Circular procurement in social rented housing

Experience from and perspectives for Dutch housing associations

Di Wu

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“Every human thought, and every human action, is based in either love or fear.”

— Neale Donald Walsch

May you always choose love.

Preface

To my seven years in the Netherlands

Seven years ago, almost to the day as I write this, I came to the Netherlands to begin my master's studies. After two years in Eindhoven, I decided to pursue a PhD and moved from Eindhoven to Delft. Now, as I approach the end of my PhD journey, I feel that I have a lot to say about these past seven years. But I will try to keep it concise.

Where it begins

I still remember the day I first arrived in the Netherlands. It was during the blue hour–the sun had just gone down. Everything seemed so blue: blue trains, people's jeans, the deepening evening sky, while scattered lights began to glow against the approaching night. As I write these words seven years later, the sky outside my window is again blue and clear, the kind of sky that has nourished me through countless days here.

Half a year after I arrived, the pandemic began. Most of my memories from that period have faded, but I remember spending a great deal of time in nature around Eindhoven, which was always just around the corner: trees, grass, falling leaves, small animals, colourful skies, clouds, sunsets, and evening lights… Perhaps those quiet moments were part of what made me want to stay here a little longer.

I had been thinking about doing a PhD since the final year of my undergraduate studies. The reason was simple: I wanted to solve problems. With the intention of pursuing a PhD and the wish to remain close to the nature I had come to love in the Netherlands, I naturally found my way to the PhD I am now completing.

Transition

There was a period when I tried hard to 'integrate' myself into this country, not only as a foreigner, an outsider, or a student, but as a resident, as someone imagining that she might put down roots in a land so far away from home.

That period was not easy. The more I tried to ‘integrate’ into another culture, the more I became aware of how difficult complete integration could be, and of the distance that might always remain. Eventually, I came to realize that living somewhere does not necessarily mean that you have to become fully integrated into it, nor does it mean that you must always find a sense of belonging there. Perhaps it is enough to experience a place deeply, to allow it to become part of your life, and to recognize what the years spent there have given you.

The same realization applies to my PhD. If you asked me now whether I have achieved the objective with which I began my PhD, I would say that, from a scientific perspective, yes. But somewhere along the way, the meaning of doing a PhD became much greater than completing a thesis, publishing papers, or earning a title.

It became an experience, one that I will only have once in my life. Like moving alone to another country for the first time, it belongs to a particular time in life that cannot be repeated at another stage. Perhaps that is what makes both of them so precious. The challenges I overcame, the uncertainties I learned to live with, the things I achieved, and the joyful moments along the way have all become part of this experience. And the experience, in turn, has shaped me, transformed me, and become part of who I am today.

People sometimes ask whether my mindset has changed after living in Europe for so many years. When they ask this, I often feel that they expect me to describe how Eastern and Western values have collided within me, how they have changed me, or how I have learned to reconcile the two. Of course, both have continuously influenced me over the past seven years. But that would be a very long discussion, and it is not the one I want to have here.

What I want to say instead is this: over the past seven years, I have repeatedly tried to find my place—in another country, another culture, another society, and, during my PhD, in academia. I have come to think of all of these as different kinds of “systems.” What these years have ultimately taught me is not simply how to find my place within a system, but how to step outside it when necessary.

For me, this applies not only to academia, but also to a job, a career, a society, a culture, a country, or any other system through which we define ourselves. Instead of allowing ourselves to be constantly restricted, evaluated, and judged by the systems around us, sometimes we need to step beyond their boundaries. And this requires more than capability. It requires courage, determination, and a conscious effort to see beyond the boundaries that a system creates.

From there, we may begin to see how many possibilities life contains, how much of the world remains unexplored, and, at the same time, how small we human beings are within it.

From there, we may also have to ask what it looks like after stepping outside of the system and where it will take us. I do not know yet. But that is a question for tomorrow.

A New Start

And now, it is time for another beginning.

Seven years ago, I moved to this country to study, to explore the world, and to begin a new chapter of my life. This time, I begin again–but differently. I am stronger, and I am more certain about who I am, where I want to go, and what I want from my life.

Of course, I know that another seven years from now, when I look back at these words, I may see things differently. I look forward to that day.

People often say that when you are young, you always want to leave home and go as far away as possible, but that at a certain age, you just want to come home. Perhaps this is what I have finally begun to resonate with at the age of thirty, after being away from home for so many years.

I used to say that I have never felt a complete sense of belonging anywhere in this world. But what I have always overlooked is that belonging and home are not the same thing.

We may spend years searching for a place where we belong. We may cross continents, learn new languages and customs, build lives in unfamiliar places, and try to become part of worlds that were not originally ours.

But home does not ask to be found. Home remains home.

And that is what matters to me now.

August 17, 2026

Di Wu

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Looking back on the past four and a half years of my PhD journey, I suddenly realize how many people I have to thank. I have always believed that pursuing a PhD is not an easy journey. It is often accompanied by loneliness and solitude, with countless days and nights during which I felt that I was the only one who could keep myself moving forward. Yet, when I look back now, I see that I was never truly alone. So many people have been part of this journey, and without them, I would not be the person I am today.

First, I would like to thank my supervision team: Vincent, Paul, and Tong. Colleagues from the MBE department often told me how fortunate I was to have such a wonderful and complementary supervisory team, and I could not agree more. My PhD journey began the moment Vincent accepted my application. I will always be grateful for the opportunity he offered me and for the confidence he placed in me, which allowed this story to unfold. Throughout the past four and a half years, he has been a constant source of guidance and support. He gave me the freedom to explore my interests while always ensuring that I remained on the right track. Having him as my supervisor made many challenges seem much simpler. Paul is the one who prefers to challenge me a little more. This made our interactions intellectually stimulating. However, I never viewed the challenges he posed as real restrictions. Instead, I cherished our intellectual sparring sessions, which pushed me to sharpen my thinking and become more critical and reflective about the words I used, the way I reasoned, and the decisions I made along the way about my research. Among the many valuable lessons he taught me, which I cannot possibly fully summarize here, the most important is how to conduct research systematically and how to think as a researcher and view the world from a researcher's perspective. Last but certainly not least, I would like to thank Tong, my daily supervisor, who accompanied me throughout this journey and supported me every step of the way. Whenever I encountered a difficult problem or found myself stuck in my research, she often offered insightful ideas and fresh perspectives that helped me move forward. I feel fortunate to have become her PhD student when she started her position as an assistant professor, which allowed us to grow professionally alongside one another throughout this journey.

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Fourth, I would like to thank all the practitioners from industry who participated in my research, especially those who joined more than once. Your continued engagement and interest in my research have been a constant source of motivation. I have always believed that the ultimate purpose of research is to contribute to practice and to the development of the real world. Knowing that my work resonated with practitioners encouraged me to keep pursuing that goal. Thank you for all the support and feedback you provided throughout this journey. These exchanges have been among the most valuable experiences I have gained as a researcher.

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Summary

This thesis aims to contribute to the circular economy transition in the built environment by investigating how procurement can be transformed to facilitate it. Dutch social housing is taken as the empirical context. This thesis starts from the premise that procurement is a key leverage point in this transition because it connects demand and supply, shapes collaboration across the construction supply chain, and determines how circular ambitions are translated into project requirements, contracts, and delivery practices.

Although the circular economy has received growing attention in the built environment, most existing studies focus on design, construction, and end-of-life phases, while the procurement and inception phases remain underexplored. Research on circular procurement is also largely conceptual, with limited empirical insight into how circular procurement is implemented in real organizational settings. This gap is relevant for real estate and housing owners such as Dutch housing associations, which manage large portfolios, have long-term responsibilities for maintenance and renovation, and a strong societal mission to provide affordable housing and stimulate energy and circular transitions. This makes it both a challenging and a promising environment for circular procurement innovation. At the same time, circular procurement in practice is challenged by fragmented supply chains, uncertainties in renovation projects, and dominant price-based procurement routines.

Against this background, this thesis asks the overarching research question: How can procurement be transformed to facilitate circular transition in the built environment? To answer this, this thesis follows a pragmatist and abductive research design, combining theoretical and empirical studies in four steps. First, a systematic literature review is conducted to examine existing research on circular procurement in the built environment and develop analytical frameworks from a supply network perspective. Second, a multiple case study is conducted to investigate current practices, challenges, and development potentials of integrating circular economy principles into procurement of Dutch social housing from technological, organizational, and environmental perspectives. Third, a Q-methodology study is conducted to explore different stakeholders' perspectives on circular procurement in social housing renovation and to analyze where those perspectives converge and diverge. Fourth, the findings of the literature review study and two empirical studies are synthesized and compared to bridge the gap between theory and practice and to formulate actionable propositions for circular procurement implementation.

Findings

Chapter 2 holistically reviews 65 articles on circular procurement in the built environment and develops a six-stage-based analytical framework for the circular procurement process. Research gaps are identified, including a lack of investigation on interactions among actors, a lack of study on how lifecycle thinking can be embedded in a fragmented construction supply chain, and a lack of understanding of how decision-making processes unfold among multiple stakeholders in practice. There is also limited knowledge on organizations' innovation capacity, adaptability, incentives, and the practical barriers to the implementation of digital solutions. Future research opportunities to further develop these analytical frameworks are identified as studying broader stakeholder ecosystems that include not only supply chain actors but also other actors who can stimulate circular transition, strengthening lifecycle integration in procurement, examining organizations' innovation and adaptation capabilities in the context of circular procurement, and investigating the implementation of digital tools and intermediary platforms. It also highlights the need for a deeper understanding of multi-stakeholder decision-making and for more research on procurement in renovation and maintenance projects. Most importantly, an integrated supply chain should be developed to align actors, resources, and activities across the process.

Chapter 3 examines case studies involving seven housing associations and their supply chain partners through semi-structured interviews and document research. It reveals that housing associations are experimenting with strategies such as modular construction, contracting with consortia, and resident involvement in decision-making in circular procurement. However, circular procurement remains constrained by both internal barriers, such as limited circular knowledge and siloed departments, as well as external barriers, including supply chain uncertainty, weak stakeholder collaboration, ambiguous responsibility distributions, and the lack of regulatory and institutional support. The future development of circular procurement in Dutch social housing should prioritize integrated information systems, customized procurement strategies for various organizations, enhanced multi-stakeholder collaboration, establish supportive regulatory frameworks and sector-wide standardization of procurement strategies. It also shows that in a semi-public sector without strictly regulated procurement rules, circular transition depends less on compliance and more on organizational initiative, inter-organizational coordination, technological advances, and enabling institutional conditions.

Chapter 4 applies Q methodology with diverse stakeholders involved in circular social housing renovation in the Netherlands. It divides stakeholders' perspectives on circular procurement in social housing renovation into three narratives, each with a different focus.

One focuses on the requirements of circular procurement, another on stakeholder relationships, and the third on procurement outcomes. These narratives show that stakeholders prioritize different aspects of the circular transition. It finds no definite interrelationship between stakeholder roles and their perspectives. Actors with different roles can share similar views, while those with the same role may still hold different opinions. However, stakeholders' positions and interests in the supply chain influence the motivations behind their perspectives. This study highlights the importance of understanding stakeholder priorities and motivations as different starting points for circular transition. It is also crucial to align stakeholder requirements when designing and implementing circular procurement.

Chapter 5 synthesizes and compares the literature review in Chapter 2 and the empirical studies in Chapters 3 and 4. It shows that circular procurement is a complex process shaped by governance, organizational structures, management mechanisms, societal culture, and stakeholder behaviour. It ultimately formulates seven actionable propositions for circular procurement implementation in Dutch social housing. These propositions were tested with housing associations and their contractors, and the validation process showed that the applicability of these propositions depends on context and preconditions. There is no single universal solution for circular procurement implementation. Nevertheless, the propositions provide practical guidance for both beginners starting circular procurement and more experienced organizations seeking to improve existing practice. Future research should further validate these propositions over time and across sectors. Pertinent policies and regulations are needed to support their implementation.

Conclusion and implications

This thesis concludes that transforming the procurement process to facilitate circular transition in the built environment requires a shift from a linear, project-based, and price-driven purchasing procedure to a strategic, lifecycle-oriented, and systematic approach. Procurement should not be treated as a narrow technical function or as the simple addition of circular criteria to conventional purchasing. Instead, it must be understood as the system through which environmental ambitions, economic incentives, organizational capacities, stakeholder relationships, regulatory compliance, technological advances, and societal responsibilities are aligned across the whole building lifecycle. At the same time, procurement is highly context-dependent. There is no one-size-fits-all circular procurement model for all project types, sectors or national contexts. Circular procurement strategies should be customized to local institutional conditions, market capacities, organizational structures, and project characteristics.

This thesis contributes to the existing literature pool by adding circular economy to procurement in the built environment. It provides an empirical basis by studying Dutch social housing as a semi-public sector, where procurement is less regulated and more fragmented than in the public sector. By adopting a supply network perspective, this thesis shows that circular transition depends on the integrated transformation of the whole construction supply chain. Stakeholder collaborations and understanding of stakeholder perspectives and their priorities are essential for circular procurement. This thesis also refines theoretical concepts of circular procurement by demonstrating that procurement practice is more iterative, context-dependent, and socially embedded than theoretical models suggest.

