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Integration of circular economy principles into Dutch social housing procurement: technological, organizational and environmental practices, challenges and development potentials

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Abstract

Purpose – The procurement process is to be transformed to facilitate circular transition in the built environment by integrating the supply and demand sides' actors and resources. Compared with public bodies, Dutch social housing organizations exhibit variations in circular transition motivations and in how they govern procurement decisions. However, relevant empirical knowledge to integrate circular principles into the procurement process in the Dutch social housing sector is lacking. This research aims to investigate the integration of circular principles into the procurement process and the associated challenges in the Dutch social housing sector, and to provide development potentials based on the empirical findings.

Design/methodology/approach – Case studies with seven circular social housing projects in the Netherlands were conducted, including document studies and 18 interviews with housing associations and supply chain actors. An abductive approach with an iterative coding process was used to analyze case study data in Atlas.ti.

Findings – Various approaches are currently being adopted to integrate circular economy principles into the procurement of Dutch Social Housing, such as innovative construction and contracting methods, contracting with a consortium and adopting program-based contracts and performance-based requirements. The integration of circular economy principles is challenged by logistics and information uncertainties, a lack of knowledge on circular economy, separation of organizational structures, inefficiency in stakeholder collaboration and a lack of regulatory support in circular procurement transitions. An integrated information system, tailored circular procurement strategies and pertinent regulations and governance mechanisms are essential for the future development of circular procurement.

Originality/value – This study contributes to the current literature on circular procurement of private organizations in developed economies. It emphasizes that circular procurement should be understood not merely as a technical function but as a systematic approach encompassing technological, organizational, and environmental contexts. It also offers practical recommendations for adopting circular procurement within and beyond the construction industry.

Keywords Circular economy, Circular procurement, Supply chain management, Social housing, The built environment, Technological-Organizational-Environmental framework

Paper type Research article

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1. Introduction

The construction industry faces challenges in transforming the existing building stock in a circular way. It calls for a transition from traditional linear supply chains to circular ones (Benachio *et al.*, 2020). Circular procurement has the potential to expedite the overall transition by stimulating demand for circular services and products (EIT Climate-KIC, 2019). The European Union (2017, p. 4) defines circular procurement as "the process of purchasing services, goods or works, which seeks to contribute to closed energy and material loops within supply chains, while minimizing, and desirably avoiding adverse ecological effects and waste generation throughout the whole lifecycle of a product". The United Nations Environment Programme (UNEP) places the emphasis on the responsibility of the buyer in "supporting the assessment of designing, making, selling, reusing and recycling products to determine how to get the maximum value from them, both in use and at the end of their life" (UNEP, 2021, p. 7). From an academic perspective, Qazi and Appolloni (2022, p. 347) define circular procurement in terms of organizations "seeking to purchase regenerated biological materials toward a zero end-of-life concept where it not only closes the loop of the same supply chain, but also closes the loop of another sector's supply chain based on strong collaboration among stakeholders." For the purpose of this research, we define circular procurement as: the procurement process of circular solutions in which organizations anchor their circular ambitions in the business processes, put the circular ambitions in the market, and implement interactions with the partners internally and externally to facilitate stakeholder collaboration and close the material loops of the supply chain.

Compared to other product-based industries, the complex and fragmented characteristics of construction project delivery and production make it more challenging to integrate a circular economy with procurement in the construction industry (Ababio *et al.*, 2025a). Furthermore, the incorporation of environmental considerations into the procurement of construction projects or programs remains weak. For instance, in current public procurement rules in Europe, price is often rewarded over sustainability (Housing Europe, 2022). Selecting procurement approaches is already complex in non-circular construction projects. When combining innovative circular concepts, it is more challenging to select and follow the most appropriate procurement method (Sajid *et al.*, 2024). Therefore, it is critical to collect empirical evidence that can support the selection of procurement approaches aligned with circular transition requirements and to develop procurement strategies to stimulate demand for circular products and services, thereby further accelerating the circular transition in the construction sector (Housing Europe, 2022).

Current studies on circular construction procurement focus on the public sector and public procurement processes (Rainville, 2021; Xu *et al.*, 2022). However, a large proportion of the building stock is acquired by private and semi-public entities in the construction sector. Although the study of circular transition in public procurement could potentially stimulate the transition in the private sector by establishing standardizations and guiding the trajectory (Wang *et al.*, 2018), there are significant differences in the procurement process between the public and private sectors in terms of regulations, procurement models, and the level of fragmentation, which can lead to a lack of organized coordination practices that can facilitate the circular transformation (Xu *et al.*, 2022). Therefore, this paper examines the Dutch social housing sector as a case study to explore the circular transition of procurement in private organizations. The Dutch social housing sector is organized by housing associations, which are private, non-profit enterprises with a societal role to build, maintain, and rent houses to low-income communities and provide affordable and good-quality housing for vulnerable citizens (Priemus, 2003). It owns 30% of the Dutch housing stock, which is the largest share when compared to other European countries (Eikelenboom *et al.*, 2021). The Dutch social housing sector can play a pivotal role in the transition to a circular economy and significantly impact the entire construction industry, given its commitment to circular economy practices and substantial housing stock (Housing Europe, 2022).

As independent and private organizations, housing associations have their own purchasing processes and strategies, shaped by their internal organizational characteristics and specific projects (van Zoest *et al.*, 2020). Meanwhile, they are required to fulfill public responsibilities, which makes them partly dependent on governmental support and regulations (Lambrechts *et al.*, 2021). This dual position makes it appealing while challenging to explore housing associations' procurement choices in innovative transitions. Integrating innovative concepts, such as the circular economy, into construction procurement requires adaptation throughout the entire process (Farooque *et al.*, 2019; Kristensen, 2021). However, the approaches and strategies for achieving this transition remain unclear, as do the challenges it entails. Therefore, this study aims to investigate the current integration of circular economy principles in the procurement process of circular Dutch social housing projects and associated challenges to inspire both the social housing sector and the construction industry when transforming their procurements into a circular economy by asking the research question:

What are the current practices, associated challenges, and possibilities for development to integrate circular economy principles into the procurement process of social housing?

The remainder of the paper is structured as follows: Section 2 addresses the theoretical framework of this study, and Section 3 elaborates on the methodology adopted. The results identified from the case study in this research are described and summarized in Section 4. After that, Section 5 discusses the future research and development potential of circular procurement in the construction industry, as well as the theoretical and practical implications of this study. Section 6 concludes this study and addresses the key limitations.

2. Theoretical background

2.1 Construction procurement

Construction procurement incorporates various activities such as purchasing, tendering, contracting, pricing, and targeting, that are undertaken in construction projects to seek services, partners, knowledge, materials, equipment, etc., and realize the objectives of construction projects (Martins, 2009; Ruparathna and Hewage, 2015a; Clough *et al.*, 2000). Construction procurement is an integral part of construction projects, spanning the entire construction supply chain from project initiation and planning to project delivery. This emphasizes the importance of adopting effective management and organizational strategies in construction procurement to facilitate successful project outcomes (Bower, 2010; Ruparathna and Hewage, 2015a).

2.2 Integrating circular economy principles in construction procurement

The circular economy is about maintaining the lifecycle of materials as long as possible by slowing, closing, and narrowing material flows and adopting 9R strategies (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover) (Evertsen and Knotten, 2024). Integrating circular economy principles into the procurement process will adapt traditional procurement and purchasing to support the circular economy transition, resource efficiency, material lifecycle extension, and long-term value creation (Qazi and Appolloni, 2022; Xu *et al.*, 2022). Several emerging procurement strategies and innovative procurement techniques, such as integrated project delivery, performance-based procurement, lifecycle analysis tools, leasing and take-back services, and product-as-a-service, have been identified as essential for stimulating circular transition (De Angelis *et al.*, 2018; Goh *et al.*, 2023; Rahim *et al.*, 2015). The Netherlands has maintained a robust policy of including performance requirements in construction procurement for many years, wherein environmental criteria are articulated as performance metrics for specific projects (Kadefors *et al.*, 2021). Besides the environmental contribution of circular procurement, Witjes and Lozano (2016) emphasized the socio-economic contribution of the circular economy and examined the interplay between business models and procurement to enhance resource lifecycles. Furthermore, procurement policies have been

recognized as essential to the circular transition by developing guidelines for circular procurement, standardizing green products and services, and promoting incentives for adopting circular procurement (Hjaltadóttir and Hild, 2021; Mojumder *et al.*, 2022).

