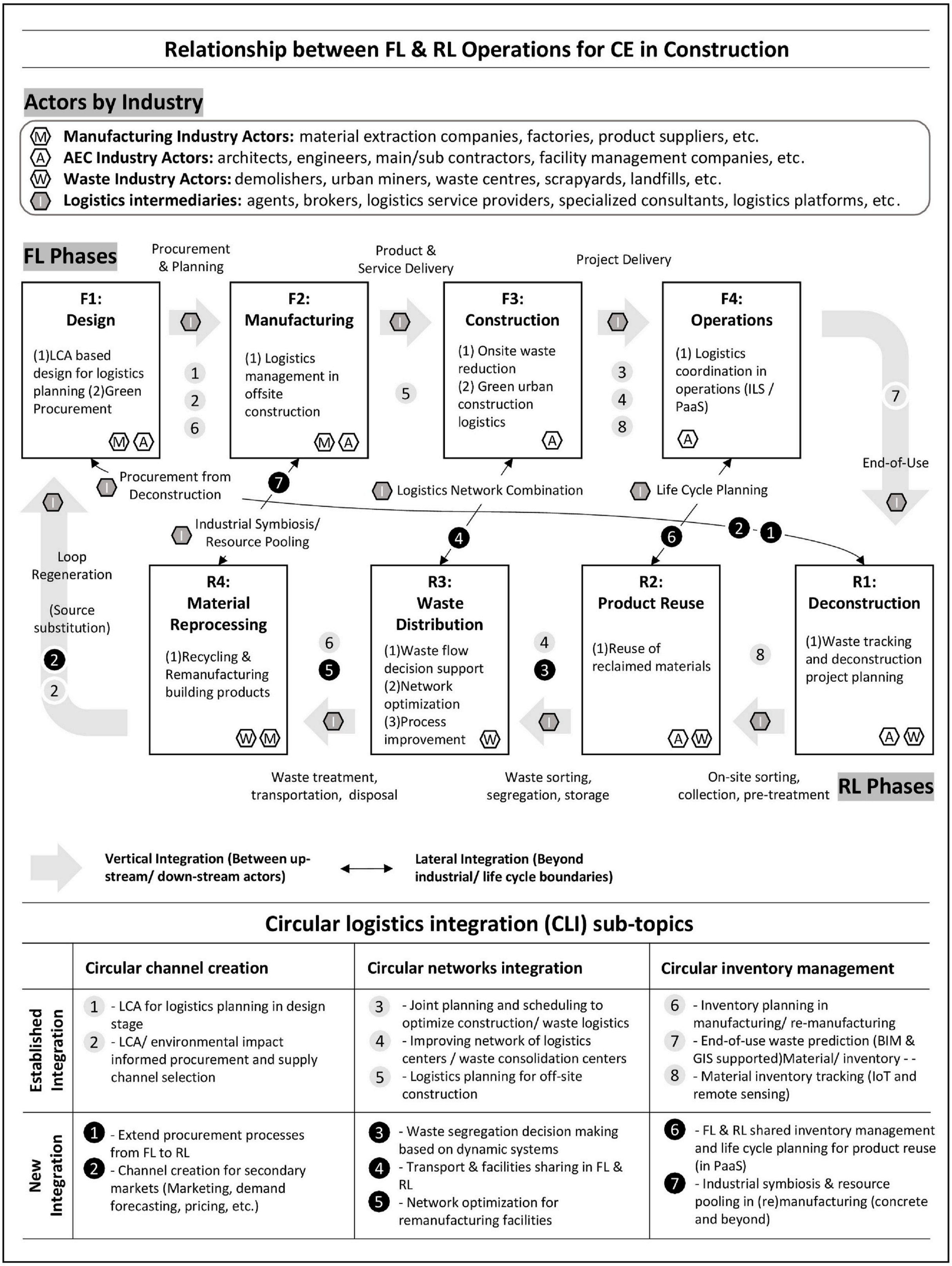

Fig. 4. Circular logistics integration (CLI) framework for FL and RL operations in construction (own work).

facilities is the other important aspect to optimize RL networks (Aydin, 2020; Shi et al., 2019). For RL network optimization, modeling is the mostly used method, like carbon footprint modeling, and multi-objective location models (Fu et al., 2017; Shi et al., 2019).

- Waste management process improvement

In the business process aspect, waste management could only be effective when properly incorporated by organizations. Case studies from different geographical regions have investigated the effect of waste management strategies by construction organizations, including the development of waste management plans and applying quality assurance measures (Gálvez-Martos et al., 2018; Rudolph Raj and Seetharaman, 2013; Tischer et al., 2013). Most studies used qualitative methods to observe organizational performances, while accurate performance is hardly measured in waste management practices due to high uncertainties in the inventory and flows. An attempt has been made to use multi-layer value stream assessment to integrate lean management in the RL process (Rabnawaz Ahmed and Zhang, 2021).

4.3.4. Material reprocessing: Recycling and remanufacturing of construction products

The last phase of RL is the recycling and remanufacturing of construction products, which has been mostly examined from an industrial process and logistics perspective. Similar to manufacturing in FL, most of the remanufacturing discourses in the construction industry is only featuring concrete mixtures and aggregates (NoParast et al., 2021; Sinha et al., 2010). Other construction materials and products are less explored. Modeling and network-based optimization is the mostly used method to improve the remanufacturing processes. For example, the location of concrete recycling plants is one of the important parameters for the CE performance of the material supply chain, GIS data, and material flow analysis featuring the concept of industrial symbiosis has been used to improve the concrete processing facilities network in cities to facilitate more use of recycled material sources (Athira et al., 2020; Van den Berghe and Verhagen, 2021; Yu et al., 2021). Broadly, the research attempt in this phase is still confined to limited CE strategies and scopes in the construction industry. The discourse is missing wider perspectives on the treatment of various secondary materials and products that requires complex industrial networks.

5. Discussion

Based on the analysis results presented, this chapter illustrates the relationship between FL and RL operations in the context of CE (5.1) by proposing a framework for integration (5.2) and associated (potential) circular logistics integration mechanisms (5.3) (See Fig. 4).

5.1. Relationship between FL and RL operations

The unique perspective of this review is the accentuation of the bi-directional nature of logistics systems and the juxtaposition of FL and RL operations in the construction industry to achieve CE. This review brings more insights into the relationship between FL and RL operations in the CE transition of the construction industry by investigating the more detailed methods used in the FL and RL phases, which go beyond the general R strategies of CE. The similarities and differences between the specific FL and RL phases are hereby presented.