Practitioners, such as housing associations, contractors, consultants, and other supply chain actors, can apply the concrete recommendations given in this thesis. By identifying where implementation often fails, the thesis helps practitioners understand the main barriers and what organizational changes are needed. It also offers a set of propositions that can be used to improve circular procurement implementation throughout the whole procurement process.

Scaling up of circular procurement requires stronger governance and regulation. Procurement in Dutch social housing is not strictly bound by public procurement rules. Nevertheless, the findings show that unclear regulation and institutional environment slow down experimentation and standardization. Policymakers should therefore create stronger financial and market incentives, support a shared but flexible framework for circular procurement, encourage collaboration among housing associations, provide clearer rules about stakeholder responsibilities, contract forms, the use and logistics of reused materials, the use of digital systems, and risk and benefit sharing.

This thesis argues that sectors with large asset ownership and strong social responsibilities, such as social housing, can play an important role in accelerating the circular transition in the construction industry. However, this is only possible if circular procurement evolves from isolated pilot projects to a more integrated approach across lifecycles, portfolios, sectors and industries. Consequently, future research is suggested to focus on long-term evaluations, comparisons across sectors and industries, and practical frameworks that scale up pilot experiences into wider implementation.

Samenvatting

Dit proefschrift beoogt bij te dragen aan de transitie naar een circulaire economie in de gebouwde omgeving door te onderzoeken hoe inkoopprocessen kunnen worden getransformeerd om deze transitie te faciliteren. De Nederlandse sociale huursector vormt de empirische context. Dit proefschrift vertrekt vanuit de aanname dat inkoop een belangrijk aangrijpingspunt is voor deze transitie, omdat inkoop vraag en aanbod met elkaar verbindt, de samenwerking binnen de bouwketen mede vormgeeft en bepaalt hoe circulaire ambities worden vertaald naar projecteisen, contracten en uitvoeringspraktijken.

Hoewel de circulaire economie steeds meer aandacht krijgt in de gebouwde omgeving, richten de meeste bestaande studies zich op ontwerp, bouw en de einde levensduurfase, terwijl de inkoop- en initiatieffasen relatief weinig zijn onderzocht. Onderzoek naar circulaire inkoop is bovendien grotendeels conceptueel van aard, met beperkte empirische inzichten in de wijze waarop circulaire inkoop in reële organisatorische contexten wordt geïmplementeerd. Deze lacune is relevant voor vastgoed- en woningeigenaren, zoals Nederlandse woningcorporaties, die grote vastgoedportefeuilles beheren, langetermijnverantwoordelijkheden dragen voor onderhoud en renovatie en een sterke maatschappelijke taak hebben om betaalbare huisvesting te bieden en de energie- en circulaire transitie te stimuleren. Dit maakt de sector zowel een uitdagende als veelbelovende omgeving voor innovatie op het gebied van circulaire inkoop. Tegelijkertijd wordt circulaire inkoop in de praktijk belemmerd door gefragmenteerde toeleveringsketens, onzekerheden in renovatieprojecten en dominante op prijsgerichte inkooproutines.

Tegen deze achtergrond staat in dit proefschrift de volgende overkoepelende onderzoeksvraag centraal: Hoe kan inkoop worden getransformeerd om de circulaire transitie in de gebouwde omgeving te faciliteren? Om deze vraag te beantwoorden, volgt het proefschrift een pragmatisch en abductief onderzoeksontwerp waarin theoretische en empirische studies in vier stappen worden gecombineerd. Ten eerste worden door een systematische literatuurstudie van bestaand onderzoek naar circulaire inkoop in de gebouwde omgeving een analytisch raamwerk ontwikkeld vanuit een supply-netwerkperspectief. Ten tweede worden door een meervoudige casestudie huidige praktijken, uitdagingen en ontwikkelingsmogelijkheden voor de integratie van principes van de circulaire economie in de inkoop van Nederlandse sociale huisvesting, vanuit technologisch, organisatorisch en omgevingsperspectief

onderzocht. Ten derde worden door een Q-methodologiestudie de perspectieven van verschillende stakeholders op circulaire inkoop bij renovatie van sociale woningen geanalyseerd en wordt onderzocht waar deze perspectieven convergeren en divergeren. Ten vierde worden de bevindingen van de literatuurstudie en de twee empirische studies gesynthetiseerd en vergeleken om de kloof tussen theorie en praktijk te overbruggen en uitvoerbare proposities voor de implementatie van circulaire inkoop te formuleren.

Bevindingen

Hoofdstuk 2 geeft een integrale review van 65 artikelen over circulaire inkoop in de gebouwde omgeving en ontwikkelt een analytisch raamwerk voor 6 verschillende fasen van het circulaire inkoopproces. Er worden verschillende onderzoekslacunes geïdentificeerd, waaronder een gebrek aan onderzoek naar interacties tussen actoren, onvoldoende aandacht voor de wijze waarop levenscyclusdenken kan worden ingebed in een gefragmenteerde bouwketen en een beperkt begrip van hoe besluitvormingsprocessen tussen meerdere stakeholders zich in de praktijk ontvouwen. Ook is er beperkte kennis over het innovatievermogen, aanpassingsvermogen en de prikkels van organisaties, evenals over praktische barrières voor implementatie van digitale hulpmiddelen. Als toekomstige onderzoeksmogelijkheden voor de verdere ontwikkeling van deze analytische raamwerken worden onder meer genoemd: het bestuderen van bredere stakeholder-ecosystemen die naast ketenactoren ook andere actoren omvatten die de circulaire transitie kunnen stimuleren; het versterken van levenscyclusintegratie in inkoop; het onderzoeken van het innovatie- en aanpassingsvermogen van organisaties in de context van inkoop; en het bestuderen van de implementatie van digitale hulpmiddelen en intermediaire platforms. Daarnaast wordt gewezen op de noodzaak van een dieper begrip van besluitvorming met meerdere stakeholders en van meer onderzoek naar inkoop bij renovatie- en onderhoudsprojecten. Het belangrijkste is dat een geïntegreerde toeleveringsketen moet worden ontwikkeld waarin actoren, middelen en activiteiten gedurende het gehele proces op elkaar worden afgestemd.

Hoofdstuk 3 onderzoekt casestudies van zeven woningcorporaties en hun ketenpartners aan de hand van semigestructureerde interviews en documentonderzoek. Hieruit blijkt dat woningcorporaties experimenteren met strategieën zoals modulair bouwen, contracteren met consortia en het betrekken van bewoners bij besluitvorming binnen circulaire inkoop. Circulaire inkoop wordt echter nog steeds beperkt door zowel interne barrières, zoals beperkte kennis over circulariteit en verkokerde afdelingen, als externe barrières, waaronder onzekerheid in de toeleveringsketen, zwakke samenwerking tussen stakeholders, onduidelijke verdeling van verantwoordelijkheden en een gebrek aan regelgevende

en institutionele ondersteuning. De toekomstige ontwikkeling van circulaire inkoop in de Nederlandse sociale huursector zou prioriteit moeten geven aan geïntegreerde informatiesystemen, op organisaties afgestemde inkoopstrategieën, versterkte samenwerking tussen meerdere stakeholders, ondersteunende regelgevende kaders en sectorbrede standaardisering van inkoopstrategieën. Het hoofdstuk laat tevens zien dat de circulaire transitie in een semipublieke sector zonder strikt gereguleerde inkoopregels minder afhankelijk is van naleving en meer van organisatorisch initiatief, interorganisationele coördinatie, technologische vooruitgang en faciliterende institutionele voorwaarden.

Hoofdstuk 4 past Q-methodologie toe met diverse stakeholders die betrokken zijn bij circulaire renovatie van sociale woningen in Nederland. De perspectieven van stakeholders op circulaire inkoop bij renovatie van sociale woningen worden onderverdeeld in drie narratieven, elk met een andere focus. Het eerste richt zich op de vereisten van circulaire inkoop, het tweede op stakeholderrelaties en het derde op inkoopresultaten. Deze narratieven laten zien dat stakeholders verschillende aspecten van de circulaire transitie prioriteren. Er wordt geen eenduidige relatie gevonden tussen stakeholderrollen en hun perspectieven. Actoren met verschillende rollen kunnen vergelijkbare opvattingen delen, terwijl actoren met dezelfde rol toch uiteenlopende meningen kunnen hebben. De posities en belangen van stakeholders in de toeleveringsketen beïnvloeden echter wel de motivaties achter hun perspectieven. Deze studie benadrukt het belang van inzicht in de prioriteiten en motivaties van stakeholders als verschillende vertrekpunten voor de circulaire transitie. Daarnaast is het van cruciaal belang om stakeholdervereisten op elkaar af te stemmen bij het ontwerpen en implementeren van circulaire inkoop.

Hoofdstuk 5 synthetiseert en vergelijkt de literatuurstudie uit Hoofdstuk 2 met de empirische studies uit Hoofdstukken 3 en 4. Hieruit blijkt dat circulaire inkoop een complex proces is dat wordt gevormd door governance, organisatiestructuren, managementmechanismen, maatschappelijke cultuur en stakeholdergedrag. Uiteindelijk worden zeven uitvoerbare proposities geformuleerd voor de implementatie van circulaire inkoop in de Nederlandse sociale huursector. Deze proposities zijn getoetst met woningcorporaties en hun aannemers, waarbij het validatieproces liet zien dat de toepasbaarheid ervan afhankelijk is van context en randvoorwaarden. Er bestaat geen universele oplossing voor de implementatie van circulaire inkoop. Niettemin bieden de proposities praktische richtlijnen voor zowel beginners die met circulaire inkoop starten als meer ervaren organisaties die hun bestaande praktijk willen verbeteren. Toekomstig onderzoek zou deze proposities verder moeten valideren over langere perioden en in verschillende sectoren. Relevante beleidsmaatregelen en regelgeving zijn nodig om de implementatie ervan te ondersteunen.

Conclusie en implicaties

Dit proefschrift concludeert dat de transformatie van het inkoopproces om de circulaire transitie in de gebouwde omgeving te faciliteren een verschuiving vereist van een lineaire, projectgebaseerde en prijsgedreven inkoopprocedure naar een strategische, levenscyclusgerichte en systematische benadering. Inkoop moet niet worden beschouwd als een beperkte technische functie of als het simpelweg toevoegen van circulaire criteria aan conventionele inkoop. In plaats daarvan moet inkoop worden begrepen als het systeem waarmee milieuambities, economische prikkels, organisatorische capaciteiten, stakeholderrelaties, naleving van regelgeving, technologische ontwikkelingen en maatschappelijke verantwoordelijkheden gedurende de gehele levenscyclus van gebouwen op elkaar worden afgestemd. Tegelijkertijd is inkoop sterk contextafhankelijk. Er bestaat geen universeel model voor circulaire inkoop dat geschikt is voor alle projecttypen, sectoren of nationale contexten. Strategieën voor circulaire inkoop moeten worden afgestemd op lokale institutionele omstandigheden, marktcapaciteiten, organisatiestructuren en projectkenmerken.

Dit proefschrift draagt bij aan de bestaande literatuur door de circulaire economie te verbinden met inkoop in de gebouwde omgeving. Het levert een empirisch basis door de Nederlandse sociale huursector te bestuderen als een semipublieke sector, waarin inkoop minder gereguleerd en meer gefragmenteerd is dan in de publieke sector. Vanuit een supply-netwerkperspectief laat dit proefschrift zien dat de circulaire transitie afhankelijk is van een geïntegreerde transformatie van de gehele bouwketen. Samenwerking tussen stakeholders en inzicht in hun perspectieven en prioriteiten zijn essentieel voor circulaire inkoop. Daarnaast verfijnt dit proefschrift theoretische concepten van circulaire inkoop door aan te tonen dat de inkooppraktijk iteratiever, contextafhankelijker en sterker sociaal ingebed is dan theoretische modellen suggereren.

Praktijkprofessionals, zoals woningcorporaties, aannemers, adviseurs en andere ketenactoren, kunnen de concrete aanbevelingen uit dit proefschrift toepassen. Door te identificeren waar de implementatie in de praktijk vaak vastloopt, helpt het proefschrift professionals inzicht te krijgen in de belangrijkste barrières en de noodzakelijke organisatorische veranderingen. Daarnaast biedt het een reeks proposities die kunnen worden gebruikt om de implementatie van circulaire inkoop gedurende het gehele inkoopproces te verbeteren.

Het opschalen van circulaire inkoop vereist sterkere governance en regelgeving. Inkoop in de Nederlandse sociale huursector is niet strikt gebonden aan regels voor publieke aanbesteding. De bevindingen laten echter zien dat onduidelijke regelgeving en een onduidelijke institutionele omgeving experimenten en standaardisering

vertragen. Beleidsmakers zouden daarom sterkere financiële en marktprikkels moeten creëren, een gedeeld maar flexibel raamwerk voor circulaire inkoop moeten ondersteunen, samenwerking tussen woningcorporaties moeten stimuleren en duidelijkere regels moeten bieden voor stakeholderverantwoordelijkheden, contractvormen, het gebruik en de logistiek van hergebruikte materialen, het gebruik van digitale systemen en de verdeling van risico's en baten.