2.3 Technological, organizational, and environmental framework

Previous studies have examined circular procurement from various aspects and theoretical lenses. For instance, Sönnichsen and Clement (2020) summarized that studies primarily look at circular procurement from the organizational aspects, individual behavior, and operational tools. The following aspects have been identified as crucial for circular procurement transitions: the organizational structures and strategic visions of organizations in supporting circular procurement, the awareness and knowledge of individuals on the adoption of innovative tools and circular procurement strategies, and the operational readiness and effectiveness for innovative transition. Xu *et al.* (2022) investigated the internal and external antecedents for the facilitation and inhibition of circular procurement. Internal antecedents, including the strategic and executive levels of organizations in circular procurement adoption, and external antecedents were developed based on institutional theory and covered regulatory, normative, and cultural-cognitive aspects. Ababio *et al.* (2023) emphasized the supply chain management in circular procurement, spanning across the entire lifecycle of construction projects. The investigation of supply chain management in the construction industry focused on materials flows, value flows, information flows, stakeholder roles, and stakeholder interactions (Leising *et al.*, 2018; Studer and De Brito Mello, 2021; Vrijhoef and Koskela, 2000). Cramer (2024) adopted a multi-scale lens in circular procurement, i.e. micro-level, meso-level, and macro-level. At the micro-level, the procurers' internal organization was focused on; interrelationship with other organizations was examined at the meso-level; and political support, social obligations, and culture-cognitive expectations of stakeholders constituted the macro-level. Sinha and Sethuraman (2025) argued that the environmental factors, governance mechanisms, and financial feasibility are the most prominent determinants for successful circular economy adoption in the construction industry.

Previous theoretical lenses used in circular procurement studies can be synthesized as organizational structures, inter-organizational interactions, technological readiness and operational tools, and external antecedents, including institutional, regulatory, societal, and cultural aspects. These lenses align well with the Technology-Organizational-Environmental (TOE) framework, introduced by Tornatzky and Fleischer (1990), which combines an organizational-level perspective with innovation and technology adoption while accounting for wider environmental context. It has been widely used to study the implementation of innovation in organizations and projects since then (e.g. Sani and Jaafar, 2025; Singh *et al.*, 2024). This framework enables understanding of the complex dynamics of the innovative transition from both internal and external organizational perspectives by collectively considering technological readiness, organizational capabilities, and environmental influences. Therefore, this study adopts the TOE framework as a theoretical lens for analyzing circular procurement. In this study, the technology aspect pertains to the technical elements inherent in circular procurement strategies and their implementation process; the organizational aspect encompasses the organizational structures and capabilities, as well as interactions among various organizations in the supply chain of the circular procurement process; and the environmental aspect comprises external factors and system changes affecting circular procurement transition, including regulatory frameworks, governance structures, and social-economic conditions, for instance (Sani and Jaafar, 2025; Singh *et al.*, 2024).

3. Methodology

A multiple case study approach was adopted to explore current practices of circular procurement in Dutch social housing. Case study research is an empirical research method for

examining contemporary phenomena in depth in the real world, where the investigators exert limited control over what is happening (Yin, 2009). The investigation of multiple cases in case study research could complement findings from each case and enhance the external validity and generalizability of research findings (Merriam, 1998). The unit of analysis in this research is the procurement process of individual housing associations, examined at the organizational or project level, including interactions with supply chain partners. Various datasets were used to gather information pertinent to the research theme and to corroborate evidence from different sources. The datasets include semi-structured interviews with housing associations and other supply chain actors, as well as desk research on relevant reports, documents, and web pages.

Although the Dutch social housing sector offers incentives for a circular transition in both its existing and new housing stocks, not every housing association has implemented circular economy principles in its procurement practices. As the primary aim of this study is to examine procurement practices in the circular transition of Dutch social housing, only housing associations with experience in circular practices are within the scope of this research. More specifically, the criteria to select appropriate case studies are: 1) housing associations that have effectively executed at least one circular project with explicit mention of circular strategies adopted; 2) have implemented the circular economy with multiple actors in the supply chain; and 3) have been implementing the circular economy at either organizational or project scale. Following an online review of the circular practices of various housing associations, nine associations were selected that met the three criteria. Due to practical access limitations, case study research was ultimately conducted with seven of those nine housing associations. Desk research and 18 semi-structured interviews were conducted with seven housing associations and additional supply chain stakeholders, such as contractors and architects. Comprehensive information regarding the cases and interviewees is available in Table 1.

Table 1. Case description

Case	Circularity adoption scales	Circular strategies adopted	Informant roles
Housing Association A	Organizational scale	Reuse of materials, bio-based materials, reduce 50% of environmental impacts	Real estate manager
Housing Association B	Organizational scale	Reuse; concept house; bio-based material; reassembled building; removable building	Managing director; Project manager; Contractor
Housing Association C	Organizational scale	Reuse of materials, improve energy use, quality, environmental impact and make a building demountable	Advisor & Project Leader in circularity; Program manager
Housing Association D	Project scale, moving towards organizational scale	Reuse; movable, modular, and reusable building; bio-based materials; use local materials	Program manager; Project leader
Housing Association E	Project scale	Bio-based materials; use materials from the same area; circular demolition	Sustainability advisor; Real estate manager; Demolisher[a]; Consultant[a]; Digital firm
Housing Association F	Project scale	Reuse; transform existing buildings to other functions	Real estate manager; Supplier; Maintenance contractor
Housing Association G	Project scale	Reuse; circular materials	Project manager; Architect and consultant

Note(s): [a]Interview with this stakeholder was conducted in Dutch originally

Source(s): Authors' own work

Semi-structured interviews were conducted with housing associations to investigate existing procurement practices in circular social housing projects. Additionally, to complement the information from interviews with housing associations, a snowballing approach was used in certain cases to identify related supply chain partners (such as contractors, architects, and demolition contractors) and conduct semi-structured interviews with them. An interview protocol was used to guide semi-structured interviews. The protocol included five primary categories of questions: 1) general practice of procurement in circular projects, 2) challenges faced in procurement of circular projects, 3) objectives to achieve in circular procurement, 4) stakeholders involved in circular procurement and their interactions and labor division, and 5) the use of tools and technologies in circular procurement. The protocol was iteratively refined throughout the data collection process to incorporate emerging insights, while ensuring consistency in the primary question categories across all interviews. Access to the detailed interview protocol can be found in the data availability statement. Some of the interviews were conducted face-to-face, and others were conducted online via Microsoft Teams. Each interview lasted between 1 and 1.5 h, totaling around 900 min. Most of the interviews were conducted in English, whereas two were conducted in Dutch and later translated into English. All the interviews were recorded and transcribed with the consent of the interviewees. Alongside the interviews, relevant presentations and reports provided by interviewees, as well as reports and information from the internet, were collected and analyzed to complement the data. The data collection, data analysis, and data management plan (DMP) have been approved by the Human Research Ethics Council (HREC).