5.1.1. Design and procurement from deconstruction

Design and procurement in FL is closely related to deconstruction waste reduction in RL as the concept of design for deconstruction is often mentioned (Akinade et al., 2020; Marzouk and Elmaraghy, 2021). However, the approaches in the two ends are quite distinctive in current studies. While LCA and environmental impact analysis methods are widely used in design and procurement processes to support CE goals in FL, the planning of deconstruction projects is mostly focused on waste sorting and recovery on-site, and the practices to set up logistics channels are scarce in RL. There is little evidence in the current literature that extends deconstruction planning to the other distribution channels in RL and connects materials from deconstruction projects to procurement processes in the secondary markets or the next life cycle. The lack of integration beyond life cycle boundaries is causing a structural gap that hinders circular resource and information flow between FL and RL operations. This is mainly caused by the extensively long life cycle of the built environment and the usually changed ownership conditions after decommissioning of buildings. This finding is in accordance with the previous review by Wijewickrama et al. (2021b), which highlighted the importance of information brokers at the end-of-use phase of construction projects. Ultimately, the matching of supply and demand sides remains a great challenge for the regeneration of the new life cycle of materials in CE. The role of forward and reverse logistics is important in this aspect as an intermediator of supply and demand channels between different life cycle phases.

5.1.2. Use and reuse of building products

The logistics operations during the in-use phase of buildings and the return/reuse of building products have both been underdeveloped topics despite growing attention from CE initiatives. As traditional logistics operations mainly serve production purposes, it becomes minimal when construction organizations such as contractors and engineering companies are no more active. The processes and relevant information are thus disintegrated once a construction project is delivered. However, engaging the in-use phase of building products and finding new asset management models are key moves toward CE (van den Berg et al., 2020a). The emerging product-as-a-service (PaaS) models in the construction industry is an initiative to improve service quality during the operational phase for both new and reused products, however, cost reduction and quality control in such business cases are difficult. For RL, efforts focus on promoting the reusability of new and reclaimed products to recapture the highest value. Little attention has been put on how construction products could be returned to the suppliers or service providers to make the business cases feasible.

5.1.3. Construction and waste logistics

The biggest portion of reviewed studies is either tackling the improvement of onsite/off-site construction logistics (FL) or the logistics procedures in waste management (RL). It is worth noting that similar research methods are used in both directions, with the majority utilizing modeling approaches to improve the distribution of materials, planning and scheduling process of logistics, or the location of facilities. From the material-centric aspect, digital material tracking and the evaluation of embodied energy/carbon have been demonstrated practices in FL to support more advanced control of inventories of construction materials on-site for improved CE performance (Teizer et al., 2020). In RL practices, the emphasis is more on the decision support for waste flows based on end-of-use cost and environmental impact calculated from geo-data or BIM (Chileshe et al., 2019; Shi and Xu, 2021). However, the modeling of RL systems is proven to be more complex as there are more factors and uncertainties to consider with extra sets of economic/environmental policies.

Both FL and RL-oriented studies have revealed a strong common interest in improving the logistics network optimization and inventory planning for CE. In the construction phase, scheduling and inventory routine planning are seen as critical practices to waste reduction (Fang et al., 2018; Nolz, 2021). For waste management, the significance of lean principles and inventory/resource planning is also highlighted to reduce the overall cost of RL (Oliveira Neto and Correia, 2019; Rabnawaz Ahmed and Zhang, 2021). Furthermore, the transportation networks and the location of logistics facilities in FL and RL could also be optimized in similar manners. Guerlain et al. (2019) and Janné and Fredriksson (2021) advocated the deployment of construction logistics/consolidation centers to improve delivery efficiency. Bi et al. (2022), and Liang and Lee (2018) also concluded that optimal facility choices are the most important for waste management performance. An important and yet unanswered question is how to combine the transportation networks and logistics facility resources in FL and RL.

5.1.4. Manufacturing and remanufacturing

Although the strategies of remanufacturing and recycling sit on the lower side of the R-cascading strategies of CE (Ellen MacArthur Foundation, 2013; Kirchherr et al., 2017). Material reprocessing is still a crucial phase of RL and is where logistics play an important role as well. An interesting finding from this review is that remanufacturing and recycling operations share some commonalities with the manufacturing phase in FL. Literature from both phases largely focused on the concrete industry. This could be because concrete is the most prominent material in the built environment by volume, which also involves a construction-exclusive supply chain that is easier to trace (NoParast et al., 2021). On the FL side, prefabrication supported by BIM and Lean production is seen as the most effective solution to improve CE performances (Bataglin et al., 2020; Ma et al., 2021). The RL-focused studies engaged logistics improvement in concrete aggregate recycling processes (Sinha et al., 2010; Van den Berghe and Verhagen, 2021; Zulcão et al., 2020). The two groups of studies show opportunities for industrial symbiosis and logistics integration between manufacturing and remanufacturing organizations, for the design of logistics networks and the coordination of inventories/resources. However, there still miss insights about how the construction industry manages the interface and systematic boundaries with other more complex sectors that supply construction products, such as the steel/timber structure and aluminum/glass facade supply chains.

5.2. Circular logistics integration in the construction industry

As both FL and RL are recognized as important operations to enable CE in construction, in the optimal situation, FL and RL operations shall be connected as a holistic system instead of segregated operations for the CE goal of closing the loop (Julianelli et al., 2020; Wijewickrama et al., 2021b). One similar concept that has been previously used by construction experts is supply chain integration, which refers to creating more long-term collaboration and trust between organizations, thereby improving the currently fragmented project-based business (Chen et al., 2022; Koc and Okudan, 2021). More specifically, logistics operations could be more integrated into the delivery of products and services, by connecting information flows, sharing resources, synchronizing organizational incentives, or building shared management platforms, etc (Banks et al., 2018; Gan and Cheng, 2015; Shi and Xu, 2021).

However, it is not always the case that supply chain stakeholders integrate their logistics operations with other actors because sharing information or coordinating operations sometimes also bring increased cost and risks (Ambekar et al., 2021; Anastasiades et al., 2022). The review framework is therefore designed to critically understand CE-driven logistics operations as parts of an interrelated system, involving manufacturing, construction, and waste management organizations in FL and RL networks, and look for evidence in current cases about how logistics integration is currently established or could be further developed.

The comparison of review findings in different phases suggests that the integration is more established in FL along the traditional construction phases compared to RL. For example, the information from LCA could more effectively influence procurement channels in new construction projects but is less compelling in post-end-of-use cases of the existing built assets. Furthermore, the findings also signify that in most conventional cases, only direct vertical integration with the upstream and downstream phases is considered. On the contrary, the new pilot cases of CE need to be based on more lateral integration beyond the life cycle and industrial boundaries. For example, facilitating the direct reuse of building products from the in-use phase of projects and applying the same manufacturing facilities for remanufacturing concrete aggregates are among such cases that sprawl between FL and RL phases rather than happening along one direction. Regarding supply chain actors, it is indicated that the current investigation of FL and RL operations in the construction context is mostly limited to the AEC industry, manufacturing industry, and waste industry actors, which leaves the role of logistics intermediaries (e.g. logistics service providers, distributors, brokers, platforms, etc.) an unexplored field. According to Skender et al. (2016) and Salmenperä et al. (2021), such roles are critical factors in the performance of logistics systems and the CE.