Dit proefschrift stelt dat sectoren met omvangrijk vastgoedbezit en sterke maatschappelijke verantwoordelijkheden, zoals de sociale huursector, een belangrijke rol kunnen spelen bij het versnellen van de circulaire transitie in de bouwsector. Dit is echter alleen mogelijk wanneer circulaire inkoop zich ontwikkelt van geïsoleerde pilotprojecten naar een meer geïntegreerde benadering over levenscycli, portefeuilles, sectoren en industrieën heen. Toekomstig onderzoek zou zich daarom onder meer kunnen richten op langetermijnevaluaties, vergelijkingen tussen sectoren en industrieën en praktische raamwerken waarmee ervaringen uit pilots kunnen worden opgeschaald naar bredere implementatie.

1 Introduction

This thesis focuses on an interdisciplinary research integrating circular economy transition, social housing, and supply chain and procurement management. It aims to address the urgent problems the built environment faces today through management research. The introduction chapter introduces the background and key concepts in this thesis, addresses the problems in practice and research gaps on the research topic, explains the research approach and potential contributions, and outlines the structure of the entire thesis.

1.1 Procurement in the Circular Economy

The traditional linear supply chain of “take-make-consume-dispose” has driven excessive resource consumption and waste generation, resulting in severe environmental consequences (Farooque et al., 2019; Zhou & Xu, 2024). To address these challenges, circular economy principles provide a sustainable solution by keeping resources in use for as long as possible, thereby reducing resource consumption and environmental pollution (Neessen et al., 2021; Zhou & Xu, 2024). The widely used definition of circular economy was proposed by Ellen MacArthur Foundation (2016) as ‘an economic and industrial system where material loops are closed and slowed and value creation is aimed for at every chain in the system.’ To realize this new economic and industrial system, supply chains need to be redesigned (De Arruda Pollice & Scarcelli, 2024). Purchasing and procurement transformation will also plays a critical role in stimulating the circular economy transition by fundamentally changing the way of doing business with suppliers and other stakeholders and creating new demand for resource efficiency (De Arruda Pollice & Scarcelli, 2024; Rainville, 2021). Integrating environmental, economic, and societal issues in the procurement process allows organizations to positively influence their supply chains and significantly contribute to a sustainable environment and societal development (Bernd, 2024).

1.2 Circular Procurement in the Built Environment

1.2.1 Circular economy in the built environment

The construction industry accounts for the largest percentage of total waste worldwide (Clark et al., 2006). The decline in raw materials and the increasingly pressing social, environmental, and economic problems in the built environment call for a paradigm shift from the traditional linear system of taking, making, and throwing away to a circular system that closes the material loop (Heisel & Hebel, 2019). In recent years, the circular economy has gained increasing interest in the built environment as a way to overcome the contradiction between economic and environmental prosperity (Pomponi & Moncaster, 2017). Compared to the traditional linear economy model, the most essential innovation in the circular economy is allowing ever-growing economic development and profitability without putting pressure on the environment (Pomponi & Moncaster, 2017). Achieving a circular economy poses not only substantial challenges for our practices and policies but also significant research challenges. Research on the circular economy in the built environment goes beyond economic and environmental dimensions. Interdisciplinary research is significant for developing a circular built environment across technical, environmental, social, behavioral, economic, and governmental dimensions, thereby contributing to a successful transition to the circular built environment (Pomponi & Moncaster, 2017).

1.2.2 Circular supply chain and procurement management

Supply chain management is the business process in which products, services, and information are integrated and transferred from suppliers to end users, providing value to customers (Leong & Stonebraker, 1994). Construction supply chain management has been defined as ‘a system where suppliers, contractors, clients and their agents work together in coordination to install and utilise information in order to produce, deliver materials, plant, temporary works, equipment and labour and/or other resources for construction projects’ (Hatmoko & Scott, 2010). A typical traditional construction supply chain consists of stakeholders, information and material flows between them, and a series of phases through which construction projects are built and put into use (Behera et al., 2015). With the increased interest

in the circular economy and the relevance between supply chain innovation and the circular principles, more and more scholars and practitioners have argued the value of combining supply chain management with the circular economy (De Angelis et al., 2018). Adapted from Farooque et al. (2019) and Batista et al. (2018), circular supply chain management is defined in this thesis as the integration of circular economy principles into organizational supply chain management through systematic innovations in business models and supply chain functions, spanning product/service design to end-of-life and waste management, involving relevant stakeholders throughout the process, with the aim of closing material flows and improving the economic, social, and environmental sustainability of organizations. To build a circular supply chain management, stakeholders need to collaborate and share information with others within and outside of organizations to maximize value creation and the utility of products and services (Lahane et al., 2020). Resource efficiency, profitability of organizations, waste generation, sustainability, and social benefits, etc., will be improved through the adoption of circular supply chain management (Farooque et al., 2019; Lahane et al., 2020).

The procurement process is the central interface between the supply and demand partners in the supply chain. The procedures in the construction procurement process have been identified as a collection of the planning stage, tendering, bid evaluation, subcontractor selection, type of payment, use of collaboration tools, design and construction stage, and performance evaluation (Eriksson & Westerberg, 2011). Procurement decisions strongly influence environmental performance throughout a project's lifecycle (Platform CB'23, 2021). Integrating the circular economy with procurement will change how we define and manage the procurement process (Farooque et al., 2019). By driving demand for circular products and services in the first place, circular procurement could accelerate the overall circular transition (EIT Climate-KIC, 2019). Circular procurement is the procurement process taken by public and private organizations to achieve circular activities (Neessen et al., 2021). It is how an organization anchors its circular ambitions in business processes, puts those ambitions in the market, purchases circular products and services, engages with the market and supply chain partners, both internally and externally, and seeks to maximize value (Platform CB'23, 2021; UNEP, 2021). Such a transition may involve both the adoption of innovative procurement approaches and the adaptation of established procurement practices. For example, lifecycle analysis, leasing, and through-life management, together with a shift in procurement policy from 'best cost' sourcing and pricing towards a service-based focus, can reshape supply chain relationships by shifting the emphasis from product ownership towards leasing and service-based arrangements (De Angelis et al., 2018).

1.2.3 Circular economy transition in Dutch social housing

A large proportion of European building stock consists of social housing (Housing Europe, 2022). There is a greater demand for social housing in Europe following COVID-19 due to the predicted rise in poverty and inequality. However, many European countries are unable to meet housing needs, particularly social housing, and more needs to be built and renovated in the coming decades. In the Netherlands, housing associations own 30% of the Dutch housing stock, which is the largest share when compared to other European countries (Eikelenboom et al., 2021). Dutch social housing organizations 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). Besides the societal role, Dutch housing associations also expect to contribute to environmental challenges corresponding to energy efficiency and the use of low-carbon building materials, and part of the wider public policy goals regarding sustainability and circularity (Lambrechts et al., 2021). Social housing organizations can therefore play a crucial role in the circular economy transition in the built environment, as they have both circular economy motivations and a large proportion of housing in Europe (Housing Europe, 2022). In today's social housing sector, a large part of activities occurs in the renovation of existing buildings (Aedes, 2016). It is an urgent mission to implement the circular economy in renovation projects to improve their efficiency and environmental value. However, the lack of legal standards and the complexity of renovation projects will bring challenges to the social housing renovation and increase the need for innovations in circular renovation (Elle et al., 2002, Gruis et al., 2011).

Different from owner-occupied housing and housing owned by small-scale landlords, the social housing sector is operated by professional management, which brings opportunities to integrate supply partners and develop innovative transformations (Gruis et al., 2011). Besides, as portfolio management strategies are available within most housing associations (van Zoest et al., 2019), it will be possible to implement circular economy in social housing organizations not only at a project level but also at portfolio and organizational levels. As housing owners, housing associations are responsible for controlling and supervising the maintenance and renovation of their properties throughout the entire lifecycle of the properties (Straub & Mossel, 2007). This gives them incentives and opportunities to apply the circular economy in their housing, since circular transition is a long-term effort (Eikelenboom et al., 2021), and sometimes the benefits are only realised after decades. However, circular economy practices in social housing could contribute significantly to the broader construction industry.

Since the 1990s, housing associations have become more market- and client-driven by adopting business management approaches to housing management (Straub & Mossel, 2007). As the manager of social housing stocks, procurement is essential for housing associations when building new houses and maintaining existing ones. A small number of housing associations in the Netherlands have already developed efforts to integrate a circular economy in their procurement process. For instance, over the past years, various housing associations have joined the Buyer Group, which is a nongovernmental organization established in the Netherlands for public and private partners to explore and share market vision and strategy for sustainability and circularity, to develop circular procurement together in the Dutch social housing sector (Buyer group, 2022). Nevertheless, circularity is far from common practice.

1.3 Problem Statement

1.3.1 Problems in practice

Although circular procurement is increasingly recognized as a key mechanism for enabling the circular economy, its development is still at an emerging stage and associated with systematic challenges (Qazi & Appolloni, 2022; Sajid et al., 2024). The challenges of developing circular procurement summarized by Qazi and Appolloni (2022) include insufficient sourcing strategy, lack of specifications and requirements for circular materials, reverse logistics barriers, resource constraints, limited skills, knowledge, and expertise of stakeholders, lack of top management support, organizational culture resistance, fragmented supply chain and weak stakeholder collaboration, and inadequate policy and regulatory support. In general, the current procurement strategy is not designed for the circular economy. The lack of coordination and industry norms to adopt circular economy strategies and use circular materials, limited mindset changes to adopt circular economy in procurement decisions, and insufficient policy support and incentives to implement circular procurement are the most critical challenges for circular procurement development (Qazi & Appolloni, 2022).

The construction industry is identified as a project-based industry with inherent uncertainty regarding the timing and specifications of projects (Behera et al., 2015). Its project-based nature also creates challenges for real-time supply chain visibility, potentially resulting in delays in project implementation and revenue

recognition (Behera et al., 2015). Compared to many other industries, production in the built environment is relatively complex and unstable (Vrijhoef, 2011). These characteristics create particular challenges for the implementation of circular procurement, which requires coordination and collaboration across supply chains and sectors (Qazi & Appolloni, 2022). In addition, under current public procurement rules in Europe, price is often prioritized over sustainability (Housing Europe, 2022). Implementing circular economy principles in social housing also creates an additional tension, as housing organizations must pursue circular ambitions while fulfilling their societal responsibilities to improve living conditions and maintain housing affordability (Eikelenboom et al., 2021).

Although construction procurement has a context-specific nature, the challenges of circular construction procurement implementation are more universally applicable (Ababio et al., 2025). Ababio et al. (2025) argued that the most significant challenge relates to financing and supply chain interactions, including insufficient supply chain collaboration, high cost of investment in the circular economy, and lack of knowledge and awareness of circular procurement. Industrial and organizational dynamics challenges are ranked as the second most significant for circular procurement implementation, which include lack of leadership, inadequate skills and training, and different priorities when adopting circular procurement. Besides, stakeholder preferences and process inefficiencies also hinder circular procurement implementation, including the lack of willingness to use circular materials and barriers in reverse logistics and supply chains (Ababio et al., 2025); Sajid et al., 2024). Other barriers include a lack of information exchange and management systems, a lack of standardization of circular procurement, a lack of profitable business models for the circular economy, a lack of collaboration and value chain thinking, and a lack of circular design and products (Sajid et al., 2024). However, even though challenges are universally applicable in circular construction procurement, the approaches to overcome these challenges should be tailored to different contexts (Ababio et al., 2025).

In addition to barriers identified in scientific research, grey literature also summarizes the constraints that hinder circular procurement implementation in the construction industry from a more operational level, including the absence of strategic pressure regarding the circular economy, unclear ambitions for the circular economy from procurers at the beginning of the procurement procedure, lack of support for circular buildings in current procurement planning, lack of sufficient implementation plan to support circular procurement after the planning phase, obstacles in setting circular contracts, difficulty to adjust current planning in the procurement process to the contract phase and carry out thoroughly through the entire phase, lack of circular expertise and circular information in every stage of

the procurement process, lack of information about reused materials in the market, lack of space and time in the deconstruction of building materials, and insufficient information steering about circular procurement (EIT Climate-KIC, 2019) .