After data collection, thematic analysis was used to analyze both interview and desk study data. To make sure the analysis of circular procurement aligns with both previous studies on construction procurement and the specific empirical context in this research, an abductive approach and iterative coding process were used to identify the qualitative themes and code data accordingly (see Figure 1). In the iterative coding process, the initial themes used were generated from both the theoretical frameworks on construction procurement, the TOE framework, and its factors mentioned in Section 2. These qualitative themes include contracting activity, tendering activity, pricing activity, challenges, development potentials, technological perspectives, organizational perspectives, environmental perspectives, as well as factors from the TOE framework, such as technology adoption, stakeholder interactions, and regulatory considerations. Then, peculiarities of procurement practices, challenges, and possibilities that are specific to circularity were identified from the T-O-E lens with an abductive and iterative approach. These emergent categories, shown as sub-sub-themes in Table 2, were identified and adjusted according to the raw data from interviews and documents alongside the coding process. This process was repeated iteratively until the final themes aligned with the theoretical framework and the raw data were linked. The final coding was conducted with the final qualitative themes in Atlas.ti software, as shown in Table 2.

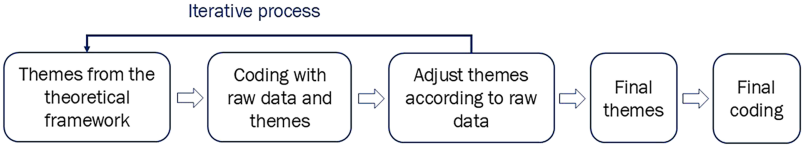

Figure 1. Iterative coding process. Source: Adapted from Willumsen *et al.* (2019)

Table 2. Qualitative themes in Atlas.ti

Example of raw data	Principal theme	Sub theme	Sub-sub-theme
"It is better to be selected based on a vision and then create a design together with the client than to have a complete design developed (before selection)." (Architect of Housing Association G)	Practice	Technological factor	Evaluation tools; Circularity measurement tools; Digital technologies
"After the newly built houses are delivered. The maintenance department takes over and starts with our own contractors. So we are two companies, one company builds, and the other one maintains and improves." (Housing Association C)		Organizational factor	Intra-organization structures: Circular ambition; Organization structure; Type of project
"We choose to cooperate in a supply chain. So we contract the supply chain with supply chain integration." (Housing Association A)			Supply network: Stakeholder roles; Stakeholder interactions; Information flow; Materials flow; Value flow
"We continuously look into the opportunities we see during the project to claim other national or regional subsidies and tax schemes." (Documents of Housing Association B)		Environmental factor	Regulation and governance; Market influence; Social impact; Economic conditions
"But then we need the right data, the right information, and right questions . . . The quality of the data is very important. But now . . . the database is incorrect, so we have to be sure that all data is validated." (Housing Association D)	Challenge	Technological challenges	Information uncertainty; Material and logistic uncertainty
"The most challenging part for me was the communication within the project. (The manufacturer) sometimes suited a change better for the product, but didn't communicate about it . . . without consulting the housing association or us." (Contractor of Housing Association B)		Organizational challenges	Intra-organizational structure; Supply chain challenge
"Normally we have a program of the requirements, (but in this case), there were (only) three ambitions . . . And then we are going to make the plan. That's what makes me uncomfortable. What will I get? And can I pay it?" (Documents of Housing Association B)		Environmental challenge	Regulation limitation; Market uncertainty

(*continued*)

Table 2. Continued

Example of raw data	Principal theme	Sub theme	Sub-sub-theme
"I think you should always have a good system to measure and combine program and data. Everyone is using the same database. Otherwise, you can't measure correctly." (Housing Association D)	Development potentials	Technological potential	Digitalization and information management
"A project leader hates when his process gets stuck. So we have special project leaders who will do nothing else but change and pilots. It's also a standard. But a different one." (Housing association C)		Organizational potential	Intra-organizational structure; Supply chain network
"Building up an organization within the umbrella housing association in the Netherlands to professionalize those standards, and we want to use the standards from other organizations as well." (Housing Association B)		Environmental potential	Regulation and governance; Market; Business model; Social impact

Source(s): Authors' own work

4. Results

4.1 Integrate circular economy principles into the social housing procurement process

Circular procurement is in its nascent stage in Dutch social housing. Due to the absence of shared objectives among housing associations in the Netherlands, each association is formulating its own plans and goals for the circular transition. Only housing associations with high levels of circular adoption have intentionally planned and conducted circular procurement in pilot projects. Though most housing associations lack a structured strategy for circular procurement, their tendering and contracting processes differ from typical projects. This research identifies how circular principles are integrated into the procurement process through technological, organizational, and environmental lenses across contracting, tendering, and pricing activities.

4.1.1 Technological lens. 4.1.1.1 Adopt innovative construction methods. From the techno-centric perspective, Housing Association B employs modular and prefabricated construction techniques in pilot circular projects, allowing contractors to act as intermediaries between clients and manufacturers rather than directly delivering houses. The industrial approach adopted in this project optimized material flow by eliminating residual flows or by returning materials to suppliers. The transport movements of prefabricated houses are around 25% lower than those of traditional constructions. Housing Association G also prefers prefabricated buildings in circular projects to reduce reliance on contractors, as most contractors in the Netherlands still prioritize cost over environmental performance. Modular houses in circular projects enable housing organizations to ascertain the concept's viability and quality in advance.

4.1.1.2 Implement circular-related selection criteria. The most critical criteria for housing associations to select partners for circular social housing include: the circularity of materials and design, the detachability and reusability of materials, the CO2 emissions of projects, bidders' innovation capability and experience in circular projects, the cost of projects, and trust between clients and bidders. Some housing associations also combine circularity with other goals in the tendering process, such as energy transition, biodiversity, and climate adaptation. Besides, partnerships with local companies and equality between partners are also essential criteria in the selection process. Price is not the most crucial factor for most housing associations now, as they are still in the pilot stage of the circular transition. They want to use

the pilot projects as experiments and learn from them. *"Money is important, but not the most important part. We have our own budget, and we must be within the budget . . . but in an experimental project like this, the first time, we accept that the cost is a little bit higher (Housing association C)"*.

4.1.2 Organizational lens. 4.1.2.1 Contract with consortia and program-based contracts. Supply chain integration is a goal for several housing associations' circular transformation. To achieve this, housing associations usually enter contracts with a consortium comprising the contractor, architect, and demolisher (if applicable), which collaborates and shares value from the outset. According to Housing Association A, during the collaborative process with their partners, no entity assumes a dominant role. Rather, supply chain partners synergize their expertise and collaborate equitably to achieve alignment across the supply chain. Contractors sometimes also intentionally close the supply chain by including suppliers early in the circular steps and by partnering with local businesses to minimize logistical challenges and promote their growth.

Some housing associations are targeted for investment in a long-term circular economy to create value over time. They prefer to make program-based contracts with partners to establish trust and meet supply and demand commitments. The long-term contracts between clients and contractors facilitate their collaboration in circular construction throughout time, allowing them to learn from their experiences. Nonetheless, as asserted by the program manager of Housing Association C, the programmatic nature of the plans makes it challenging to implement changes once the program has been decided or commenced. Prior arrangements must be established to incorporate circularity innovations into the program.

4.1.2.2 Adopt innovative contracting methods. Housing association B aims to adopt circular procurement for at least 50% of new construction in the coming decades. They started this by adopting the Rapid Circular Contracting (RCC) method in a pilot circular project. The UK-developed RCC contracting method is designed especially for circular transition in the built environment. Following this contracting method, clients and partners will collaboratively plan and design projects after the award (Pianoo, 2017). However, in the case of Housing Association B, the RCC method was adopted only in the initial phase of the circular project, without any financial aspects or design plan attached to the contract to guide and facilitate collaboration among supply chain partners. It was ultimately discarded during the execution phase due to its protracted communication and decision-making processes, which delayed project progress. Additionally, it has proved challenging to integrate a contractual system developed under UK legislation within a Dutch context.