Conjointly, the reviewed findings showed that integrating logistics in the construction industry is still hindered by the cost disadvantage of the RL supply channels compared to the traditional virgin material sources and the lack of resource and information channels that connect reclaimed material sources to the new life cycle. The main barriers that cause those disconnections exist between the systematic boundaries from RL to FL. Our findings are also aligned with several previous studies that identified general logistics barriers to CE in construction (Chileshe et al., 2015, 2018; Pushpamali et al., 2021; Wijewickrama et al., 2021b). Hence, we propose a new concept of 'circular logistics integration (CLI)' that refers to the coordination and collaboration between FL and RL specialized actors to improve CE performances of the material and resource flows through the CPLC.

For future development of CE-centric integrated logistics operations in the construction context, a key research question will be.

- *How to integrate the key logistics operations that connect supply channels from deconstruction planning in RL back to the new distribution channels in FL?*

5.3. Subtopics of CLI

The objective of CLI is to connect the supply and demand channels from the back end to the front end of the CPLC. The goal aligns with the CE's ambitions in closing the loop (Akinade et al., 2020). In this regard, the implementation of CLI involves mainly the roles of logistics intermediaries that may help bridge the gaps in materials, information, and organizational flows in the RL to FL boundary. Hereafter, the following more specific research areas are established based on the findings of this review.

5.3.1. Circular logistics channel creation

One barrier to matching supply and demand for construction materials in the circular life cycle is the extremely long in-use phase of buildings that is difficult to predict and trace. The availability of materials is a great challenge to CE as locally sourced reclaimed materials need to be matched with new project demands in complex spatial temporal dimensions, which post more quality control issues and supply chain risks. Although pilot studies have attempted to bring more information from FL to RL through deconstruction planning and waste tracking, the logistics channels from RL to FL have been hardly investigated. One important step would be to extend the procurement processes beyond the life cycle boundary, and focus on the interface between RL to FL material flows and the sourcing of supply channels in the secondary market. This could mean that the role definitions for the intermediaries in logistics operations need to be re-examined and improved, such as the specialized consultants, sellers, circular procurement platforms, third-party logistics providers, etc. For further research, relevant questions could be:

- *Who are the logistics intermediaries and what are their roles in FL and RL networks to integrate circular distribution channels of construction materials?*

- *What are the procurement processes (sourcing, forecasting, contracting, etc.) in the logistics channels that support the connection of material/resource flows between RL and FL in the construction industry?*

5.3.2. Circular logistics networks integration

The findings of this review also suggested that despite different CPLC phases, the logistics networks in forward and reverse directions have shown some commonalities and could be potentially integrated. For example, the transportation operations that deliver new construction materials (FL) and waste materials (RL) may be merged and managed through shared platforms. And further, more extensive collaboration in channel facilities and resource sharing in the distribution networks may be made possible by conjointly managing the capacities of construction logistics centers and waste consolidation centers. The difficulty for such integration is the already highly complex networks and fragmented operations in the construction sector in both FL and RL domains. Especially, many location and cost models in RL have shown limitations when dealing with logistics operations in CE that often involves highly dynamic multi-stakeholder scenarios and extensive policy measures (e.g. carbon taxes, embodied energy, etc.). There are yet questions to be explored for the integration of circular logistics networks.

- *When and where may FL and RL networks be integrated to improve the CE-driven performance of logistics operations in the construction industry?*
- *How to implement circular logistics networks to overcome the operational barriers to RL to FL connections (route planning, collecting, delivery, etc. of reclaimed materials)?*

5.3.3. Circular inventory management

This review has concluded that most studies in FL and RL phases of the construction industry have been limited to operations by the Architecture, Engineering and Construction (AEC) actors, or only extend to a narrow range of manufacturing and waste management practices, mostly within the concrete production and recycling branches. Many other cross-industrial integration opportunities have not been given the same amount of attention, such as industrial symbiosis in remanufacturing and product-as-a-service (PaaS) models of construction products. The insights about cross-branch integration and collaboration that include more complex industrial networks are missing. The greatest barrier to such integration is the segregated management of inventories in different industries. While the delivery of construction projects by the AEC sector relies on the prediction of quantity surveyors and building information models (BIM), the manufacturing and waste industries acquire inventory information in very different methods. Whilst in CE, the existing built environment should also be seen as another inventory for the future stock of construction products. A practical route could be to first develop the existing inventory models from different industries and focus on the links between systems and the key bottlenecks to integrating FL and RL inventories. For example, to set up specialized platforms for information sharing and resource pooling in supply chains of particular construction materials/products.

After all, information unavailability and obstructions are prominent challenges for FL and RL inventory integration beyond the industrial barriers. Due to growing information demand in the CE transition, studies have also revealed more interest in digital data systems. For instance, BIM and materials passports are recognized as a key development to increase data integrity between FL and RL inventories, and geo-data has been widely used for location-based decisions. Despite being a focus for both FL and RL, the ICT systems used in the two directions of the logistics system have shown little evidence of compatibility. The digital collaboration for logistics systems in the construction industry is still in its infancy and awaits experiments with more advanced solutions such as digital twins and artificial intelligence. More intelligent and intuitive methods are desired beyond the available building and product inventory data systems to support decisions in FL and RL. Thereby the further research questions are:

- *What is the role of information in the integration of inventory management systems that connect RL to FL?*
- *How to develop more information-driven inventory management methods to track, guide, and control material stocks in the CE-driven CPLC?*

6. Conclusions

Facing the CE transition challenge in the construction industry, logistic management has gained more interest from researchers and practitioners. Despite the effort to develop greener forward logistics (FL) and reverse logistics (RL), there is little overlap between the two strains of literature, and the relationship between FL and RL in the construction context remains unexplored. Therefore, we have performed an SLR to identify the research efforts in FL and RL in the construction industry based on the logistics operations performed in different phases of the construction project life cycle. Four phases each are categorized in FL and RL sides to comprehensively analyze the current logistics practices in achieving the CE goals of the construction industry.