1.3.2 Research Gaps

Despite the significance of procurement challenges for the whole construction supply chain, current research on this topic within the construction sector remains insufficient (Farooque et al., 2019). Most current studies on the circular built environment focus on the design, manufacturing, and construction phases, as well as the stakeholders involved (such as architects, contractors, and suppliers) in these phases. Compared with studies in other phases of the supply chain, research in the inception, tendering, and procurement phases is surprisingly limited, even though these phases also play an essential role in supply chain performance. Moreover, little is known about real estate and housing owners who manage sizeable portfolios of buildings and primarily engage in the procurement, tendering, and inception phases (Çetin et al., 2022). These actors take an essential part in realizing the circular economy transition in the built environment, as they hold strong market power and have the potential to accelerate the adoption of circular strategies in their portfolio management (Çetin et al., 2022). Multiple studies have systematically analyzed circular procurement in a general context (e.g., Adjei-Bamfo et al., 2023; Qazi & Appolloni, 2022; Rejeb & Appolloni, 2022; Sönnichsen & Clement, 2020; Xu et al., 2022). However, there is a lack of a holistic study about circular procurement in the context of the built environment to summarize which practices have been implemented, what recommendations have been given, and what a feasible process for circular construction procurement could be.

While research on circular procurement in the built environment remains limited, the broader circular procurement literature also largely focuses on conceptual development, identifying potential strategies and directions for circular procurement (e.g., Rejeb and Appolloni, 2022; Qazi and Appolloni, 2022). Nonetheless, few studies have examined how these conceptually proposed circular procurement strategies can be translated into complex real practice and the challenges to doing so, especially in the built environment (Ababio et al., 2025). Identifying good practice in circular procurement implementation in the construction industry and examining its real-world implications and challenges can be essential to stimulate a large-scale transition to circular procurement (Ababio et al., 2025). Bridging the gaps between conceptual strategies and empirical evidence will also be crucial to further develop actionable knowledge for circular procurement implementation (Ababio et al., 2025; Sajid et al., 2024).

Many scholars have recognized partnering and collaboration in the procurement process within an integrated supply chain as critical elements (e.g., Briscoe et al., 2004; Love et al., 1998; van Zoest et al., 2019). However, current circular procurement practice and development lack collaboration and value chain thinking (Sajid et al., 2024). The project-based and fragmented nature of the construction supply chain and the involvement of different stakeholders at different stages of the construction process make it even harder for stakeholder collaboration (Vrijhoef & Koskela, 2000). Besides, conflicts of interest among stakeholders in the circular economy also hinder collaboration (Berardi & de Brito, 2021). Effective stakeholder engagement in circular procurement and understanding of multi-stakeholder perspectives on circular procurement will be important to ensure a circular transition of the entire supply chain (Ababio et al., 2023; Marcon et al., 2023; Marjamaa et al., 2021; Sajid et al., 2024).

Most current research focuses on the design, construction, and end-of-life phases, whereas life extension strategies, such as the renovation and maintenance of existing buildings, should be given higher priority due to buildings' long lifetimes (Çetin et al., 2022; van Stijn & Gruis, 2020). However, research about maintenance and renovation of existing buildings for a circular built environment is currently overlooked in the literature, particularly from a procurement and supply chain management perspective. Implementing circular procurement not only in new constructions but also in the renovation and maintenance of existing buildings will be crucial.

1.3.3 Research aims and questions

Taken together, while circular procurement is increasingly recognized as a key strategic mechanism for accelerating the circular economy transition, important knowledge gaps remain. Existing research lacks a holistic understanding of circular procurement in the built environment, provides limited empirical evidence on its implementation and associated challenges, pays insufficient attention to stakeholder collaboration and supply chain dynamics, and offers little insight into how conceptual recommendations for circular procurement translate into real-world practice. Therefore, this study aims to investigate the circular transformation of procurement to facilitate circular transition in the built environment by taking Dutch social housing as a case study. Both theoretical and empirical perspectives will be adopted to examine circular procurement transformation. The first objective is to examine circular procurement in the built environment theoretically. Then the second and third objectives are to empirically investigate the practice and multi-stakeholder perspectives on circular procurement in Dutch social housing, respectively. Finally, the last objective aims to synthesize theoretical and practical studies on circular procurement.

Together, the main research question in this thesis is:

— **How can procurement be transformed to facilitate circular transition in the built environment?**

Due to the lack of holistic study of circular procurement in the built environment and the importance of supply chain management in circular procurement as identified in previous studies (Qazi & Appolloni, 2022; De Angelis et al., 2018) I first examined existing studies on this topic from a supply network perspective and developed an analytical framework to guide the process of circular procurement. To achieve this, I first needed to understand what stages are included in the procurement process by examining previous studies. Then I identified what actors are involved at different stages, what resources, such as digital solutions, data, procurement regulations, procurement solutions, etc., they require to successfully carry out circular procurement, and what activities they conduct and how they interact with each other at different stages. The first research question is:

— Q1: **What recommendations do existing studies give about circular procurement in the built environment to conceptualize a circular construction procurement process, and what directions for its further theoretical and empirical development emerge from this conceptualization?**

Given the limited empirical evidence on the implementation of circular procurement in practice (Ababio et al., 2025), further empirical investigation is needed to examine how circular procurement is implemented in real-world contexts after generating an analytical framework of it. I investigated the integration of circular principles in Dutch social housing procurement and examined its practices, challenges, and potential development. The focus is not only on housing associations and client perspectives in procurement transformation, but also on the supply chain by taking supply chain dynamics into consideration. The second research question to ask is:

— Q2: **What are the current practices, associated challenges, and possibilities for development to integrate circular economy principles into the procurement process of social housing?**

After examining the integration of circular principles in the procurement of Dutch social housing. I planned to give equal attention to supply chain actors and understand their perspectives on circular procurement as supply chain collaboration and value chain thinking is considered crucial in circular procurement implementation (Sajid et al., 2024). To narrow down the research scope and to address the research gap in circular renovation, the focus is put on the Dutch social housing renovation.

I aimed to further advance the understanding of circular procurement by examining different stakeholders' perspectives and exploring how similarities and differences among these perspectives can inform multi-stakeholder collaboration and the further development of circular procurement. The third research question is:

— Q3: **What are the perspectives of different stakeholders on circular procurement in social housing renovation, and where do their perspectives align, and where do they differ? What recommendations can be made to facilitate circular transformation of construction procurement by understanding multi-stakeholder perspectives?**

At the end of this thesis, in order to strengthen the connection between conceptual strategies and empirical evidence (Ababio et al., 2025), I aimed to reflect on the first three studies, synthesize the insights derived from them, and bridge the gap between theories and the practice of circular procurement. I investigated how findings generated from theoretical and practical studies on the topic of circular procurement complement or conflict with each other, and how new insights can be derived by synthesizing different studies. Concrete and actionable propositions were proposed to guide housing associations and their partners to implement circular procurement. The last research question is:

— Q4: **What are the points of divergence between the literature review and the empirical studies of circular procurement in Dutch social housing? What insights on circular procurement development can be generated by synthesizing and comparing the findings from both the literature review and empirical studies?**

1.4 Research Approach

1.4.1 Research paradigm

This research follows a pragmatic research paradigm. Pragmatism emphasizes practical outcomes and real-world applications to solve problems (Maxcy, 2003). It emerges as a duality between positivism, which posits an objective and measurable world, and interpretivism, which asserts that the world is shaped by human experience and meaning (Biesta, 2010; Morgan, 2014). Pragmatism provides the primary philosophical foundation for Mixed Methods Research and encourages the use of a combination of qualitative and quantitative research methods to solve real-world problems (Johnson & Onwuegbuzie, 2004; Morgan, 2014). Originating from American philosophers in the late 19th century, pragmatism focuses on the consequences of research and has gained considerable interest in social science and organizational management research (Maxcy, 2003; Morgan, 2014). It is suitable when the research problem is complex, multifaceted, and requires both objective evaluation and subjective observation (Morgan, 2014).

The pragmatist research paradigm is frequently related to abductive reasoning, which oscillates between inductive and deductive reasoning (Kaushik & Walsh, 2019). First coined by Peirce (1932), abductive reasoning refers to the inferential process of proposing a plausible explanation for an unexpected result. More recently, authors from the Academy of Management Discoveries described abduction as a form of inference that enables researchers to move from puzzling empirical anomalies to plausible explanations, particularly when existing theory cannot adequately account for observed phenomena (Cohen et al., 2025). Following the principles of the pragmatist research paradigm and abductive reasoning, this research aimed to explore the research topic by understanding existing theories, conducting empirical observations, and systematically comparing them to develop new categories iteratively. Four steps were employed in this thesis, as shown in Figure 1.1. This thesis is exploratory, as the topic is emerging and much remains unknown. The exploratory research in this thesis also means that although the research approaches are planned upfront, the results of earlier studies influence later studies.

TOC

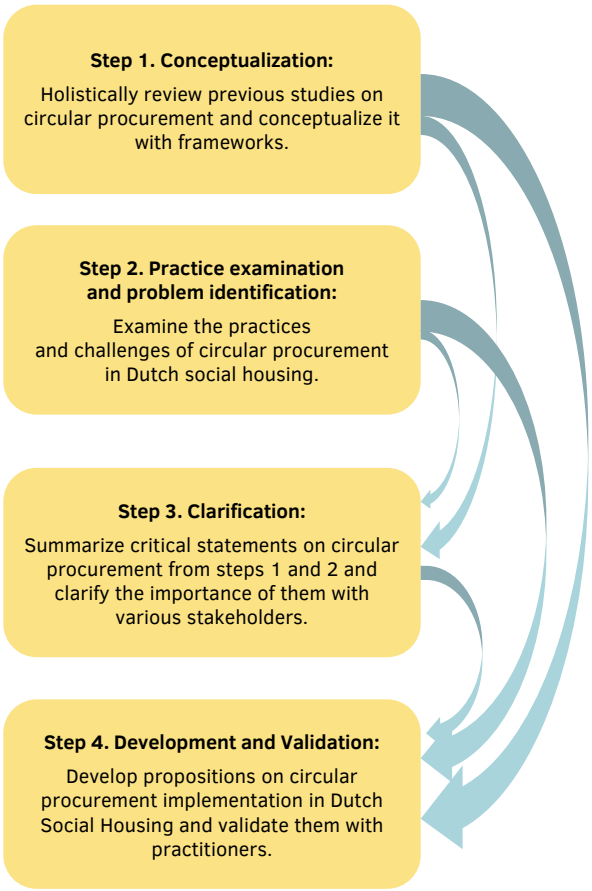

FIG. 1.1 Four steps of research methods

1.4.2 Scope and case selection

This thesis takes the Dutch social housing sector as the case study. Both circular new construction and large-scale circular renovation will be examined in this study. The empirical studies in this thesis focus on Dutch social housing organizations and their supply chain partners. The criteria to select housing associations and their supply chain partners are those that have some experience in circular social housing and circular built environment, or have the ambition to implement the circular economy in their social housing projects in the coming years. The primary level of analysis in this study is organizational, encompassing both intra-organizational aspects of housing associations and inter-organizational interactions among supply chain actors. Within this scope, technological, organizational, and institutional factors influencing circular procurement are examined.

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1.4.3 Research design

Various research methods are designed to be adopted in this thesis, including both theoretical and empirical research methods. Four objectives are designed to answer the four sub-research questions, and together, they answer the main research question of this thesis. This thesis is article-based, with Chapters 2, 3, and 4 as three independent scientific research papers conducted with independent research methods. Chapter 5 is a summarized section that synthesizes the outcomes from those three papers. The four objectives in this thesis and relevant study types, research methods, and explanations are presented in Table 1.1 to link the different aims in this thesis.

TABLE 1.1 Overview of research design in this study

Objective I	**Development of an analytical framework for circular procurement in the built environment.**
Study type	Theoretical study
Research methods	Systematic literature review, BPMN
Explanation	To examine current literature and develop a conceptual framework accordingly on circular procurement in the built environment, a systematic literature review method is used, which provides a top-down perspective on the current literature about a particular topic (Tranfield et al., 2003). Previous studies on circular procurement in the built environment are examined and critical actors, resources, and activities required at different stages of circular procurement are identified to develop an analytical framework that conceives the circular procurement process. A Business Process Modelling Notation approach, which provides a standardized approachfor graphical representations of business process operations (White, 2004), are used to map the analytical framework, including the workflow in circular procurement, the interactions between different actors, and the resources that support the process.
Objective II	**Investigate integration of circular economy principles into the procurement process in circular Dutch social housing transition, and its challenges and development potentials.**
Study type	Empirical study
Research methods	Case study, document research, semi-structured interview
Explanation	To conduct an in-depth examination of the real-world implementation of circular procurement, a case study research method is used as the empirical approach. Case study research method is a method used to examine contemporary phenomena in depth in the real world, where the investigators exert limited control over what is happening (Yin, 2009). It is used in this study to examine current procurement in the circular Dutch social housing transition and its associated challenges and propose potential developments. Desk research and semi-structured interviews will be used to conduct the case study and complement the data collection with different sources. Desk research includes the study of any websites and documents that are related to the topic or describe the cases of circular social housing practice. Semi-structured interviews are conducted with selected housing associations and their supply chain partners, including contractors, suppliers, architects, demolishers, digital solution providers, consultants, etc. The interviewees from these organizations are those who are personally involved in the execution of circular projects or circular developments at their organizations, which can include project managers, sustainable and circular advisors, directors, program managers, e.g.