4.1.2.3 Adopt best value procurement and performance-based requirements. Housing associations want to challenge their contractors in tendering. This requires purchasing strategies such as prioritizing performance-based requirements over key performance indicators in tendering and using competitive bidding to increase market participation and competitiveness. Housing Association A adopts Best Value Procurement (BVP) through open bidding to select and evaluate partners for circular projects. BVP was created by Dean Kashiwagi and the Performance Based Studies Research Group (PBSRG) from 1991 to 2010, with consideration on price and performance when choosing partners (PBSRG, 1991). With this approach, bidders must demonstrate their ability to meet the circular performance criteria established by the housing associations in tendering. Building upon BVP, Housing Association A delineates the expected performance for contractors to achieve, instead of specific requirements or indicators. Housing Association B implements a Value for Money strategy in the bidding process to balance quality, cost, and benefits. It also awards based on bidders' conceptual visions, without accurate pricing or comprehensive technical specifications, and develops design plans collaboratively after the award.

4.1.2.4 Explore the circular economy with familiar contractors. In contrast to open bidding, another tender approach is to negotiate with familiar contractors who already have long-term partnerships with housing associations and to explore circular strategies together. Current contractors are familiar with the properties, and some even live in the same area, which enhances their ability to oversee the maintenance of housing stocks after. Housing Association

F asserts that employing these contractors and retaining them locally is also a form of circular transition. Consequently, long-term relationships are more likely to be built between housing associations and their contractors. *"We try to keep it (partnership with contractors) local . . . Especially if you have to maintain a building, you also have to talk with people who live in the building, and you have to communicate very well (Housing Association F)."*

4.1.2.5 Adapt pricing method and apply shared investment. A fixed-price technique is typically employed as the basis for pricing in circular social housing between clients and contractors. In a fixed-price method, contractors receive remuneration based on a predetermined price established in the contract. However, due to uncertainty in cost estimates before detailed construction plans are developed in circular projects, housing associations need to leave room for price adjustments during execution. *"We pay the same price for the standards we make. When we have something totally new in it, we make a new price, so that's not fixed upfront, but within the fixed prices we have (Housing Association C)."* In some cases, supply chain partners also actively aim to distribute investment equally as a consortium in which various organizations assume leadership in distinct aspects of the circular transition. A shared value in the supply chain is attained through collaborative investment. *"We invest together in circular economy . . . If we contract consultants to do research for us, we split the bill. We also try to split the innovation costs, because one company takes the lead in sustainability, the other company takes the lead in total cost of ownership and develops a relevant strategy (Housing Association A)."*

4.1.2.6 Compare different project types. Most housing organizations have different procurement procedures for circular renovations and circular new builds. This stems primarily from the differing requirements and objectives of these two construction forms, as well as the distinct circular strategies employed. Besides, different departments within housing associations are responsible for renovation and new construction, which leads to different approaches being adopted for each. There are also differences in procurement between pilot initiatives and long-term plans. At Housing Association C, pilot projects for circular renovation restimulate regular long-term plans to test innovative circular materials or processes. Housing associations tend to make different choices in partner selection, tendering methods, and evaluation criteria in pilot projects compared to regular long-term projects. This is because housing associations are more willing to take risks, prioritize circular performance and qualitative factors over cost, and invest more money in pilot projects. Should the pilot project prove successful, it will be included in the standard procedure and establish a new norm.

4.1.3 Environmental lens. 4.1.3.1 Involve residents in decision-making. In a unique experimental project of Housing Association D, a close collaboration was established between the housing association and its residents. Residents in this project participated in the decision-making process for the contracting and tendering activities for circular renovation. They were also involved in the design and execution of the circular renovation of their residences, with some employed by the contractors. Involving residents in the circular transition of their own housing stimulated their motivation and interest in the circular economy and created social impacts by creating job opportunities for some of the residents. However, due to the varying education levels of residents living in social housing and the lack of an appropriate monitoring system, it was also challenging for housing associations to communicate with residents and convey pertinent rules efficiently and effectively.

4.1.3.2 Use regulatory and financial incentives for circular transition. Housing associations take the initiative to invest in the circular transition and rely on policies and regulations to create opportunities for additional cash flow, facilitating further investment in the circular economy. In the Netherlands, the government established tax and subsidy incentives for circular transition, which promote housing associations and supply chain partners' investments in sustainable and circular initiatives. For instance, the architect and consultant of Housing Association G said: *"the projects that we do, often require subsidy. It is not feasible without subsidy from the province or from the municipality."* Alongside regulatory incentives for the circular transition, housing associations and their partners actively create financial value and ensure long-term benefits. In the case of Housing Association B, contractors take

Total Cost of Ownership by selecting detachable, reusable materials with minimal maintenance requirements, constructing energy-efficient housing, and ensuring the home retains its value at the end of its lifespan. However, even though the materials are designed to be detachable and reusable, it is still difficult to forecast residual values due to the unpredictability of future demand.

4.2 Challenges in integrating the circular economy principles into the Dutch social housing procurement process

4.2.1 Technological challenges. In circular housing renovation, a major challenge is the time and space gaps between material harvesting and reuse. This challenge directly influences the division of labor between demolishers who harvest materials and contractors who purchase and reuse those materials on the storage of these materials. *"For new goods, the delivery is quite certain, but for reuse projects, it is not certain. You have a gap between harvest and reuse. When the goods are harvested and before you use them, where do you put them . . . Do you have space for your own, or does the party that delivers it have room for it (Housing association D)?"* Some practitioners mentioned the significance of integrated management of the entire material supply chain to reduce logistics gaps in material reuse.

Most social housing managers have expressed a need for data about their properties to predict damage, assess the reusability of materials, and exchange information with partners. However, the quality, interpretation, and value of the data remain uncertain to them. Although most practitioners have recognized the necessity of data, some have argued that uncertainty about the value of information would only result in more information, rather than fundamental changes in circular transition. *"But then I thought: will it make a direct impact on circular economy? Because you're not making a change, you're just getting more information. And when you have more information, you probably can make the change. But I think in this stage it is a better way to use it to make direct impacts instead of making digital twins of all the things (Housing association D)"*.

4.2.2 Organizational challenges. Organizational challenges are twofold: those arising from internal organizational structures and those associated with external interactions with other supply chain stakeholders. From an internal organizational perspective, housing associations' limited knowledge and understanding of circularity and circular procurement constrain their options when determining procurement strategies and hinder their ability to scale up their circular programs. In most cases, they can adopt innovation only at the project level and use pilot projects as opportunities to gather insights for future projects. Separation among different departments within housing associations, such as procurement, digitalization, and sustainability, also hinders the circular transition due to a lack of communication and goal alignment across departments.

External organizational challenges arise from the division of interactions and responsibilities among supply chain stakeholders. Unlike conventional building procedures, where the contractor or architect oversees the entire design, supply chain partners now collaboratively develop design plans. Therefore, robust cooperation is required from the beginning of the project. However, stakeholder collaboration and early engagement are challenged by ineffective communication and frequent project redesigns. Besides, the risk-avoidant nature of most supply chain partners and their limited capacity for innovation increases supply chain uncertainty. Moreover, there are also challenges in the division of responsibilities among different stakeholders. For instance, most housing associations are willing to use digital tools in circular projects when it is easy and necessary. However, the responsibilities of developing and maintaining digital tools between housing associations and their contractors remain unclear. *"Who has access to the data in the digital twin? Who can make changes in the digital twin? If something is wrong, do we have to do it ourselves, or can we let our contractors handle it? . . . There must be a protocol (which indicates) what he (contractor) can do, how he (contractor) has to do it (Housing association C)"*.

4.2.3 Environmental challenges. Housing associations face uncertainties about costs, project quality, and loosely defined project plans when entering into agreements with selected partners in circular procurement. In traditional tendering, contractors present a detailed project plan to clients to set expectations for price and outcome. However, circular procurement shifts from clients solely defining technical specifications and requirements to mutual planning with other partners. More risks arise on both the demand and supply sides in this transformation process without adequate regulatory and governance support. Since project quality is difficult to predict when entering into agreements, contractors on some of the circular projects of Housing Association B no longer provide maintenance services. Moreover, implementing the circular economy in existing contract types is likewise uncertain. The inflexibility of existing contract types and the lack of governance mechanisms to support changes make it nearly impossible to modify a fixed contract without incurring significant penalties. Similar challenges arise when plans are established at the program level, as changes become difficult once the program has been decided on or commenced.