Based on the analytical insights, we have further developed a synthesized framework to analyze the relationship between FL and RL phases. In total, 81 studies were selected for content analysis. To answer RQ1, the studies are categorized based on the phases in which the main FL or RL operation took place and the CE-driven logistics approach. The comparison between FL and RL phases showed that similar methods and strategies are sometimes used by studies tackling corresponding phases in both directions, but RL is less predictable and approachable to construction organizations than FL as the operations are less project-centric, and often involve actors beyond the industrial and life cycle boundaries of the AEC industry. And further, to answer RQ2, the existing and potential integration mechanisms between the FL and RL phases are analyzed, showing that more integration is needed in RL for the CE transition, and the lateral integration beyond the systematic boundaries between FL and RL phases is favorable for new CE pilot cases. After all, more specialized joint operations enabled by the roles of logistics intermediaries may be required to connect the supply channels of deconstruction planning to the new distribution channels in FL. Future research opportunities are identified to enable a new framework of circular logistics integration (CLI) in the CPLC from the different subtopics of channels, networks, and inventory.

This review contributes to the theories of CE-driven logistics and supply chain management in the construction context by synthesizing, clarifying, and elaborating the different theories of FL and RL into one framework, which maps the bi-directional logistics operations into the phases of a CPLC. While an innovative perspective is established to understand the logistics operations in the existing body of literature on the construction industry consisting of FL and RL, the review also delivered new input of knowledge to the current academic and practical field to further develop integrated logistics management methodologies in both construction project delivery (FL) and project decommissioning and dismantling (RL), in alignment with the CE goals of minimizing overall material and carbon footprint in the future of the industry.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2023.135981.

References

Adams, K.T., Osmani, M., Thorpe, T., Thornback, J., 2017. Circular economy in construction: current awareness, challenges and enablers. Proceedings of the Institution of Civil Engineers - Waste and Resource Management 170, 15–24. https://doi.org/10.1680/jwarm.16.00011.

Ahmed, R.R., Zhang, X., 2021. Multi-stage network-based two-type cost minimization for the reverse logistics management of inert construction waste. Waste Manag. 120, 805–819. https://doi.org/10.1016/j.wasman.2020.11.004.

Ajayi, S.O., Oyedele, L., Akinade, O., Bilal, M., Alaka, H., Owolabi, H., 2017a. Optimising material procurement for construction waste minimization: an exploration of success factors. Sustainable Materials and Technologies 11, 38–46. https://doi.org/10.1016/j.susmat.2017.01.001.

Ajayi, S.O., Oyedele, L.O., Bilal, M., Akinade, O.O., Alaka, H.A., Owolabi, H.A., 2017b. Critical management practices influencing on-site waste minimization in construction projects. Waste Manag. 59, 330–339. https://doi.org/10.1016/j.wasman.2016.10.040.

Akinade, O., Oyedele, L., Oyedele, A., Davila Delgado, J.M., Bilal, M., Akanbi, L., Ajayi, A., Owolabi, H., 2020. Design for deconstruction using a circular economy approach: barriers and strategies for improvement. Prod. Plann. Control 31, 829–840. https://doi.org/10.1080/09537287.2019.1695006.

Almashaqbeh, M., El-Rayes, K., 2021. Minimizing transportation cost of prefabricated modules in modular construction projects. Eng. Construct. Architect. Manag. https://doi.org/10.1108/ECAM-11-2020-0969.

Ambekar, S., Roy, D., Hiray, A., Prakash, A., Patyal, V.S., 2021. Barriers to adoption of reverse logistics: a case of construction, real estate, infrastructure and project (CRIP) sectors. Eng. Construct. Architect. Manag. https://doi.org/10.1108/ECAM-02-2021-0112.

Anastasiades, K., Michels, S., Van Wuytswinkel, H., Blom, J., Audenaert, A., 2022. Identifying barriers for the circular reuse of steel in the Belgian construction sector, an industry wide perspective. PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS-MANAGEMENT PROCUREMENT AND LAW. https://doi.org/10.1680/jmapl.21.00044.

Athira, G., Bahurudeen, A., Sahu, P., Santhanam, M., Nanthagopalan, P., Lalu, S., 2020. Effective utilization of sugar industry waste in Indian construction sector: a geospatial approach. J. Mater. Cycles Waste Manag. 22, 724–736. https://doi.org/10.1007/s10163-019-00963-w.

Aydin, N., 2020. Designing reverse logistics network of end-of-life-buildings as preparedness to disasters under uncertainty. J. Clean. Prod. 256 https://doi.org/10.1016/j.jclepro.2020.120341.

Azcarate-Aguerre, J.F., Heijer, A.C.D., Klein, T., 2018. Integrated Facades as a Product-Service System: business process innovation to accelerate integral product implementation. J. Facade Des. Eng. 6, 41–56. https://doi.org/10.7480/jfde.2018.1.1840.

Azcarate-Aguerre, J.F., Klein, T., Konstantinou, T., Veerman, M., 2022. Facades-as-a-Service: the role of technology in the circular servitisation of the building envelope. Appl. Sci. 12, 1267.

Badi, S., Murtagh, N., 2019. Green supply chain management in construction: a systematic literature review and future research agenda. J. Clean. Prod. 223, 312–322. https://doi.org/10.1016/j.jclepro.2019.03.132.

Bai, X.-P., Wang, X.-W., 2020. A novel planning method of urban building wastes for environment protection and sustainable development. Sage Open 10. https://doi.org/10.1177/2158244020951269.

Bajželj, B., Allwood, J.M., Cullen, J.M., 2013. Designing climate change mitigation plans that add up. Environ. Sci. Technol. 47, 8062–8069. https://doi.org/10.1021/es400399h.

Banks, C., Kotecha, R., Curtis, J., Dee, C., Pitt, N., Papworth, R., 2018. Enhancing high-rise residential construction through design for manufacture and assembly a - UK case study. PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS-MANAGEMENT PROCUREMENT AND LAW 171, 164–175. https://doi.org/10.1680/jmapl.17.00027.

Bataglin, F., Viana, D., Formoso, C., Bulhoes, I., 2020. Model for planning and controlling the delivery and assembly of engineer-to-order prefabricated building systems: exploring synergies between Lean and BIM. Can. J. Civ. Eng. 47, 165–177. https://doi.org/10.1139/cjce-2018-0462.

Benachio, G.L.F., Freitas, M.C.D., Tavares, S.F., 2019. Green supply chain management in the construction industry: a literature review. Presented at the IOP Conference Series: Earth and Environmental Science. https://doi.org/10.1088/1755-1315/225/1/012011.

Bernon, M., Tjahjono, B., Ripanti, E.F., 2018. Aligning retail reverse logistics practice with circular economy values: an exploratory framework. Prod. Plann. Control 29, 483–497. https://doi.org/10.1080/09537287.2018.1449266.

Bertin, I., Lebrun, F., Braham, N., Le Roy, R., 2019. Construction, deconstruction, reuse of the structural elements: the circular economy to reach zero carbon. Presented at the IOP Conference Series: Earth and Environmental Science. https://doi.org/10.1088/1755-1315/323/1/012020.