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TABLE 1.1 Overview of research design in this study

Objective III	Investigate multi-stakeholder perspectives in circular social housing renovation, and how they can contribute to the future development of circular procurement.
Study type	Empirical study
Research methods	Workshop, Q methodology
Explanation	To both structurally investigate stakeholder perspectives on circular procurement and qualitatively understand their underlying reasons, a Q methodology is used. Q methodology is a research method that has been widely used in various fields of social sciences to understand individuals' perspectives and shared experiences and patterns of belief in them (Cuppen et al., 2010; Kerr et al., 2018). It is a combination of qualitative and quantitative research methods that analyze perspectives and patterns in a structured and statistic way (Stephenson, 1935; Barry and Proops, 1999). In this study, Q methodology is conducted in the form of a workshop to understand stakeholders' perspectives on circular social housing renovation. With Q methodology, stakeholders are asked to rank statements related to the topic of circular procurement in social housing according to their levels of agreement. The statements are elicited from reviews of previous studies conducted in the first study and the case study conducted in the second study. A workshop is organized to conduct the Q methodology and ask participants to discuss their rationale and perspectives in a group setting. This enables stakeholders with different roles to discuss their opinions with others and facilitate their value exchange and understanding from others' perspectives.
Objective IV	**Reflect on the findings from the first three studies, examine the gaps between theories and practices of circular procurement, and propose recommendations for the development of circular procurement in Dutch social housing.**
Study type	Comparison and synthesis study
Research methods	Focus group, interview
Explanation	To further investigate what can be learned by comparing the literature review and empirical studies, I synthesize and compare the outcomes of the first three studies and generate insights on circular procurement with an interpretive approach. According to the results of the comparison and synthesize of the first three studies, actionable propositions are proposed for housing associations and their partners to implement circular procurement. To further refine the research results, these propositions are validated with housing associations and contractors through the form of focus groups and interviews. Focus groups and interviews are effective qualitative research methods to understand participants interpretations, experiences, and evaluations on a phenomenon from their perspectives (Kvale & Brinkmann, 2009). The propositions are updated according to the results of the validation.

1.5 Research Contribution

1.5.1 Scientific relevance

This thesis first aims to contribute to circular procurement literature. By systematically reviewing existing studies that cover the intersections of circular economy, procurement and supply chain management, and the built environment, it conceptualizes a circular construction procurement process, synthesizes fragmented studies on circular construction procurement, and examines the research gaps and potentials. By conducting case studies and in-depth analysis of the practice, it provides empirical evidence for the practices and challenges of circular procurement implementation, which has been identified as limited in existing research (Ababio et al., 2025). By investigating multi-stakeholders' perspectives on circular procurement, it enhances stakeholder analysis in circular procurement. By comparing and synthesizing the literature review and empirical studies, it highlights the theory and practice gap in current circular procurement studies. Second, this study also contributes to supply chain management theories by integrating supply chain perspectives in both the literature review and empirical studies in this thesis. It enhances the interrelationship between supply chain management and procurement management, which has been stated as crucial in previous research (De Angelis et al., 2018; Stokke et al., 2023), and demonstrates how procurement is coordinated across the supply chain as an integrated system rather than simply purchasing and tendering techniques. Third, this study contributes to the literature in the built environment with its particular focus on construction procurement, while most of the existing studies in the built environment focus on design and construction activities (Farooque et al., 2019). Fourth, this study contributes to stakeholder analysis and stakeholder collaboration literature by investigating multi-stakeholder perspectives and proposing recommendations on strengthening stakeholder collaboration in circular procurement as emphasized in existing studies (Ababio et al., 2025; Sajid et al., 2024). Fifth, this study contributes to social housing studies by understanding housing associations as active demand-side actors in circular procurement and guiding them on translating circular economy ambitions into organizational practice.

1.5.2 Societal relevance

The findings of this study provide practical guidance for practitioners, researchers, and policymakers to facilitate circular procurement development and implementation in the construction industry. The first party that can benefit from this study is Dutch social housing organizations, including around 300 housing associations and the overarching organization that manages all social housing organizations in the Netherlands. Housing associations can refer to this study to design and manage the procurement processes in the circular transition at the strategic and organizational level across projects and asset portfolios. More specifically, procurement professionals from housing associations, such as project managers, sustainability advisors, and asset managers, can use the findings to integrate circular objectives into procurement planning and decision-making, select and collaborate with supply chain partners, allocate responsibilities, manage material and information flows, and evaluate circular performance across different procurement stages. The overarching organization of social housing can develop guidelines and standardizations for housing associations to adapt to their own organizations at a national level.

The findings in the Dutch social housing sector also provide a reference point and can be further examined and adapted to other construction sectors, industries, and regions to support their circular procurement transition. Demand-side stakeholders and procurement authorities in other sectors and industries can learn from the experiences identified in this thesis and adapt the findings to the context of their organizations. Supply-side stakeholders, including contractors, suppliers, consultants, architects, and other supply chain partners, can use the findings to better understand demand-side circular objectives, identify their roles and responsibilities across procurement stages, and improve their capabilities in circular project and product delivery. Furthermore, studying the Dutch social housing sector as a semi-public sector in this thesis can also contribute to pertinent policy and regulations for non-public circular procurement implementation. Policymakers can reflect on findings from this study to identify where regulatory interventions are required and where the current regulations and policy hinder circular procurement implementation. They can further develop regulatory mechanisms and policies to support non-public authorities and regulate public procurement in the circular economy transition. National and international circular economy and procurement development organizations and platforms can use the findings of this study on guideline-making for circular procurement development at a broader and generic level.

This thesis therefore facilitates the circular economy transition primarily by strengthening stakeholders' capacity to translate circular ambitions into procurement decisions, organizational practices, supply chain collaboration, and enabling institutional conditions. The extent to which these contributions result in improved circular outcomes will depend on their context-specific implementation.

1.6 Outline of the Thesis

This thesis follows an article-based structure. Chapters 2, 3, and 4 are independent papers that answer research questions 1, 2, and 3, respectively. Chapter 5 synthesizes Chapters 2, 3, and 4 and answers research question 4. Chapter 6 concludes this thesis by answering the four sub-research questions and the main research question, addressing theoretical contributions and practical implications of this thesis, proposing policy recommendations on circular procurement in the built environment, reflecting on the limitations of this thesis, and suggesting future research recommendations. Below are the titles and key contributions of Chapters 2, 3, 4, and 5:

Chapter 2

Holistic Analysis of Circular Procurement in the Built Environment: An Integrated Supply Chain Perspective.

Key contributions: Holistically and critically reviewed relevant research on circular procurement in the built environment from supply chain network perspectives; analyzed the activities, resources, and actors involved at different stages of circular procurement; conceptualize an analytical framework for circular construction procurement; identified future research opportunities to further theoretically and empirically develop the process of circular construction procurement.

Chapter 3

Integration of Circular Economy Principles into Dutch Social Housing Procurement: Technological, Organizational, and Environmental Practices, Challenges, and Development Potentials.

Key contributions: Conducted case studies to investigate the integration of circular economy in procurement of Dutch social housing as non-public organizations from technological, organizational, regulatory, and institutional aspects; analyzed associated challenges in integrating circular economy principles in procurement; identified possibilities for the implementation of circular procurement to bridge the gap between theoretical guidelines and operational realities.

Chapter 4

Multi-stakeholder perspectives on circular economy transformation in procurement of Dutch social housing renovatio.

Key contributions: Investigated multi-stakeholder perspectives on circular procurement in Dutch social housing renovation with a holistic perspective; identified interrelations between stakeholder roles and their perspectives; contributed to multi-stakeholder collaboration and value creation in circular procurement; proposed recommendations to guide future developments of circular procurement in the construction industry.

Chapter 5

Examine the gaps between theories and practices of circular procurement in Dutch social housing.

Key contributions: Examined the gap between theories and practice of circular procurement in the built environment by reflecting on and synthesizing the insights from our literature review study and empirical studies on circular procurement. Developed propositions on circular procurement and validated them with housing associations and their partners to provide concrete and actionable recommendations on circular procurement implementation.

1.7 Contributor statement

This thesis is the result of research conducted by the doctoral candidate (D.W.) under the supervision of T.W., P.C., and V.G. The doctoral candidate is the primary researcher and takes the leading role in the development and execution of the research, including research design, data collection and analysis, interpretation of findings, and preparation of the thesis. T.W., P.C., and V.G. provided academic supervision and contributed to the conceptual and methodological development of the research and the critical review and refinement of the work. The extent and nature of these contributions varied across the individual studies. Detailed author contributions are therefore reported separately for each co-authored chapter.

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2 Literature Review of Circular Procurement in the Built Environment

An Integrated Supply Chain Perspective

The research gaps and research objectives of the overall thesis are established in Chapter 1 and guide research questions across Chapters 2-5. The purpose of this chapter is not to identify research gaps for the rest of the chapters. Instead, it aims to address the first research gap, i.e., the lack of holistic analysis of circular procurement in the built environment, with a systematic literature review approach. Then, based on the analytical framework developed for a circular procurement process in the built environment, this chapter identifies areas requiring further attention and proposes future research opportunities to further develop and empirically examine the analytical framework. The future research opportunities proposed in this chapter, therefore, do not aim to guide research questions in the following chapters. However, this chapter provides a conceptual foundation for the rest of the chapters. Some of the research directions are subsequently explored in Chapters 3-5, while others remain directions for future research beyond the scope of this thesis.

Author Contributions: Conceptualization, D.W., T.W., P.C., V.G.; methodology, D.W., T.W., P.C.; formal analysis, D.W.; investigation, D.W.; resources, D.W.; data curation, D.W.; writing-original draft preparation, D.W.; writing-review and editing, D.W., T.W., P.C., V.G.; visualization, D.W.; supervision, T.W., P.C., V.G.

ABSTRACT Procurement management plays an essential role in the circular transition by stimulating demand for circular products and services and connecting demand and supply within the supply chain. The field of circular procurement has gained interest in recent years as a means of transforming traditional procurement into a circular model. However, a holistic and state-of-the-art review of the development of circular procurement in the built environment is lacking in the current literature. Therefore, this study aims to systematically and critically review the relevant literature on circular procurement in the built environment to identify the procurement process in circular projects, develop theories on the principles and procedures for the development and implementation of circular procurement, and identify future research themes on this topic. A supply chain perspective was adopted to analyze 65 journal articles that are relevant to this topic. A six-stages-based analytical framework for circular procurement are proposed, using a standardized approach to describe the actors, resources, and activities involved in the circular procurement process. This study concludes that an integrated supply chain that integrates actors, resources, and activities should be developed to facilitate the implementation of circular procurement. In addition, future research should focus on developing an ecosystem of actors, adopting a whole-lifecycle perspective in procurement functions, enhancing the innovative and adaptive capabilities of organizations, implementing digital technologies and intermediary platforms, clearly identifying the decision-making process in circular procurement, and distinguishing between circular procurement for new construction and renovation projects.

KEYWORDS Circular Economy, Circular Procurement, Supply Chain Management, Built Environment, Actors-Resources-Activities

2.1 Introduction

The construction industry faces challenges when transforming existing building stocks in a circular way (Gerding et al., 2021). It calls for a transition from traditional linear supply chains to circular ones (Nasir et al., 2017). Procurement, which refers to the purchase of goods and services by public and private organizations, plays an essential role in the transformation of the circular economy. As the central interface between supply chain partners, the procurement process not only plays a crucial role in achieving the required flow and connections between supply and demand but also accelerates the overall circular transition by driving demand for circular services and products and leveraging recycled materials (EIT Climate-KIC, 2019).

Construction procurement operates as a multidisciplinary process throughout the entire project lifecycle, integrating multidimensional factors, such as sustainability, construction performance, and monetary value, into a single system (Ruparathna & Hewage, 2015a). Previous studies have shown that a large amount of budget in private and public sectors is consumed to procure products and services, which makes procurement management a key factor for the operational, financial, and environmental performances of organizations (Qazi & Appolloni, 2022; Xu et al., 2022).

Circular procurement is the procurement process taken by public and private organizations to achieve circular activities (Neessen et al., 2021). There are various definitions of circular procurement. The European Union defined circular procurement as 'the process by which public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains, whilst minimizing, and in the best case avoiding, negative environmental impacts and waste creation across their whole lifecycle' (European Union, 2017). Qazi & Appolloni (2022) defined circular procurement in their review study as 'the integration of circularity into the procurement process whereby organizations seek to purchase regenerated biological materials toward a zero end-of-life concept. 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.' By synthesizing different definitions of circular procurement, we understand it as how an organization makes efforts to maximize the value, achieve zero end-of-life impacts, and close the materials loop by anchoring its circular ambition in the business processes, putting the circular ambitions in the market, purchasing or providing circular products and services, and implementing interactions with the market and supply chain partners internally and externally (Platform CB'23, 2021; UNEP, 2021; Qazi & Appolloni, 2022).