The lack of relevant governance and regulatory support also challenges the division of responsibilities among supply chain partners in the circular economy. Supply chain partners, primarily suppliers, manufacturers, and demolishers in this instance, contended over who should assume responsibility for providing material certification. Currently, some manufacturers and suppliers of reclaimed materials are issuing certifications to circular materials. Occasionally, an external engineering firm is accountable for this. The absence of a standard, generalized rule for circular material certification often causes suppliers to acquire substantial quantities of unusable materials from demolitions, resulting in significant waste.

5. Discussion

5.1 Development of circular procurement in the construction industry

Based on the findings presented, development potentials from technological, organizational, and environmental aspects are briefly discussed here.

5.1.1 Technological factors. First, it is recommended to investigate the potential and value of using digital technologies and information systems in circular construction procurement to align material and information flows and to reduce uncertainties. An integrated information system could be developed within and across organizations, which facilitates the management of all data and information of housing portfolios in circular transition and aids the associated decision-making processes (Sajid *et al.*, 2024). A top-down approach at the organizational level, incorporating housing portfolio programs, is suggested for implementing the information system. Simultaneously, future studies are recommended to focus on balancing the costs of intelligent systems with the benefits of these investments. Second, this study suggests that, unlike traditional procurement, circular procurement brings to the fore considerations about the long-term management of the built asset. In such long-term considerations, actions such as adopting modular construction are seen not simply as a stand-alone technological innovation, but one that transforms a contractor-driven project approach to an industrial process that can improve the efficiency of material and information exchange. Nevertheless, to further enhance the adoption of modular construction, pertinent contract forms and a regulatory framework will be required to clearly regulate the distribution of responsibilities and the sharing of risks and benefits among stakeholders.

5.1.2 Organizational factors. Previous studies suggested that tailored circular procurement strategies are required for specific contexts and organizations to adopt circular procurement at each different stage (Ababio *et al.*, 2025b; Qazi and Appolloni, 2022). Considering the diverse housing associations in the Netherlands, which are at different stages of circular transition and have varying organizational scales and ambitions, a one-size-fits-all procurement model is insufficient to support the transition to circular construction. Instead, the circular procurement model must be adaptable to account for these differences and address potential uncertainties (Cheng *et al.*, 2018; Granheimer *et al.*, 2022). Therefore, this study suggests developing a

protocol with tailored guidance across different activities and stages of procurement, considering the diverse situations of housing associations, offering more practical and effective support, and monitoring the implementation of the tailored protocol (Abadi *et al.*, 2025). Moreover, it is essential to integrate the separate departments within housing associations to align their circular objectives and procurement approaches during the circular transition.

Besides, from the inter-organizational perspective, this study shows that circular procurement cannot be implemented by clients alone but requires integrated coordination across the construction supply chain. Previous studies argued that although clients' capabilities, commitment, and leadership take essential roles in the circular procurement transition (Akomea-Frimpong *et al.*, 2025; Kadefors *et al.*, 2021), reliance on demand-side stakeholders and on demand for circular products will hinder the development of the circular market. This is because demand-side stakeholders are not always clear about their requirements, the market readiness, innovative solutions, and new business models (Dadzoe *et al.*, 2024; Kristensen, 2021). Stakeholder collaborations need to be strategically established during the procurement process (Rainville, 2021). It is also essential to comprehend the interests and requirements of diverse stakeholders throughout the process while seeking shared benefits and objectives (Alhola *et al.*, 2019; Assaad, 2024). Furthermore, this study finds that the choice of procurement approaches in the early stages of a project consistently shapes supply chain dynamics throughout the process. For instance, innovative contracting methods and consortia encourage early involvement of key partners and supply chain collaboration. Program-based contracts are more likely to facilitate long-term collaboration, align stakeholder goals and values, and promote trust and consistent communication across stakeholders. Future studies are suggested to focus on facilitating multi-stakeholder collaboration and synthesizing the requirements of different stakeholders in circular procurement. It is also essential to investigate the interrelationship between procurement approaches and supply chain dynamics during the circular transition to further stimulate circular supply chain development and to align procurement strategies with stakeholder requirements and interactions (Stokke *et al.*, 2023). Potential contract forms and compliance activities should be investigated to support stakeholder collaboration and the integration of their requirements (Lingegard *et al.*, 2021b).

5.1.3 Environmental factors. Integrating circular requirements or innovative models directly into conventional procurement processes is inadequate and will result in numerous challenges. Instead, a systematic transformation of the process and procurement environment is required to align the overarching business objectives and stakeholder expectations (Ogunmakinde *et al.*, 2025). Previous studies identified the importance of financial incentives, associated business models, and appropriate policies and regulatory instruments to facilitate systematic transformation and effective implementation of circular procurement (Ababio *et al.*, 2025b; Ahmed *et al.*, 2023; Sajid *et al.*, 2024). This study identifies specific solutions to stimulate circular procurement transition, such as reducing taxes on circular materials and projects and as regulatory incentives and incorporating the Total Cost of Ownership model as financial incentives. Besides, industry nudging and the market environment influence the implementation of circular procurement. The adoption of open bidding might increase market competition and nudge companies to transform due to the competitive market pressures (Xu *et al.*, 2022). Innovation risks may diminish if follow-up contracts are secured in a niche market (Adjei-Bamfo *et al.*, 2023). Moreover, it is important to develop pertinent regulatory frameworks and contract forms to govern the contracting process and contract types, and monitor compliance in circular procurement to reduce associated uncertainties. Bao *et al.* (2019) proposed that future contracts should specify the contingencies that pertain to transactions in circular transition. The distribution of responsibilities among stakeholders in the circular transition should also be clearly identified in contract specifications and supported by pertinent regulatory rules.

Although each housing association in the Netherlands has the autonomy to procure and manage its properties independently (van Zoest *et al.*, 2020), most of them have indicated that a unified and standardized circular procurement approach will facilitate their circular transition. The overarching organization of social housing in the Netherlands, which provides a platform for housing associations to develop visions and exchange ideas (Aedes, 2016), could play a leading role in establishing standards and regulations for the circular procurement of Dutch social housing. Besides, previous studies found that the national government in the Netherlands has clear objectives and plans for the sustainable procurement transition in large infrastructure projects, which have also been implemented successfully in practice (Lingegard *et al.*, 2021a). Therefore, private and semi-public sectors could also learn from the large public sectors in the Netherlands regarding sustainable and circular procurement.

Previous studies argued that future studies on circular procurement should focus on the social impact it creates, given that the majority of existing studies primarily examine economic and environmental dimensions (Ababio *et al.*, 2023; Xu *et al.*, 2022). This study has analyzed a specific project in Dutch social housing renovation, in which societal values are shaped through residents' participation in the procurement and renovation processes. Residents' participation in circular renovation contributes to Social Return on Investment by creating employment opportunities for residents living in social housing. However, this kind of project remains a unique project, lacking widely applicable and pertinent regulations to support and monitor residents' participation. Future studies are recommended to evaluate the social performance of residents' participation and investigate the legal and contractual environments that can stimulate and support residents' participation.

5.2 Theoretical contribution

Previous studies predominantly examined circular procurement in the public construction sector and focused on the clients' perspective. This study examines the circular procurement of private clients as housing associations in a semi-public sector without the mandatory requirement to follow public rules and regulations (van Zoest *et al.*, 2020). Compared with public circular procurement, there are fewer regulations governing circular non-public procurement, making it more challenging to establish a systematic approach to circular procurement in the private and semi-public sectors. In our study, this is evident in how each housing association develops its own procurement strategy based on project-specific conditions, while also facing the risks and uncertainties of innovation due to limited external support and guarantees. Besides, most existing studies on circular construction procurement focus on the barriers that hinder the transition (e.g. Ababio *et al.*, 2025b; Qazi and Appolloni, 2022; Sajid *et al.*, 2024), although this has started to shift to the solutions to tackle the barriers as pointed out by Polonsky *et al.* (2022). This study goes beyond challenges by examining the integration of circular economy principles into procurement, identifying practical achievements, validating challenges identified in previous research, and proposing future developments in circular procurement.