Bi, W., Lu, W., Zhao, Z., Webster, C., 2022. Combinatorial optimization of construction waste collection and transportation: a case study of Hong Kong. Resour. Conserv. Recycl. 179 https://doi.org/10.1016/j.resconrec.2021.106043.

Bocken, N.M.P., Olivetti, E.A., Cullen, J.M., Potting, J., Lifset, R., 2017. Taking the circularity to the next level: a special issue on the circular economy: taking circularity to the next level. J. Ind. Ecol. 21, 476–482. https://doi.org/10.1111/jiec.12606.

Brusselaers, N., Mommens, K., Macharis, C., 2021. Building bridges: a participatory stakeholder framework for sustainable urban construction logistics. Sustainability 13, 1–33. https://doi.org/10.3390/su13052678.

Calmon, A.P., Graves, S.C., 2017. Inventory management in a consumer electronics closed-loop supply chain. Manuf. Serv. Oper. Manag. 19, 568–585. https://doi.org/10.1287/msom.2017.0622.

Campbell-Johnston, K., Vermeulen, W.J.V., Reike, D., Brullot, S., 2020. The circular economy and cascading: towards a framework. Resour. Conserv. Recycl. X 7, 100038. https://doi.org/10.1016/j.rcrx.2020.100038.

Cannella, S., Bruccoleri, M., Framinan, J.M., 2016. Closed-loop supply chains: what reverse logistics factors influence performance? Int. J. Prod. Econ. 175, 35–49. https://doi.org/10.1016/j.ijpe.2016.01.012.

Charef, R., Morel, J.-C., Rakhshan, K., 2021. Barriers to implementing the circular economy in the construction industry: a critical review. Sustainability 13. https://doi.org/10.3390/su132312989.

Chen, C., Pierobon, F., Jones, S., Maples, I., Gong, Y., Ganguly, I., 2022. Comparative life cycle assessment of mass timber and concrete residential buildings: a case study in China. Sustainability 14. https://doi.org/10.3390/su14010144.

Chen, Q., Feng, H., Garcia de Soto, B., 2022. Revamping construction supply chain processes with circular economy strategies: a systematic literature review. J. Clean. Prod. 335 https://doi.org/10.1016/j.jclepro.2021.130240.

Chileshe, N., Rameezdeen, R., Hosseini, M.R., 2015. Barriers to implementing reverse logistics in South Australian construction organisations. Supply Chain Manag. 20, 179–204. https://doi.org/10.1108/SCM-10-2014-0325.

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 Manag. 79, 48–57. https://doi.org/10.1016/j.wasman.2018.07.013.

Chileshe, N., Jayasinghe, R.S., Rameezdeen, R., 2019. Information flow-centric approach for reverse logistics supply chains. Autom. ConStruct. 106 https://doi.org/10.1016/j.autcon.2019.102858.

Chinda, T., Ammarapala, V., 2016. Decision-making on reverse logistics in the construction industry. Songklanakarin J. Sci. Technol. 38, 7–14.

Christopher, M., 2016. Logistics & Supply Chain Management. Pearson, UK.

Copeland, S., Bilec, M., 2020. Buildings as Material Banks Using RFID and Building Information Modeling in a Circular Economy. Presented at the Procedia CIRP, pp. 143–147. https://doi.org/10.1016/j.procir.2020.02.122.

de Lorena Diniz Chaves, G., Siman, R.R., Ribeiro, G.M., Chang, N.-B., 2021. Synergizing environmental, social, and economic sustainability factors for refuse derived fuel use in cement industry: a case study in Espirito Santo, Brazil. J. Environ. Manag. 288 https://doi.org/10.1016/j.jenvman.2021.112401.

Dixit, M.K., Venkatraj, V., Pariafsai, F., Bullen, J., 2022. Site logistics factors impacting resource use on construction sites: a delphi study. Frontiers in Built Environment 8. https://doi.org/10.3389/fbuil.2022.858135.

El-Aghoury, M., Ebid, A., Mahdi, I., 2021. Decision support system to select the optimum steel portal frame coverage system. Ain Shams Eng. J. 12, 73–82. https://doi.org/10.1016/j.asej.2020.07.021.

El-Haram, M.A., Horner, M.W., 2002. Factors affecting housing maintenance cost. J. Qual. Mainten. Eng. 8, 115–123. https://doi.org/10.1108/13552510210430008.

El-Haram, M.A., Horner, R.M.W., 2003. Application of the principles of ILS to the development of cost effective maintenance strategies for existing building stock. Construct. Manag. Econ. 21, 283–296. https://doi.org/10.1080/0144619032000093774.

Ellen MacArthur Foundation, 2013. Towards the Circular Economy.

Fang, Y., Ng, S., Ma, Z., Li, H., 2018. Quota-based carbon tracing model for construction processes in China. J. Clean. Prod. 200, 657–666. https://doi.org/10.1016/j.jclepro.2018.08.028.

Fargnoli, M., Lleshaj, A., Lombardi, M., Sciarretta, N., Di Gravio, G., 2019. A BIM-based PSS approach for the management of maintenance operations of building equipment. Buildings 9, 139. https://doi.org/10.3390/buildings9060139.

Fu, P., Li, H., Wang, X., Luo, J., Zhan, S., Zuo, C., 2017. Multiobjective location model design based on government subsidy in the recycling of CDW. Math. Probl Eng. 2017 https://doi.org/10.1155/2017/9081628.

Gálvez-Martos, J.-L., Styles, D., Schoenberger, H., Zeschmar-Lahl, B., 2018. Construction and demolition waste best management practice in Europe. Resour. Conserv. Recycl. 136, 166–178. https://doi.org/10.1016/j.resconrec.2018.04.016.

Gan, V.J.L., Cheng, J.C.P., 2015. Formulation and analysis of dynamic supply chain of backfill in construction waste management using agent-based modeling. Adv. Eng. Inf. 29, 878–888. https://doi.org/10.1016/j.aei.2015.01.004.

Gebhardt, M., Kopyto, M., Birkel, H., Hartmann, E., 2021. Industry 4.0 technologies as enablers of collaboration in circular supply chains: a systematic literature review. Int. J. Prod. Res. 1–29. https://doi.org/10.1080/00207543.2021.1999521.

Geldermans, B., Tenpierik, M., Luscuere, P., 2019. Circular and flexible indoor partitioning-A design conceptualization of innovative materials and value chains. Buildings 9. https://doi.org/10.3390/buildings9090194.