Several existing studies have reviewed relevant literature about circular procurement in a general context or about a specific aspect of construction procurement (as shown in Table 2.1). However, a holistic and state-of-the-art review of circular procurement in the built environment is still missing. In most review studies of the circular built environment, the research on the procurement function and related activities is ignored, while the focus has been mostly on the design, manufacture, construction, maintenance, and end-of-life functions or phases of the construction supply chain, e.g., Chen et al. (2022), Ding et al. (2023), and Charef et al. (2022). Only a few review studies mentioned the role of procurement and tendering-related activities for circular transition in the built environment, e.g., Charef (2022) and Dewagoda et al. (2022).

TABLE 2.1 Current review studies about circular procurement in a general context

Authors	Research objectives and contributions	Limitations in relation to the scope of this study	Title of the article
(Adjei-Bamfo et al., 2023)	Study sustainable-oriented Public Procurement Innovation from a supplier perspective. Identify how suppliers' incentives and capabilities contribute to sustainable innovation for public procurement.	Does not concentrate on the built environment. Emphasizes the suppliers' lens in sustainable public procurement instead of the entire supply chain perspective.	Public procurement for innovation through supplier firms' sustainability lens: A systematic review and research agenda
(Polonsky et al., 2022)	Uncover the drivers and barriers for public procurement of recycled and recovered products and materials. Identify the impact of different factors on the change of purchasing process.	Does not concentrate on the built environment.	Identifying the drivers and barriers of the public sector procurement of products with recycled material or recovered content: A systematic review and research propositions
(Qazi & Appolloni, 2022)	Identify barriers and drivers for circular procurement management from various perspectives. Propose a multi-factor conceptual framework for circular procurement management.	Does not concentrate on the built environment. The analysis of circular procurement is not organized by the different stages of the procurement process.	A systematic review of barriers and enablers toward circular procurement management
(Rahla et al., 2021)	Identify the selection criteria for building materials and components in accordance with circular economy principles and strategies.	Focuses only on the selection criteria for building elements. Other activities in the procurement process, e.g., tendering and contracting, are not included.	Selection Criteria for Building Materials and Components in Line with the Circular Economy Principles in the Built Environment—A Review of Current Trends
(Rejeb and Appolloni, 2022)	Study the application of Industry 4.0 technologies on circular procurement. Propose a conceptual framework that identifies the antecedents, enablers, and outcomes of the implementation of Industry 4.0 on circular procurement.	Does not concentrate on the built environment. Focuses on the intersection of Industry 4.0 and circular procurement rather than on the process of circular procurement.	The Nexus of Industry 4.0 and Circular Procurement: A Systematic Literature Review and Research Agenda
(Scherz et al., 2022)	Systematically review current studies about the implementation of Life Cycle Analysis (LCA) in the public building tendering and awarding process in the construction industry. Identify the challenges to implementing LCA in the procurement process.	Focuses only on the adoption of LCA in the procurement process, which can be an aspect of circular procurement. The big picture of circular procurement is not touched.	Implementation of Life Cycle Assessment (LCA) in the Procurement Process of Buildings: A Systematic Literature Review

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TABLE 2.1 Current review studies about circular procurement in a general context

Authors	Research objectives and contributions	Limitations in relation to the scope of this study	Title of the article
(Sönnichsen & Clement, 2020)	Systematically study green and sustainable procurement from perspectives of organizational aspects, individual behavior, and operational tools. Propose insights for the development and implementation of circular procurement.	Does not concentrate on the built environment.	Review of green and sustainable public procurement: Towards circular public procurement
(Xu et al., 2022)	Systematically synthesize the knowledge about CIRCULAR PROCUREMENT. Identify antecedents, practices, performances, and their relationships to circular procurement development.	Does not concentrate on the built environment.	Circular procurement: A systematic literature review
(Yu et al., 2020)	Develop an integration framework to promote sustainable and electronic procurement in the construction industry. Identify strategies to support the integration of sustainable and electronic procurement.	Emphasizes integrating sustainable and electronic procurement rather than developing a sustainable procurement process.	Towards an integration framework for promoting electronic procurement and sustainable procurement in the construction industry: A systematic literature review

In recent years, an increasing number of studies have identified supply chain management as the most significant tool for the circular transition across the built environment and other industries (Qazi & Appolloni, 2022). It could facilitate the transition from a traditional linear way of production and consumption to a circular approach. Previous studies have demonstrated that supply chain and procurement types are interrelated, indicating that the circular transition of procurement will influence supply chain transformation and vice versa (De Angelis et al., 2018; Stokke et al., 2023). Therefore, this study aims to systematically and critically review existing research on circular procurement in the built environment from a supply chain perspective to understand the actors, resources, and activities within this supply chain. The aim of this study will be achieved through four steps: 1) Understand the procurement process and its supply chain for circular construction according to existing studies; 2) identify principles, strategies, and recommendations for the development and implementation of circular procurement in the built environment; 3) develop an analytical framework with a standardized approach for the circular procurement process based on the findings from steps one and two; 4) identify areas that remain insufficiently understood and propose directions for further theoretical and empirical development of the analytical framework. The following research question will be asked in this study:

— **What recommendations do existing studies give about circular procurement in the built environment to conceptualize a circular construction procurement process, and what directions for its further theoretical and empirical development emerge from this conceptualization?**

The remainder of the chapter is structured as follows: Section 2 will elaborate on the concept, stages, and supply chain perspective of circular procurement. The methodology of this review study will be explained in Section 3. Section 4 is the results section, in which the activities, actors, and resources in the supply chain will be analyzed in depth. After this, critical research gaps and future research directions will be discussed in Section 5. Section 6 concludes the chapter by summarizing the main findings and articulating the study's societal and theoretical relevance.

2.2 Theoretical Background

2.2.1 Green procurement, sustainable procurement, and circular procurement

Although the study of circular procurement is still in its infancy, research about green procurement and sustainable procurement has existed for decades. The key differences among green, sustainable, and circular procurement are outlined in Table 2.2. Studies have shown that the knowledge of green procurement and sustainable procurement provides the fundamental foundation to move towards circular procurement, and the strategies and policies for green procurement and sustainable procurement can be borrowed and adapted to the development of circular procurement(Ababio et al., 2023; Alhola et al., 2019; Sönnichsen & Clement, 2020). Green public procurement is 'a process whereby public authorities seek to procure goods, services and works with a reduced environmental impact throughout their life cycle when compared to goods, services and works with the same primary function that would otherwise be procured' (EU Commission, 2016). Sustainable public procurement is defined as 'a process whereby organisations meet their needs for goods, services, works and utilities in a way that achieves value for money on a whole life basis in terms of generating benefits not only for the organisation, but also for the society and the economy, whilst minimising damage to the environment' (UNEP, 2021). The main difference between green procurement,

sustainable procurement, and circular procurement is that, in green and sustainable procurement, efforts are made to contribute to the benefits of society, the environment, and the economy, whereas the supply chain of materials does not need to be closed or circular (Qazi & Appolloni, 2022). Circular procurement ultimately aims to minimize waste generation, retain materials and products at their highest possible value, and facilitate closed material flows across the supply chain (Qazi & Appolloni, 2022). Besides this difference, these three concepts share many similarities, and it is essential to promote a circular transition through green and sustainable procurement strategies (Alhola et al., 2019). Because existing academic research on circular procurement is still quite limited, this study also includes previous studies on green and sustainable procurement, which can contribute to circular procurement.

TABLE 2.2 Differences between green procurement, sustainable procurement, and circular procurement, adapted from Qazi and Appolloni (2022)

	Reduced environmental impact	Economic benefits	Open loop	Closed loop	Circular supply chain	Landfill ratio	Recovery ratio
Green procurement	X	X	X			Moderate	Moderate
Sustainable procurement	X	X	X	X		Low	Maximum
Circular procurement	X	X		X	X	Zero	100%

2.2.2 Stages in circular construction procurement

The activities in circular procurement can be clustered into different stages. Five stages of procurement are identified by Cheng et al. (2018) as, pre-requirements, calls for tenders, selection, awarding, and contract. Yevu et al. (2021) classified construction supply chain and procurement into four stages, i.e., planning, pre-contract, contract, and post-contract, in which the post-contract stage mainly refers to the activities of construction and project delivery after contracts are made. By combining the stages of procurement proposed by Cheng et al. (2018) and Yevu et al. (2021) while considering the nature of construction supply chain, this study distinguishes activities in circular construction procurement into six stages: planning stage, criteria specification stage, tendering and selection stage, contracting stage, design stage, and construction and delivery stage. The planning stage is to

explicitly set ambitions and circular strategies and make decisions about the projects before launching into the procurement procedures. The criteria specification stage involves making specific implementation plans and circular procurement criteria. The tendering and selection stage is about selecting partners to collaborate with. The contracting stage involves entering into contracts with selected partners that reflect circular ambitions. After making agreements, clients and other partners will plan and realize the construction projects together during the design and the construction and delivery stages. Besides, it is necessary to mention that these six stages can occur through a building's lifecycle and refer not only to new construction but also maintenance, renovation, and demolition of buildings.

2.2.3 Actors-Resources-Activities model and the supply chain

To elaborate on the supply chain from the layers of actors, resources, and activities in this study, we employ an Actors-Resources-Activities (ARA) model. The ARA model was first developed by the Industrial Marketing and Purchasing group in 1992 to study the business network and relationships of industrial organizations (Håkansson and Johansson, 1992). In the ARA model, actors are those who perform activities and manage resources, such as individuals, organizations, groups, and departments. Resources refer to the social network connections and the tangible and intangible resources that are required and exchanged between organizations, which include materials, facilities, technologies, knowledge, organizational capabilities, and financial capital, for instance. Activities are the actions and interactions performed by actors to create resources, including purchasing, contracting, tendering, information exchange, and stakeholder interactions, for instance (Koporcic, 2017). Studies have mostly adopted this model to research business relationships across different industries, e.g., studies by Carloni & Galvani (2023) and Choi & Hara (2018). Tran (2017) has proposed studying the supply chain from an ARA model perspective to gain a holistic view and understand it as a network of individuals or organizations rather than a linear chain. The three aspects of the ARA model were used in this study to emphasize different organizations and their networks and relationships in circular procurement.

2.3 Methodology

A systematic literature review approach was adopted in this research to search for relevant studies. Systematic literature review method provides a top-down perspective on the current literature and answers questions about a particular topic by identifying, selecting, synthesizing, and critically assessing the existing studies (Tranfield et al., 2003). It highlights the current trends, problems, themes, and potential future developments of the well-defined topic with a comprehensive, unbiased approach (Fink, 2019). The process of reviewing in this study follows the guidelines provided by Tranfield et al. (2003), which include planning, conducting, reporting, and discussing a systematic literature review.

2.3.1 Systematic review queries

A search protocol has been developed (see Table 2.3) to find and select articles. Since some supply chain management studies include discussions of procurement-related topics, 'Procurement' and 'Supply Chain Management' were combined into a single block of search terms. Besides, supply chain management-related topics, e.g., information flow, stakeholder interaction, and material flow, were also included in this block. Considering the fact that procurement studies in a circular economy context are currently limited, '9R strategies', 'green', and 'sustainable' were included in the block 'Circular Economy' as keywords to expand search results. Moreover, this review study focuses specifically on the built environment because construction procurement is strongly shaped by its project-based production context and therefore differs from procurement in other product-based industries. For instance, construction procurement involves temporary supply chains by projects, project-specific procurement arrangements, substantial dependence on the services from contractors and subcontractors, and unique project characteristics that influence procurement choices (Adamtey, 2022; Dubois & Gadde, 2002; Mbachu, 2008). Consequently, to keep the boundary of the systematic literature review clean and maintain the focus on procurement in the built environment, literature from other industries was excluded from the literature pool of this chapter.