Furthermore, previous studies claimed that significant regional differences exist in circular procurement development, with strategies and approaches shaped by local regulations, policies, market readiness, and cultural and societal contexts, for example (Ruparathna and Hewage, 2015b; Xu *et al.*, 2022). This study contributes to a case in developed countries. In addition, studies have shown that developed economies have more complex supply chains that are less flexible and more resistant to change than those in developing economies (Ababio *et al.*, 2025b). This is reflected in our findings, which show that housing associations often need to separate pilot projects from regular projects to adopt innovations. Meanwhile, once circular strategies are introduced into the supply chain, it becomes difficult to assign new circular-related responsibilities among stakeholders in a way that is both reasonable and well-coordinated.

Overall, this study contributes to the novelty of circular procurement by emphasizing that integrating circular economy principles into procurement should move beyond viewing it

solely as a purchasing and tendering technique. Instead, circular procurement transformation should be understood as a systematic approach, encompassing technological, intra-organizational, inter-organizational, societal, governance, and regulatory dimensions (as synthesized with the TOE framework in Table 3). Within these dimensions, this study makes particular contributions to the societal and regulatory ones, broadening the comprehension of circular procurement in Dutch social housing. It contributes to the societal impacts of circular procurement by analyzing residents' participation in the procurement of circular social housing renovation, when the majority of existing studies primarily focus on economic and environmental dimensions (Ababio *et al.*, 2023; Xu *et al.*, 2022). It also emphasizes the regulatory lens on circular procurement transformation by identifying the challenges posed by the lack of relevant governance mechanisms and proposing potential future regulatory

Table 3. Integration of circular economy principles in the procurement process of Dutch social housing

	Practices	Challenges	Development potentials
Technological factor	• Modular and prefabricated techniques • Circular-related criteria for tender evaluation	• Logistics uncertainties • Information uncertainties	• Investigate the values of digital technologies and information systems • Development of an integrated information system
Organizational factor	• Contracting with consortia and program-based contracts • Innovative contracting methods • Best Value Procurement and performance-based requirements • Explore the circular economy together with familiar contractors • Keep adaptation in pricing method, adopt shared investment, and keep financial incentives in the circular economy • Different strategies between circular new construction and renovation, as well as pilot projects and regular projects	• Limited knowledge and capability to implement circular procurement • Separation of different departments within housing associations • Supply chain uncertainty • Inefficiency in stakeholder collaboration • Uncertainty in responsibility distribution	• Tailored circular procurement strategies at different stages of circular procurement • Facilitate multi-stakeholder collaboration and synthesize their requirements • Investigate the interrelationships between procurement approaches and supply chain dynamics
Environmental factor	• Involve residents in decision-making • Total Cost of Ownership	• Lack of regulatory frameworks on the contracting process and contract forms • Lack of regulation and governance on responsibility division	• Develop associated business models • Industry and market nudging • Develop pertinent regulatory and governance frameworks • Standardize circular procurement • Facilitate residents' participation and associated societal value

Source(s): Authors' own work

developments. This includes standardized circular procurement frameworks, tax incentives, and regulatory support for specifying contract contingencies.

5.3 Practical implications

From a practical perspective, this study can be referenced by both private and public clients to facilitate their transition to circular procurement and enhance their purchasing and contracting operations in the circular economy. The practice, challenges, and development potentials of circular procurement have been synthesized in Table 3. This study employs a supply chain perspective to analyze circular procurement and finds that both clients and supply-side stakeholders, such as contractors and architects, could improve their bidding and project execution competencies in circular practices based on the findings of this study. While the Dutch Social Housing sector is not mandatory to follow the public procurement rules, the public sector is nonetheless obligated to promote both private and public procurement in a circular transition (Xu *et al.*, 2022). This study also advocates for pertinent regulations, governance mechanisms, guidelines, and increased industry and market emphasis to support the transition to circular procurement in private and semi-public construction organizations. Policymakers may consider the findings from this study when devising regulations and policies for the circular procurement implementation in the construction industry. In the end, this study has presented a case in the social housing sector of a developed country; nevertheless, its findings could be extended and validated in other construction sectors, industries, and regions.

6. Conclusion

This study investigated the integration of circular economy principles into the procurement process in the Dutch social housing sector and examined its challenges and development potential through technological, organizational, and environmental lenses. A case study research method was adopted, including desk research and semi-structured interviews. Various procurement approaches and techniques are adopted to integrate circular economy strategies in Dutch social housing, such as adopting modular construction, contracting with consortia, and involving residents in decision-making. Both intra-organizational factors (limited knowledge and capabilities in the circular economy transition and departmental silos) and inter-organizational factors (supply chain uncertainty, stakeholder collaboration uncertainty, and responsibility distribution uncertainty) challenge housing associations' circular practices. The lack of governance mechanisms clarifying stakeholder roles and responsibilities distribution also hinders circular transition and the establishment of effective collaborative frameworks. Future development of circular procurement in Dutch social housing should focus on developing an integrated information system for circular procurement, creating tailored circular procurement strategies for different organizations, facilitating multi-stakeholder collaboration, establishing pertinent regulatory and governance frameworks, and standardizing the process at the sector level.

By examining the Dutch social housing sector as a semi-public sector, this study provided an important example of the circular transition of non-public procurement in the absence of a strictly regulated procurement system. It emphasizes that the circular transition of non-public procurement relies less on compliance and more on technological advances, organizational initiatives, inter-organizational coordination, and enabling institutional conditions. Because circularity requires whole lifecycle thinking, engagement with actors extends far beyond business-as-usual procurement. This leads to greater consideration of issues such as maintenance routines, innovative construction approaches, and their implications for pricing mechanisms, redistribution of stakeholder responsibilities, and changing supply chain dynamics. Furthermore, while activities such as innovative contracting and construction approaches are already discussed in existing literature, integrating circularity into these

activities requires a more systematically coordinated approach, in which procurement plays a central role. Such transformation also demands a broader consideration of resource management, not just resources from the supply chain but also from a planetary perspective. Consequently, new ways of measuring key performance indicators, developing integrated information systems, and establishing regulatory support and market incentives are essential to facilitate the large-scale implementation of circular procurement.

The results of this study indicate that sectors with substantial asset ownership and societal obligations, such as social housing, have the potential to expedite the circular transition within and beyond the construction industry. However, realizing this potential requires a shift from fragmented pilot initiatives within individual sectors to comprehensive integration and standardization throughout the whole industry. Consequently, future research should prioritize longitudinal evaluations of circular procurement practices, cross-sector and cross-industry comparisons, and the development of practical frameworks that translate pilot projects into extensive implementations.

The case study method used in this research has limitations due to the exclusive selection of housing organizations experienced in circular practices, which may introduce bias in case selection. Consequently, the findings cannot be fully generalized across the entire Dutch social housing sector. However, this study does not aim to conduct a comprehensive investigation of current practice across all possible scenarios. Instead, it aims to examine housing associations that have undergone a relatively advanced circular transition to generalize experiences and insights that may inspire other organizations, sectors, or industries in developing circular procurement. Future research is advised to expand the data collection on this topic among social housing and other construction sectors to further validate the hypotheses and conclusions drawn in this study.

Data availability

Interview transcripts and interview protocol of this research can be accessed at: 10.4121/7d2dc2e2-0332-4ca8-9b9a-cba85509a707.

AI generative

Generative AI and AI-based tools, including ChatGPT, Grammarly, and QuillBot, were used solely to assist with language editing and proofreading. All content, data interpretation, and conclusions are the authors' original work.