Gharehbaghi, K., McManus, K., Robson, K., 2019. Minimizing the environmental impacts of mega infrastructure projects: Australian public transport perspective. J. Eng. Des. Technol. 17, 736–746. https://doi.org/10.1108/JEDT-12-2018-0223.
Ghisellini, P., Ripa, M., Ulgiati, S., 2018. Exploring environmental and economic costs and benefits of a circular economy approach to the construction and demolition sector. A literature review. J. Clean. Prod. 178, 618–643. https://doi.org/10.1016/j.jclepro.2017.11.207.
González-Sánchez, R., Settembre-Blundo, D., Ferrari, A.M., García-Muiña, F.E., 2020. Main dimensions in the building of the circular supply chain: a literature review. Sustainability 12, 2459. https://doi.org/10.3390/su12062459.
Guerlain, C., Renault, S., Ferrero, F., 2019. Understanding construction logistics in urban areas and lowering its environmental impact: a focus on construction consolidation centres. Sustainability 11. https://doi.org/10.3390/su11216118.
Guerra, B., Shahi, S., Mollaei, A., Skaf, N., Weber, O., Leite, F., Haas, C., 2021. Circular economy applications in the construction industry: a global scan of trends and opportunities. J. Clean. Prod. 324 https://doi.org/10.1016/j.jclepro.2021.129125.
Hale, S.E., Roque, A.J., Okkenhaug, G., Sørmo, E., Lenoir, T., Carlsson, C., Kupryianchyk, D., Flyhammar, P., Žlender, B., 2021. The reuse of excavated soils from construction and demolition projects: limitations and possibilities. Sustainability 13. https://doi.org/10.3390/su13116083.
Honic, M., Kovacic, I., Aschenbrenner, P., Ragossnig, A., 2021. Material Passports for the end-of-life stage of buildings: challenges and potentials. J. Clean. Prod. 319 https://doi.org/10.1016/j.jclepro.2021.128702.
Hossain, MdU., Ng, S.T., Antwi-Afari, P., Amor, B., 2020. Circular economy and the construction industry: existing trends, challenges and prospective framework for sustainable construction. Renew. Sustain. Energy Rev. 130, 109948 https://doi.org/10.1016/j.rser.2020.109948.
Hosseini, M.R., Rameezdeen, R., Chileshe, N., Lehmann, S., 2015. Reverse logistics in the construction industry. Waste Manag. Res. 33, 499–514. https://doi.org/10.1177/0734242X15584842.
Janné, M., Fredriksson, A., 2021. Construction logistics in urban development projects – learning from, or repeating, past mistakes of city logistics? Int. J. Logist. Manag. 33, 49–68. https://doi.org/10.1108/IJLM-03-2020-0128.
Jaskowska-Lemańska, J., Sagan, J., 2019. Non-destructive testing methods as a main tool supporting effective waste management in construction processes. Arch. Civ. Eng. 65, 263–276. https://doi.org/10.2478/ace-2019-0059.
Joensuu, T., Edelman, H., Saari, A., 2020. Circular economy practices in the built environment. J. Clean. Prod. 276 https://doi.org/10.1016/j.jclepro.2020.124215.
Julianelli, V., Caiado, R.G.G., Scavarda, L.F., Cruz, S.P.D.M.F., 2020. Interplay between reverse logistics and circular economy: critical success factors-based taxonomy and framework. Resour. Conserv. Recycl. 158 https://doi.org/10.1016/j.resconrec.2020.104784.
Kar, S., Jha, K., 2020. Assessing criticality of construction materials for prioritizing their procurement using ANP-TOPSIS. INTERNATIONAL JOURNAL OF CONSTRUCTION MANAGEMENT. https://doi.org/10.1080/15623599.2020.1742637.
Kirchherr, J., Reike, D., Hekkert, M., 2017. Conceptualizing the circular economy: an analysis of 114 definitions. Resour. Conserv. Recycl. 127, 221–232. https://doi.org/10.1016/j.resconrec.2017.09.005.
Koc, K., Okudan, O., 2021. Assessment of life cycle risks of deconstruction in urban regeneration projects. J. Construct. Eng. Manag. 147 https://doi.org/10.1061/(ASCE)CO.1943-7862.0002161.
Kothman, I., Faber, N., 2016. How 3D printing technology changes the rules of the game Insights from the construction sector. J. Manuf. Technol. Manag. 27, 932–943. https://doi.org/10.1108/JMTM-01-2016-0010.
Li, C., Shen, G., Xu, X., Xue, F., Sommer, L., Luo, L., 2017. Schedule risk modeling in prefabrication housing production. J. Clean. Prod. 153, 692–706. https://doi.org/10.1016/j.jclepro.2016.11.028.
Li, X., Shen, G.Q., Wu, P., Fan, H., Wu, H., Teng, Y., 2018. RBL-PHP: simulation of lean construction and information technologies for prefabrication housing production. J. Manag. Eng. 34 https://doi.org/10.1061/(ASCE)ME.1943-5479.0000577.
Liang, C., Lee, J., 2018. Carbon footprint model for reverse logistics of waste disposal in interior design industry. Asia Pac. J. Market. Logist. 30, 889–906. https://doi.org/10.1108/APJML-01-2018-0035.
Lin, Z., Xie, Q., Feng, Y., Zhang, P., Yang, Y., 2020. AN optimal C&D waste logistics network design from contractors' perspective. JOURNAL OF GREEN BUILDING 15, 121–137.
Liu, H., Zhang, Y., Lei, Z., Li, H., Han, S., 2021. Design for manufacturing and assembly: a BIM-enabled generative framework for building panelization design. Adv. Civ. Eng. 2021 https://doi.org/10.1155/2021/5554551.
Lummus, R.R., Krumwiede, D.W., Vokurka, R.J., 2001. The relationship of logistics to supply chain management: developing a common industry definition. Ind. Manag. Data Syst. 101, 426–432. https://doi.org/10.1108/02635570110406730.
Ma, W., Sun, D., Deng, Y., Meng, X., Li, M., 2021. Analysis of carbon emissions of prefabricated buildings from the views of energy conservation and emission reduction. Nat. Environ. Pollut. Technol. 20, 39–44. https://doi.org/10.46488/NEPT.2021.V20I01.004.
Mak, T., Yu, I., Wang, L., Hsu, S., Tsang, D., Li, C., Yeung, T., Zhang, R., Poon, C., 2019. Extended theory of planned behaviour for promoting construction waste recycling in Hong Kong. Waste Manag. 83, 161–170. https://doi.org/10.1016/j.wasman.2018.11.016.
Marzouk, M., Elmaraghy, A., 2021. Design for deconstruction using integrated lean principles and bim approach. Sustainability 13. https://doi.org/10.3390/su13147856.
Mojumder, A., Singh, A., 2021. An exploratory study of the adaptation of green supply chain management in construction industry: the case of Indian Construction Companies. J. Clean. Prod. 295 https://doi.org/10.1016/j.jclepro.2021.126400.