TABLE 2.3 Search protocol

Criterion	Description		
Scientific database	Scopus, Web of Science		
Search fields	Title, Abstract, Keywords		
Publication date	Unlimited to November 15th, 2023		
Language	English		
Publication type	Journal		
Search terms	**Block 1:** Circular Economy	TITLE-ABS-KEY	(‘circular*’ OR ‘circular economy’ OR ‘reverse’ OR ‘reus*’ OR ‘remanufacture*’ OR ‘recycle*’ OR ‘refurbish*’ OR ‘reduc*’ OR ‘repair*’ OR ‘renovat*’ OR ‘revitalize*’ OR ‘recover*’ OR ‘regenerat*’ OR ‘end of life’ OR ‘closed loop’ OR ‘green’ OR ‘sustainable’ OR ‘sustainability’)
	Block 2: Procurement and Supply Chain Management	TITLE-ABS-KEY	(‘supply chain’ OR ‘value chain’ OR ‘procurement’ OR ‘demand chain’ OR ‘information flow’ OR ‘material flow’ OR ‘value flow’ OR ‘stakeholder interaction’ OR ‘stakeholder relationship’ OR ‘information sharing’ OR ‘contracting’ OR ‘tendering’ OR ‘sourcing’ OR ‘supplier selection’ OR ‘contractor selection’)
	Block 3: The Built Environment	TITLE-ABS-KEY	(‘construction industry’ OR ‘built environment’ OR ‘building industry’ OR ‘building environment’ OR ‘housing’ OR ‘real estate’)

2.3.2 The systematic review filtering and classifying process

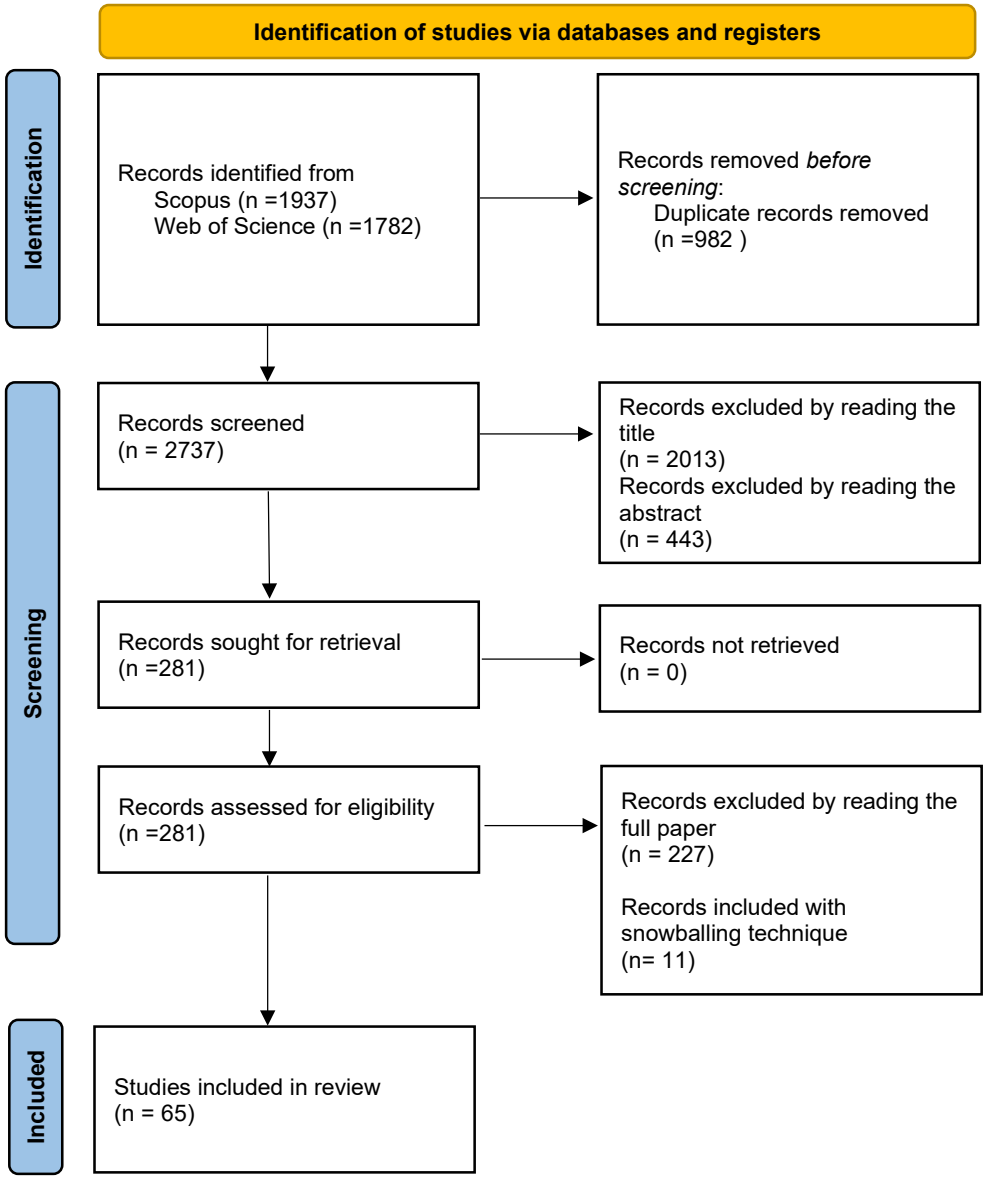

FIG. 2.1 Flow diagram for systematic literature review (PRISMA method). Source: Steps based on Page et al. (2021).

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The screening process for this study followed the PRISMA 2020 flow diagram guidelines (Page et al., 2021), as shown in Figure 2.1. Zotero software was used to integrate results and remove duplicate articles found across different search engines. The specific inclusion and exclusion criteria for paper selection are listed in Table 2.4. After the screening process, 65 articles were selected for the final review.

During the review process, Atlas.ti software was used to systematically analyse the 65 articles. Five principal qualitative themes were developed in Atlas.ti as 'stages in circular procurement', 'supply chain', 'barriers to adopting circular procurement', 'drivers to adopting circular procurement', and 'future research potential' to code the selected articles. Sub-themes for 'supply chain' were identified from the layers of 'actors', 'resources', and 'activities'. In the scope of this study, actors refer to stakeholders involved in the circular procurement process. Resources refer to the intermediary models, digital tools, knowledge, organizational capabilities, databases, information, materials, and other social network connections that actors in circular procurement require and manage. Activities are identified as the actions and interactions performed by actors in the procurement process, such as stakeholder collaboration, purchasing, and project delivery. More specific classifications within these three layers are shown in Table 2.5.

TABLE 2.4 Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Paper related to the topic of circular procurement.	Paper that is not in the context of the built environment, construction industry, real estate, housing, or relevant infrastructure industry.
Paper related to green procurement, sustainable procurement, green sourcing and tendering, sustainable sourcing and tendering, etc., which can contribute to circular procurement.	Paper with technical studies, e.g., the probabilistic analysis of material flows or onsite waste hazard assessment.
Paper that aims to achieve the recycling of materials or the reduction of waste and carbon emissions in the procurement process, which can contribute to circular procurement.	
Paper related to circular supply chain studies and circular economy studies, in which procurement, tendering, contracting, or sourcing is discussed.	

TABLE 2.5 Qualitative themes in Atlas.ti

Principal theme	Sub-theme	Sub-sub-theme
Stages in CIRCULAR PROCUREMENT	Planning stage; Criteria specification stage; Tendering and selection stage; Contracting stage; Design stage; Construction and delivery stage.	-
Supply chain	Actors	Clients; contractors; suppliers; architect; consultants; digital firms; municipalities; demolishers; other actors
	Resources	Intermediary models; information; materials; values; digital technologies; knowledge; organizational capabilities; databases; tools; other network connections
	Activities	Stakeholder interactions; purchasing; project delivery; tendering; contracting; logistics; other activities
Barriers to adopting circular procurement	-	-
Drivers to adopting circular procurement	-	-
Future research potentials	-	-

2.3.3 Synthesize protocols

Content analysis was used to review relevant articles in-depth and critically. An overview of the actors, resources, and activities involved in the different stages of circular procurement was analysed and described following the protocol outlined in Table 2.6. The final result of this overview is presented in Appendix A. To standardize the approach to visualizing actors, their activities, and resources in the circular procurement process, this study used the Business Process Model and Notation (BPMN) language. BPMN is a flowchart technique for graphical representations of business process operations (White, 2004). Previous studies have used this method for modelling and mapping supply chain processes, including Mohammadi & Mukhtar (2012) and Pratama & Nurmala (2021). This study established a six-stages-based analytical framework for the circular procurement process (see Figures 2.2-2.7) using BPMN notation.

TABLE 2.6 The protocol for the overview of circular procurement

	Planning stage	Criteria specification stage	Tendering and selection stage	Contracting stage	Design stage	Construction and delivery stage
Actors	Activities	Activities	Activities	Activities	Activities	Activities
Resources	X	X	X	X	X	X

2.4 Results

2.4.1 Planning stage

Clients, consultants, and governments are identified as the major stakeholders who join the planning stage of circular procurement (see Figure 2.2). An ongoing dialogue and learning between government and market actors is recommended at this stage to drive long-term innovation.

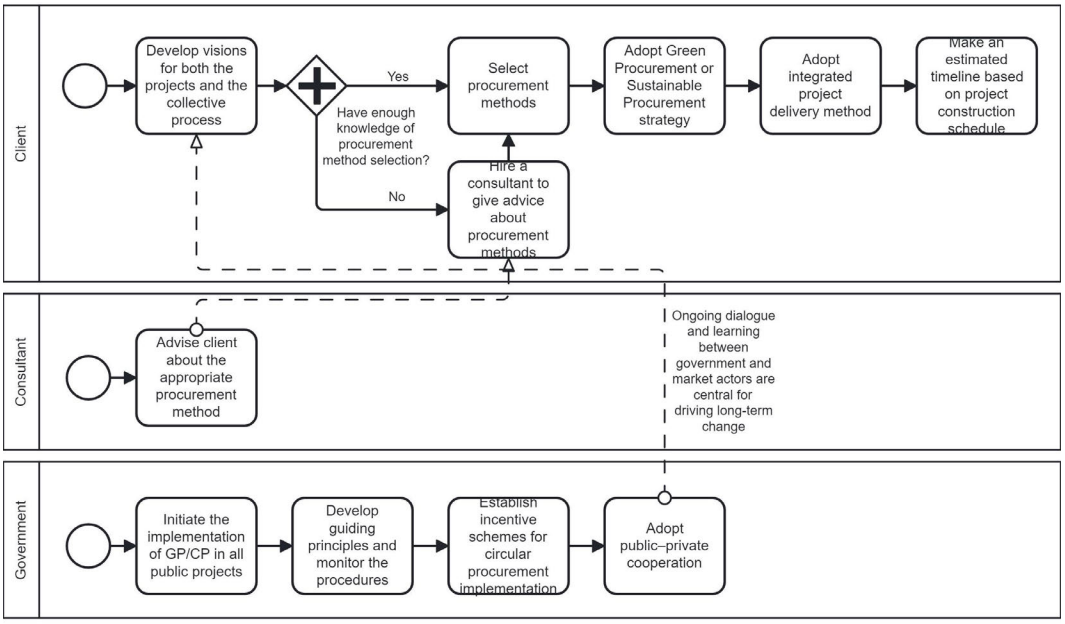

FIG. 2.2 The analytical framework for the planning stage in circular procurement

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Activities in the planning stage

Vision development and procurement method selection

Circular procurement starts with clients developing visions for both the projects and the collective processes (see Figure 2.2). The leadership and motivation of clients at this stage are critical to the successful realization of a circular project (Leising et al., 2018). Besides project ambitions, the procurement method, which also needs to be determined at the planning stage, is another critical factor in achieving circular and sustainable outcomes (Montalbán-Domingo et al., 2019). The selection of procurement methods for green and circular buildings should encourage stakeholder collaboration and avoid disputes and competitive relationships (Ferme et al., 2018). An integrated project delivery method is suggested for innovative construction projects to facilitate collaboration, information sharing, and cost-benefit sharing among all stakeholders, and to support long-term cost-efficient decision-making throughout the construction process (Goh et al., 2023; Rahim et al., 2015). Top management from clients, developers, or consulting companies on procurement management would prioritize and facilitate the implementation of circular supply chains (Asante et al., 2022). The current problem in practice is that many practitioners in the construction industry do not have adequate time for the planning stage (Shooshtarian et al., 2022). Lack of planning at the start of circular initiatives will cause additional issues during the follow-up phases.

Actors in the planning stage

The role of governments and municipalities

The government takes on essential responsibilities in the development of circular procurement. Insufficient policies, regulations, and leadership from the government would hinder the construction companies' incentives to adopt circular procurement (Ruparathna & Hewage, 2015b). Governments could facilitate the circular transformation by developing guidelines to direct the building industry (Hjaltadóttir & Hild, 2021), standardizing green products and services (Mojumder et al., 2022), and promoting incentive schemes (e.g., tax reduction) for the implementation of circular procurement (Wong et al., 2016; Hassan et al., 2023). Additionally, establishing public-private partnerships would also support long-term transformation by fostering constant communication and knowledge sharing between market participants and governments (Lingegard et al., 2021b).

Supply chain collaboration and collective business model

Organizational support from supply chain partners is critical to establishing a co-creation process within the supply chain. To establish supply chain collaboration, the circular procurement business model is suggested to be designed around collective

interests and shared values among all supply chain partners rather than solely concentrating on a single actor (Leising et al., 2018, Tsytsyna et al., 2023). As such, responsibilities will be shared across the entire supply chain, and different supply chain partners will have incentives to contribute to the common goals of circular projects (Leising et al., 2018).

2.4.2 Criteria specification stage

More actors are recommended to join the criteria stage through early market dialogue to specify the criteria and requirements in circular transition (see Figure 2.3). Digital techniques such as BIM and Lifecycle Cost Analysis can be adopted at this stage to support and stimulate the adoption of circular economy strategies.

Activities in the criteria specification stage

Specify functional requirements

Clients need to specify objectives and work programs by identifying specific needs, requirements, and interventions during the criteria specification stage (Ajayi and Oyedele, 2018). Including performance indicators in construction procurement ensures that project objectives are met (Montalbán-Domingo et al., 2019). It is essential for clients to provide functional requirements to suppliers and contractors rather than static requirements or practical solutions, to ensure that suppliers and contractors have sufficient space for innovation and adaptation (Sparrevik et al., 2018, Xia et al. 2014).