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References

Ababio, B.K., Lu, W. and Ghansah, F.A. (2023), "Transitioning from green to circular procurement in developing countries: a conceptual framework for Ghana's construction sector", *Building Research and Information*, Vol. 51 No. 7, pp. 798-815, doi: 10.1080/09613218.2023.2229456.

Ababio, B.K., Lu, W., Agyekum, K. and Ghansah, F.A. (2025a), "Enhancing circular construction through procurement: a conceptual stakeholder-centric collaborative framework for sustainable outcomes", *Environmental Impact Assessment Review*, Vol. 1, March, 107784, doi: 10.1016/j.eiar.2024.107784.

Ababio, B.K., Lu, W., Darko, A. and Agyekum, K. (2025b), "A cross-economy examination of circular procurement implementation in construction: key drawbacks and strategies toward a

sustainable built environment", *Smart and Sustainable Built Environment*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/SASBE-09-2024-0349.

Abadi, M., Moore, D.R., Huang, J., Mohandes, S.R. and Ejohwomu, O. (2025), "Embedding circularity assessments in building projects' frontend decision-making: presenting a compelling behaviour change case", *Smart and Sustainable Built Environment*, Vol. ahead-of-print No. ahead-of-print, pp. 1-25, doi: 10.1108/SASBE-04-2025-0173.

Adjei-Bamfo, P., Djajadikerta, H.G., Jie, F., Brown, K. and Kiani Mavi, R. (2023), "Public procurement for innovation through supplier firms' sustainability lens: a systematic review and research agenda", *Business Strategy and the Environment*, Vol. 32 No. 1, pp. 387-407, doi: 10.1002/bse.3137.

Aedes (2016), "Dutch social housing in a nutshell", available at: https://www.iut.nu/wp-content/uploads/2017/03/Dutch-Soical-Housing-in-a-Nutshell.pdf (accessed 4 November 2025).

Ahmed, S., Majava, J. and Aaltonen, K. (2023), "Implementation of circular economy in construction projects: a procurement strategy approach", *Construction Innovation*, Vol. 24 No. 7, pp. 204-222, doi: 10.1108/CI-12-2022-0327.

Akomea-Frimpong, I., Ofori, J.N.A., Botchway, B., Tumpa, R.J. and Tetteh, P.A. (2025), "Key success factors towards circular economy in public-private partnership projects", *Smart and Sustainable Built Environment*, Vol. ahead-of-print No. ahead-of-print, pp. 1-27, doi: 10.1108/SASBE-02-2025-0074.

Alhola, K., Ryding, S.O., Salmenperä, H. and Busch, N.J. (2019), "Exploiting the potential of public procurement: opportunities for circular economy", *Journal of Industrial Ecology*, Vol. 23 No. 1, pp. 96-109, doi: 10.1111/jiec.12770.

Assaad, R.H. (2024), "Examining low-carbon material initiatives: existing policies, impacts on the procurement of projects, current challenges, and potential solutions to reduce embodied carbon in the construction industry", *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, Vol. 16 No. 2, 04523060, doi: 10.1061/JLADAH.LADR-1101.

Bao, Z.K., Lu, W.S., Chi, B., Yuan, H.P. and Hao, J.L. (2019), "Procurement innovation for a circular economy of construction and demolition waste: lessons learnt from Suzhou, China", *Waste Management*, Vol. 99, pp. 12-21, doi: 10.1016/j.wasman.2019.08.031.

Benachio, G.L.F., Freitas, M.do.C.D. and Tavares, S.F. (2020), "Circular economy in the construction industry: a systematic literature review", *Journal of Cleaner Production*, Vol. 1 July, 121046, doi: 10.1016/j.jclepro.2020.121046.

Bower, D. (2010), *Management of Procurement*, Thomas Telford, London.

Cheng, W., Appolloni, A., D'Amato, A. and Zhu, Q. (2018), "Green public procurement, missing concepts and future trends – a critical review", *Journal of Cleaner Production*, Vol. 176, pp. 770-784, doi: 10.1016/j.jclepro.2017.12.027.

Clough, R.H., Sears, G.A. and Sears, S.K. (2000), *Construction Project Management*, Wiley, New York.

Cramer, J. (2024), "Unlocking market transformation through circular procurement: the Amsterdam metropolitan area experience", *Urban Science*, Vol. 8 No. 4, p. 225, doi: 10.3390/urbansci8040225.

Dadzoe, F., Addy, M., Duah, D.Y.A. and Adesi, M. (2024), "Towards a circular economy: a knowledge-attitude gap between demand and supply-side operators on green building construction in Ghana", *Smart and Sustainable Built Environment*, Vol. 13 No. 4, pp. 763-779, doi: 10.1108/SASBE-03-2022-0048.

De Angelis, R., Howard, M. and Miemczyk, J. (2018), "Supply chain management and the circular economy: towards the circular supply chain", *Production Planning and Control*, Vol. 29 No. 6, pp. 425-437, doi: 10.1080/09537287.2018.1449244.

Eikelenboom, M., Long, T.B. and de Jong, G. (2021), "Circular strategies for social housing associations: lessons from a Dutch case", *Journal of Cleaner Production*, Vol. 292, 126024, doi: 10.1016/j.jclepro.2021.126024.

European Union (2017), "Public procurement for a circular economy: good practice and guidance", available at: http://ec.europa.eu/environment/gpp/pdf/Public_procurement_circular_economy_brochure.pdf (accessed 5 June 2023).

Evertsen, P.H. and Knotten, V. (2024), "Toward a collaborative circular ecosystem within the built environment", *Sustainable Production and Consumption*, Vol. 52, pp. 95-110, doi: 10.1016/j.spc.2024.10.019.

Farooque, M., Zhang, A., Thürer, M., Qu, T. and Huisingh, D. (2019), "Circular supply chain management: a definition and structured literature review", *Journal of Cleaner Production*, Vol. 10, August, pp. 882-900, doi: 10.1016/j.jclepro.2019.04.303.

Goh, C.S., Su, F. and Rowlinson, S. (2023), "Exploring economic impacts of sustainable construction projects on stakeholders: the role of integrated project delivery", *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction*, Vol. 15 No. 3, 04523026, doi: 10.1061/jladah.ladr-963.

Granheimer, K., Eriksson, P.E. and Gustavsson, T.K. (2022), "Adaptability in public procurement of engineering services promoting carbon reduction: an organizational control perspective", *Sustainability*, Vol. 14 No. 10, doi: 10.3390/su14105958.

Hjaltadóttir, R.E. and Hild, P. (2021), "Circular Economy in the building industry European policy and local practices", *European Planning Studies*, Vol. 29 No. 12, pp. 2226-2251, doi: 10.1080/09654313.2021.1904838.

Housing Europe (2022), "Circular renovation in affordable housing", available at: https://www.housingeurope.eu/file/1109/download (accessed 20 March 2023).

Kadefors, A., Lingegård, S., Uppenberg, S., Alkan-Olsson, J. and Balian, D. (2021), "Designing and implementing procurement requirements for carbon reduction in infrastructure construction–international overview and experiences", *Journal of Environmental Planning and Management*, Vol. 64 No. 4, pp. 611-634, doi: 10.1080/09640568.2020.1778453.

Kristensen, H.S. (2021), "Circular public procurement practices in Danish municipalities", *Sustainability*, Vol. 14 No. 18, 11528, doi: 10.3390/su141811528.

Lambrechts, W., Mitchell, A., Lemon, M., Mazhar, M.U., Ooms, W. and van Heerde, R. (2021), "The transition of Dutch social housing corporations to sustainable business models for new buildings and retrofits", *Energies*, Vol. 14 No. 3, p. 631, doi: 10.3390/en14030631.