Morseletto, P., 2020. Targets for a circular economy. Resour. Conserv. Recycl. 153, 104553 https://doi.org/10.1016/j.resconrec.2019.104553.
Munaro, M.R., Tavares, S.F., 2021. Materials passport's review: challenges and opportunities toward a circular economy building sector. Built. Environ. Proj. Asset. Manag. 11, 767–782. https://doi.org/10.1108/BEPAM-02-2020-0027.
Nikmehr, B., Hosseini, M.R., Rameezdeen, R., Chileshe, N., Ghoddousi, P., Arashpour, M., 2017. An integrated model for factors affecting construction and demolition waste management in Iran. Eng. Construct. Architect. Manag. 24, 1246–1268. https://doi.org/10.1108/ECAM-01-2016-0015.
Nolz, P., 2021. Optimizing construction schedules and material deliveries in city logistics: a case study from the building industry. Flex. Serv. Manuf. J. 33, 846–878. https://doi.org/10.1007/s10696-020-09391-7.
NoParast, M., Hematian, M., Ashrafian, A., Amiri, M., AzariJafari, H., 2021. Development of a non-dominated sorting genetic algorithm for implementing circular economy strategies in the concrete industry. Sustain. Prod. Consum. 27, 933–946. https://doi.org/10.1016/j.spc.2021.02.009.
Nunes, K., Mahler, C., Valle, R., 2009. Reverse logistics in the Brazilian construction industry. J. Environ. Manag. 90, 3717–3720. https://doi.org/10.1016/j.jenvman.2008.05.026.
Oliveira Neto, G.C., Correia, J.M.F., 2019. Environmental and economic advantages of adopting reverse logistics for recycling construction and demolition waste: a case study of Brazilian construction and recycling companies. Waste Manag. Res. 37, 176–185. https://doi.org/10.1177/0734242X18816790.
Olorunniwo, F.O., Li, X., 2010. Information sharing and collaboration practices in reverse logistics. Supply Chain Manag. 15, 454–462. https://doi.org/10.1108/13598541011080437.
Pan, X., Xie, Q., Feng, Y., 2020. Designing recycling networks for construction and demolition waste based on reserve logistics research field. J. Clean. Prod. 260 https://doi.org/10.1016/j.jclepro.2020.120841.
Pantini, S., Rigamonti, L., 2020. Is selective demolition always a sustainable choice? Waste Manag. 103, 169–176. https://doi.org/10.1016/j.wasman.2019.12.033.
Pushpamali, N.N.C., Agdas, D., Rose, T.M., 2019. A review of reverse logistics: an upstream construction supply chain perspective. Sustainability 11. https://doi.org/10.3390/su11154143.
Pushpamali, N.N.C., Agdas, D., Rose, T.M., 2020. Strategic decision making in construction supply chains: a comparison of reverse logistics strategies. Frontiers in Built Environment 6. https://doi.org/10.3389/fbuil.2020.593372.
Pushpamali, N.N.C., Agdas, D., Rose, T.M., Yigitcanlar, T., 2021. Stakeholder perception of reverse logistics practices on supply chain performance. Bus. Strat. Environ. 30, 60–70. https://doi.org/10.1002/bse.2609.
Rabnawaz Ahmed, R., Zhang, X., 2021. Multi-layer value stream assessment of the reverse logistics network for inert construction waste management. Resour. Conserv. Recycl. 170 https://doi.org/10.1016/j.resconrec.2021.105574.
Rinsatitnon, N., Dijaroen, W., Limpiwun, T., Suktavee, G., Chinda, T., 2018. Reverse logistics implementation in the construction industry: paper waste focus. Songklanakarin J. Sci. Technol. 40, 798–805. https://doi.org/10.14456/sjst-psu.2018.113.
Rogers, D.S., Tibben-Lembke, R., 2001. AN examination of reverse logistics practices. J. Bus. Logist. 22, 129–148. https://doi.org/10.1002/j.2158-1592.2001.tb00007.x.
Roth, L., Eklund, M., 2003. Environmental evaluation of reuse of by-products as road construction materials in Sweden. Waste Manag. 23, 107–116. https://doi.org/10.1016/S0956–053X(02)00052-1.
Rudolph Raj, J., Seetharaman, A., 2013. Role of waste and performance management in the construction industry. Journal of Environmental Science and Technology 6, 119–129. https://doi.org/10.3923/jest.2013.119.129.
Salmenperä, H., Pitkänen, K., Kautto, P., Saikku, L., 2021. Critical factors for enhancing the circular economy in waste management. J. Clean. Prod. 280, 124339 https://doi.org/10.1016/j.jclepro.2020.124339.
Sanchez, B., Rausch, C., Haas, C., Hartmann, T., 2021. A framework for BIM-based disassembly models to support reuse of building components. Resour. Conserv. Recycl. 175 https://doi.org/10.1016/j.resconrec.2021.105825.
Sea-Lim, K., Plianpho, C., Sukmake, P., Pongcharoenkiat, W., Chinda, T., 2018. Feasibility study of reverse logistic of steel waste in the construction industry. Songklanakarin J. Sci. Technol. 40, 271–277. https://doi.org/10.14456/sjst-psu.2018.43.
Seroka-Stolka, O., Ociepa-Kubicka, A., 2019. Green logistics and circular economy. Transport. Res. Procedia 39, 471–479. https://doi.org/10.1016/j.trpro.2019.06.049.
Sezer, A., Fredriksson, A., 2021. Environmental impact of construction transport and the effects of building certification schemes. Resour. Conserv. Recycl. 172 https://doi.org/10.1016/j.resconrec.2021.105688.
Shakantu, W.M., Muya, M., Tookey, J., Bowen, P., 2008a. Evaluating truck empty running in construction: a case study from Cape Town, South Africa. CONSTRUCTION ECONOMICS AND BUILDING 8, 41–49.
Shakantu, W.M., Muya, M., Tookey, J., Bowen, P., 2008b. Flow modelling of construction site materials and waste logistics A case study from Cape Town, South Africa. Eng. Construct. Architect. Manag. 15, 423. https://doi.org/10.1108/09699980810902721.
Shi, Y., Xu, J., 2021. BIM-based information system for econo-enviro-friendly end-of-life disposal of construction and demolition waste. Autom. ConStruct. 125 https://doi.org/10.1016/j.autcon.2021.103611.
Shi, Q., Ren, H., Ma, X., Xiao, Y., 2019. Site selection of construction waste recycling plant. J. Clean. Prod. 227, 532–542. https://doi.org/10.1016/j.jclepro.2019.04.252.
Shi, Y., Huang, Y., Xu, J., 2020. Technological paradigm-based construction and demolition waste supply chain optimization with carbon policy. J. Clean. Prod. 277 https://doi.org/10.1016/j.jclepro.2020.123331.