Leising, E., Quist, J. and Bocken, N. (2018), "Circular economy in the building sector: three cases and a collaboration tool", *Journal of Cleaner Production*, Vol. 176, pp. 976-989, doi: 10.1016/j.jclepro.2017.12.010.

Lingegard, S., Olsson, J.A., Kadefors, A. and Uppenberg, S. (2021a), "Sustainable public procurement in large infrastructure projects-policy implementation for carbon emission reductions", *Sustainability*, Vol. 13 No. 20, p. 11182, doi: 10.3390/su132011182.

Lingegard, S., Havenvid, M.I. and Eriksson, P.E. (2021b), "Circular public procurement through integrated contracts in the infrastructure sector", *Sustainability*, Vol. 13 No. 21, p. 11983, doi: 10.3390/su132111983.

Martins, M. (2009), "Procurement", in Wankel, C. (Ed.), *Encyclopedia of Business in Today's World*, SAGE Publications, Thousand Oaks, CA, pp. 1309-1311.

Merriam, S.B. (1998), *Qualitative Research and Case Study Applications in Education*, Jossey-Bass, San Francisco.

Mojumder, A., Singh, A., Kumar, A. and Liu, Y. (2022), "Mitigating the barriers to green procurement adoption: an exploratory study of the Indian construction industry", *Journal of Cleaner Production*, Vol. 372, 133505, doi: 10.1016/j.jclepro.2022.133505.

Ogunmakinde, O.E., Aghajani, M. and Memari, A. (2025), "Identifying risks in sustainable procurement for construction: a systematic literature review and text-mining approach", *Smart and Sustainable Built Environment*, Vol. ahead-of-print No. ahead-of-print, pp. 1-27, doi: 10.1108/SASBE-12-2024-0543.

PBSRG (1991), "Best value approach", available at: https://pbsrg.com/best-value-approach/ (accessed 25 June 2025).

Pianoo (2017), "Rapid circular contracting", available at: https://www.pianoo.nl/sites/default/files/documents/gerelateerd/fs_40-rcc_-_rapid_circular_contracting_-_innovatie_gericht_circulair_inkopen.pdf (accessed 20 March 2023).

Polonsky, M.J., Wijayasundara, M., Noel, W. and Vocino, A. (2022), "Identifying the drivers and barriers of the public sector procurement of products with recycled material or recovered content: a systematic review and research propositions", *Journal of Cleaner Production*, Vol. 358, 131780, doi: 10.1016/j.jclepro.2022.131780.

Priemus, H. (2003), "Dutch housing associations: current developments and debates", *Housing Studies*, Vol. 18 No. 3, pp. 327-351, doi: 10.1080/02673030304237.

Qazi, A.A. and Appolloni, A. (2022), "A systematic review on barriers and enablers toward circular procurement management", *Sustainable Production and Consumption*, Vol. 33, pp. 343-359, doi: 10.1016/j.spc.2022.07.013.

Rahim, S.A., Nifa, F.A.A. and Mohd Nawi, M.N. (2015), "Integrated project delivery (IPD) in Malaysian construction industry dealing with waste issue", *Advances in Environmental Biology*, Vol. 9 No. 4, pp. 35-38, available at: http://www.aensiweb.com/AEB/

Rainville, D.A. (2021), "Stimulating a more circular economy through public procurement: roles and dynamics of intermediation", *Research Policy*, Vol. 50 No. 4, 104193, doi: 10.1016/j.respol.2020.104193.

Ruparathna, R. and Hewage, K. (2015a), "Review of contemporary construction procurement practices", *Journal of Management in Engineering*, Vol. 31 No. 3, 04014038, doi: 10.1061/(ASCE)ME.1943-5479.0000279.

Ruparathna, R. and Hewage, K. (2015b), "Sustainable procurement in the Canadian construction industry: challenges and benefits", *Canadian Journal of Civil Engineering*, Vol. 42 No. 6, pp. 417-426, doi: 10.1139/cjce-2014-0376.

Sajid, Z.W., Aftab, U. and Ullah, F. (2024), "Barriers to adopting circular procurement in the construction industry: the way forward", *Sustainable Futures*, Vol. 8, 100244, 1 December, doi: 10.1016/j.sftr.2024.100244.

Sani, H.A.A. and Jaafar, N.I. (2025), "Exploring the impact of IoT on governance and public service transformation: evidence from Malaysia's public sector", *Smart and Sustainable Built Environment*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/SASBE-10-2024-0453.

Singh, A.K., Mohandes, S.R., Awuzie, B.O., Omotayo, T., Kumar, V.R.P. and Kidd, C. (2024), "A roadmap for overcoming barriers to implementation of blockchain-enabled smart contracts in sustainable construction projects", *Smart and Sustainable Built Environment*, Vol. 15 No. 2, pp. 570-596, doi: 10.1108/SASBE-10-2023-0303.

Sinha, S. and Sethuraman, S.J. (2025), "Unveiling success determinants for circular economy adoption in construction and the built environment: an empirical study using AHP and PLS-SEM", *Smart and Sustainable Built Environment*, Vol. ahead-of-print No. ahead-of-print, doi: 10.1108/SASBE-04-2025-0177.

Sönnichsen, S.D. and Clement, J. (2020), "Review of green and sustainable public procurement: towards circular public procurement", *Journal of Cleaner Production*, Vol. 245, 118901, doi: 10.1016/j.jclepro.2019.118901.

Stokke, R., Qiu, X., Sparrevik, M., Truloff, S., Borge, I. and de Boer, L. (2023), "Procurement for zero-emission construction sites: a comparative study of four European cities", *Environment Systems and Decisions*, Vol. 43 No. 1, pp. 72-86, doi: 10.1007/s10669-022-09879-7.

Studer, W.P. and De Brito Mello, L.C.B. (2021), "Core elements underlying supply chain management in the construction industry: a systematic literature review", *Buildings*, Vol. 1, December, p. 569, doi: 10.3390/buildings11120569.

Tornatzky, L.G. and Fleischer, M. (1990), *The Processes of Technological Innovation*, Lexington Books, Lexington.

UNEP, U.N. (2021), *Second Edition of UNEP's Sustainable Public Procurement Guidelines*, UNEP - UN Environ, Programme, available at: http://www.unep.org/resources/publication/second-edition-uneps-sustainable-public-procurement-guidelines (accessed 5 June 2023).

van Zoest, S., Volker, L. and Hermans, M. (2020), "Implementing a new procurement strategy: the case of social housing associations", *International Journal of Managing Projects in Business*, Vol. 13 No. 2, pp. 409-425, doi: 10.1108/IJMPB-09-2018-0189.

Vrijhoef, R. and Koskela, L. (2000), "The four roles of supply chain management in construction", *European Journal of Purchasing and Supply Management*, Vol. 6 Nos 3-4, pp. 169-178, doi: 10.1016/S0969-7012(00)00013-7.

Wang, H., Xiong, W., Wu, G. and Zhu, D. (2018), "Public–private partnership in public administration discipline: a literature review", *Public Management Review*, Vol. 20 No. 2, pp. 293-316, doi: 10.1080/14719037.2017.1313445.

Willumsen, P., Oehmen, J., Stingl, V. and Geraldi, J. (2019), "Value creation through project risk management", *International Journal of Project Management*, Vol. 37 No. 5, pp. 731-749, doi: 10.1016/j.ijproman.2019.01.007.

Witjes, S. and Lozano, R. (2016), "Towards a more circular economy: proposing a framework linking sustainable public procurement and sustainable business models", *Resources, Conservation and Recycling*, Vol. 112, pp. 37-44, doi: 10.1016/j.resconrec.2016.04.015.

Xu, L., Jia, F., Yan, F. and Chen, L. (2022), "Circular procurement: a systematic literature review", *Journal of Cleaner Production*, Vol. 365, 132845, doi: 10.1016/j.jclepro.2022.132845.

Yin, R.K. (2009), *Case Study Research: Design and Methods*, 4th ed., Sage, Thousand Oaks, California.

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