Sinha, S., Shankar, R., Taneerananon, P., 2010. Modelling and case study of reverse logistics for construction aggregates. Int. J. Logist. Syst. Manag. 6, 39–59. https://doi.org/10.1504/IJLSM.2010.029720.

Skender, H.P., Host, A., Nuhanović, M., 2016. The role of logistics service providers in international trade. In: 16th International Scientific Conference Business Logistics in Modern Management. Osijek, Croatia.

Son, S., Park, K., Fitriani, H., Kim, S., 2021. Embodied CO2 reduction effects of composite precast concrete frame for heavily loaded long-span logistics buildings. Sustainability 13. https://doi.org/10.3390/su13031060.

Souza, F., Mendes, J., Morais, L., Silva, J., Peixoto, R., 2022. Mapping and recycling proposal for the construction and demolition waste generated in the Brazilian Amazon. Resour. Conserv. Recycl. 176 https://doi.org/10.1016/j.resconrec.2021.105896.

Steins, J.J., Volk, R., Schultmann, F., 2021. Modelling and predicting the generation of post-demolition autoclaved aerated concrete (AAC) volumes in Germany until 2050. Resour. Conserv. Recycl. 171 https://doi.org/10.1016/j.resconrec.2021.105504.

Su, Y., Chen, J., Si, H., Wu, G., Zhang, R., Lei, W., 2021. Decision-making interaction among stakeholders regarding construction and demolition waste recycling under different power structures. Waste Manag. 131, 491–502. https://doi.org/10.1016/j.wasman.2021.06.025.

Superti, V., Forman, T., Houmani, C., 2021. Recycling thermal insulation materials: a case study on more circular management of expanded polystyrene and stonewool in Switzerland and research agenda. RESOURCES-BASEL 10. https://doi.org/10.3390/resources10100104.

Teizer, J., Neve, H., Li, H., Wandahl, S., Konig, J., Ochner, B., Konig, M., Lerche, J., 2020. Construction resource efficiency improvement by long range wide area network tracking and monitoring. Autom. ConStruct. 116 https://doi.org/10.1016/j.autcon.2020.103245.

Tischer, A., Besiou, M., Graubner, C.-A., 2013. Efficient waste management in construction logistics: a refurbishment case study. Logistics Research 6, 159–171. https://doi.org/10.1007/s12159-013-0105-5.

Tsai, W., Yang, C., Chang, J., Lee, H., 2014. An Activity-Based Costing decision model for life cycle assessment in green building projects. Eur. J. Oper. Res. 238, 607–619. https://doi.org/10.1016/j.ejor.2014.03.024.

van den Berg, M., Voordijk, H., Adriaanse, A., 2020a. Recovering building elements for reuse (or not) – ethnographic insights into selective demolition practices. J. Clean. Prod. 256 https://doi.org/10.1016/j.jclepro.2020.120332.

van den Berg, M., Voordijk, H., Adriaanse, A., 2020b. Information processing for end-of-life coordination: a multiple-case study. CONSTRUCTION INNOVATION-ENGLAND 20, 647–671. https://doi.org/10.1108/CI-06-2019-0054.

Van den Berghe, K.B.J., Verhagen, T.J., 2021. Making it concrete: analysing the role of concrete plants' locations for circular city policy goals. Frontiers in Built Environment 7.

Volk, R., Luu, T., Mueller-Roemer, J., Sevilmis, N., Schultmann, F., 2018. Deconstruction project planning of existing buildings based on automated acquisition and reconstruction of building information. Autom. ConStruct. 91, 226–245. https://doi.org/10.1016/j.autcon.2018.03.017.

Wibowo, M., Handayani, N., Mustikasari, A., Wardani, S., Tjahjono, B., 2022. Reverse logistics performance indicators for the construction sector: a building project case. Sustainability 14. https://doi.org/10.3390/su14020963.

Wijewickrama, M.K.C.S., Chileshe, N., Rameezdeen, R., Ochoa, J.J., 2021a. Information sharing in reverse logistics supply chain of demolition waste: a systematic literature review. J. Clean. Prod. 280 https://doi.org/10.1016/j.jclepro.2020.124359.

Wijewickrama, M.K.C.S., Rameezdeen, R., Chileshe, N., 2021b. Information brokerage for circular economy in the construction industry: a systematic literature review. J. Clean. Prod. 313 https://doi.org/10.1016/j.jclepro.2021.127938.

Winans, K., Kendall, A., Deng, H., 2017. The history and current applications of the circular economy concept. Renew. Sustain. Energy Rev. 68, 825–833. https://doi.org/10.1016/j.rser.2016.09.123.

Xu, J., Shi, Y., Zhao, S., 2019. Reverse logistics network-based multiperiod optimization for construction and demolition waste disposal. J. Construct. Eng. Manag. 145 https://doi.org/10.1061/(ASCE)CO.1943-7862.0001592.

Xu, K., Kang, H., Wang, W., Jiang, P., Li, N., 2021. Carbon emission estimation of assembled composite concrete beams during construction. Energies 14. https://doi.org/10.3390/en14071810.

Yu, Y., Yazan, D.M., Bhochhibhoya, S., Volker, L., 2021. Towards Circular Economy through Industrial Symbiosis in the Dutch construction industry: a case of recycled concrete aggregates. J. Clean. Prod. 293 https://doi.org/10.1016/j.jclepro.2021.126083.

Zhai, Y., Choi, T., Shao, S., Xu, S., Huang, G., 2020. Spatial-temporal hedging coordination in prefabricated housing production. Int. J. Prod. Econ. 229 https://doi.org/10.1016/j.ijpe.2020.107792.

Zhang, X., Ahmed, R.R., 2022. A queuing system for inert construction waste management on a reverse logistics network. Autom. ConStruct. 137 https://doi.org/10.1016/j.autcon.2022.104221.

Zhu, M., Dai, J., Liu, R., Xu, J., Alwisy, A., 2021. Two-period based carbon-economy equilibrium strategy for modular construction supply planning. J. Clean. Prod. 290 https://doi.org/10.1016/j.jclepro.2020.125674.

Zulcão, R., Calmon, J.L., Rebello, T.A., Vieira, D.R., 2020. Life cycle assessment of the ornamental stone processing waste use in cement-based building materials. Construct. Build. Mater. 257 https://doi.org/10.1016/j.conbuildmat.2020.119523.

Zuo, K., Potangaroa, R., Wilkinson, S., Rotimi, J., 2009. A project management prospective in achieving a sustainable supply chain for timber procurement in Banda Aceh, Indonesia. Int. J. Manag. Proj. Bus. 2, 386–400. https://doi.org/10.1108/17538370910971045.