Actors in the criteria specification stage

The innovation ecosystem in the criteria specification

However, the client's requirements should not take precedence over other voices in a context where supply chain collaboration is highly valued. To ensure that the procurement requirements are made in accordance with the latest information and qualifications from the market, it will be critical to include other supply chain actors and create market interaction at this stage (Lingegard et al. 2021b). While practitioners' incentives for circular transition are not always strong enough, engaging with key circular-driven actors in the innovation ecosystem, such as academics, public institutions, and governments, to provide bottom-up initiatives will be essential (Stokke et al., 2023; Condotta and Zatta, 2021).

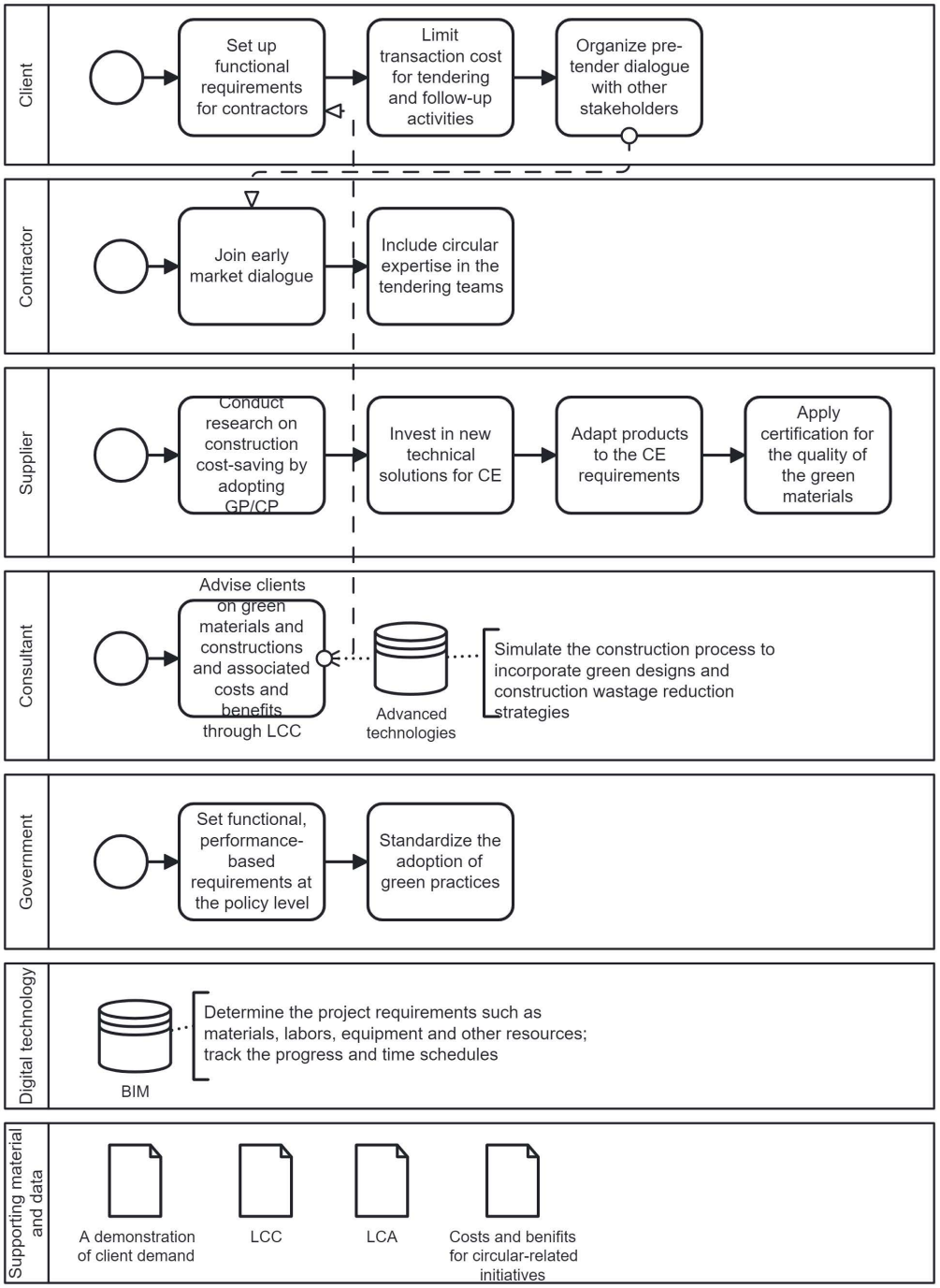

FIG. 2.3 The analytical framework for the criteria specification stage in circular procurement

Resources in the criteria specification stage

Principles in criteria specification

Several principles need to be taken into account when establishing criteria for tendering circular projects. First, the procurement strategies or requirements should encourage contractors' long-term innovations (Koc et al., 2023). Second, to promise and incentivize market competence for contractor and supplier selection, the criteria shouldn't exclude too many potential participants. Third, the use of circular materials and circular strategies in construction projects can be set as a pre-qualification criterion (Kadefors et al., 2021). Fourth, clients should add environmental criteria as award criteria to tender documents to improve contractors' environmental awareness and construction management strategies (Montalbán-Domingo et al., 2023). Fifth, transaction costs should be limited in tendering and follow-up activities. Last but not least, even with all the new adaptations in tendering requirements, it is always essential to align new requirements with the logic and timeline of the chosen project delivery model (Kadefors et al., 2021).

2.4.3 Tendering and selection stage

The tendering and selection stage of circular procurement places emphasis on contractors' capabilities in the circular transition (see Figure 2.4). It also highlights the integration of lifecycle thinking and standardization of the tendering process.

Resources in the tendering and selection stage

Contractors' capabilities in bidding for circular projects

For contractors who are participating in the call for tenders, incorporating greenelements and cost predictions about their circular projects in the tendering preliminaries will be essential (Alshboul et al., 2022). They need to gather information on the emissions and circular levels of materials from their suppliers and incorporate this data into their bid package (Assaad, 2024). It is also recommended that contractors procure a demolisher with experience and knowledge of circular projects to make predictions about demolition costs and integrate them into tender documents (Wijewickrama et al., 2022; Pellegrini et al., 2021). Nevertheless, contractors' financial capacity is always essential to their ability to balance investment in circular transitions with corresponding financial burdens (Koc et al., 2023). Clients should make sure to involve different competencies in the tendering procedure and add awards for circular projects to improve contractors' capabilities in circular projects and generate circular concepts during the process (Sparrevik et al., 2018).

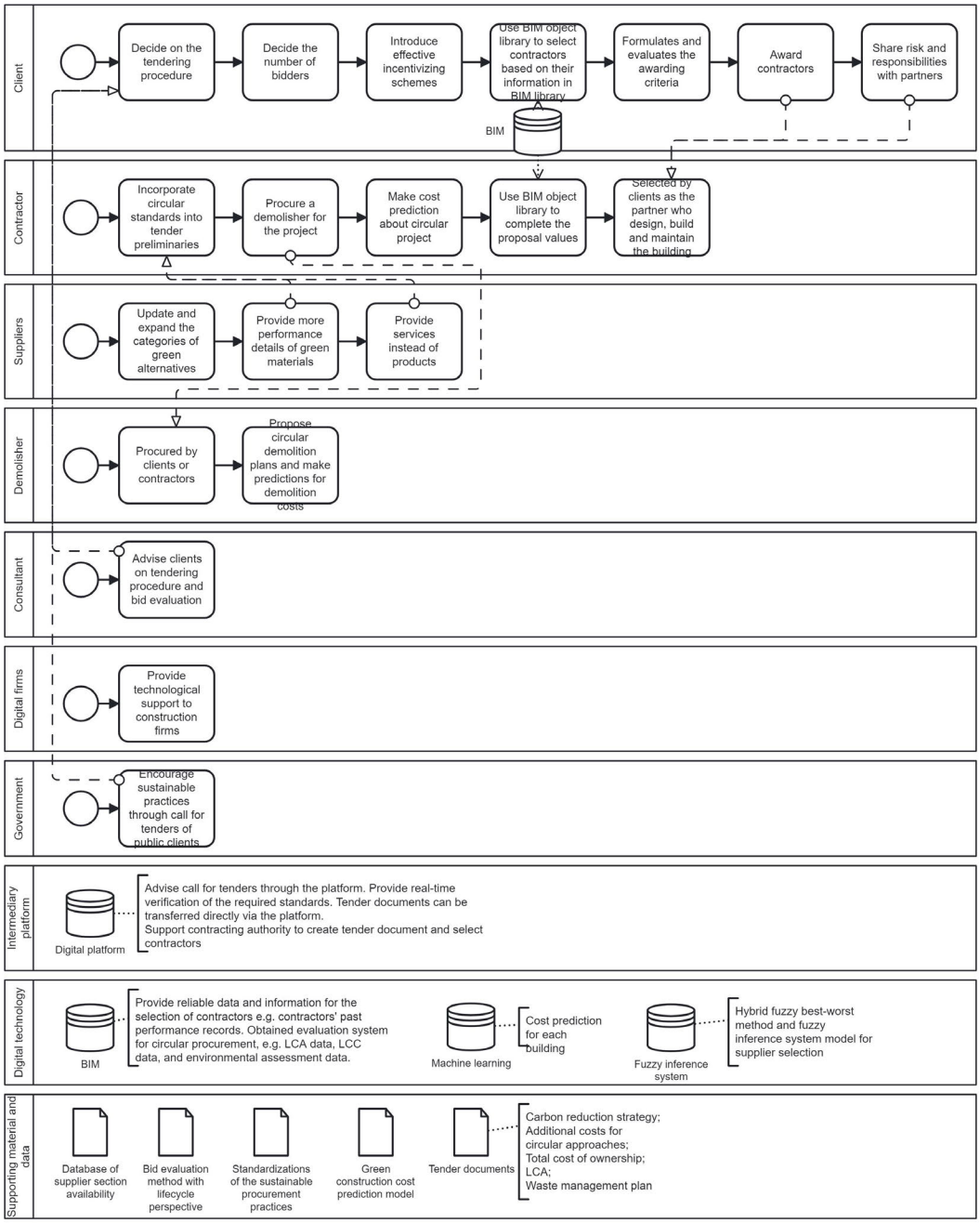

FIG. 2.4 The analytical framework for the tendering and selection stage in circular procurement

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Standardization and lifecycle perspective in tendering and bid evaluation

At the tendering and selection stage, clients procure services from contractors and other relevant actors based on certain tendering procedures and evaluation criteria (Granheimer et al., 2022). Current tendering and procurement procedures have been identified with a lack of standardization and an objective bid evaluation method (Ruparathna & Hewage, 2015a). Besides, current approaches frequently disregard the life cycle view of projects and place a higher weight on the initial cost than the lifecycle cost (Abduh et al., 2012). Therefore, it will be critical to standardize the tendering process and integrate the whole life cycle perspective with the circular procurement process and bid evaluation methods (Abduh et al., 2012; Ababio et al., 2023).

Innovations in tender documents and evaluation criteria

Studies have shown that the following technical elements could be incorporated in tender documents for circular projects: total cost of ownership with a calculation of the Life Cycle Cost (LCC) approach to guide the cost in circular projects; the Life Cycle Analysis (LCA) of circular materials and products; the additional cost for the application of the carbon evaluation method; the plan to adopt circular strategies and solutions in projects; and a waste management plan for circular projects (Ababio et al., 2023; He et al., 2022; Kar and Jha 2021). Aside from these technical requirements, soft factors, such as the stakeholders' experiences in circular projects, their capabilities for innovation, their capabilities to collaborate with other supply chain partners, and their construction management strategies, have also been identified as critical criteria in circular bid evaluation (Ababio et al., 2023; He et al., 2022; Xia et al. 2015).

The use of digital technologies in tendering

The use of digital technologies has been identified with great potential for evaluating bidders and improving the interaction processes between clients and bidders. For instance, a BIM object library containing LCA and LCC data could be used as an evaluation system for contractor and supplier selection (Barbini et al., 2020). It can support the tendering process by processing a large amount of data within a limited time and resources. Besides BIM, machine learning can be used to make cost predictions about circular buildings based on databases of other existing circular and green projects (Alshboul et al., 2022). The combination of a fuzzy inference system with a traditional multi-criteria decision-making method developed by Hoseini et al. (2021) could facilitate sustainable supplier selection by simulating the supplier selection decision-making process and reducing computational difficulties when the criteria are numerous and complex.

The use of intermediary platforms in circular procurement

Intermediary platforms can be used to connect supply and demand actors in circular procurement with their synergistic characteristics. The integration of different interactive functions, technical standards, and environmental legislations in the platform could make it possible to synthesize different decision-making points in the procurement process, such as the one developed by Luciano et al. (2021), in which the marketplace, interactive catalogs of products, an interactive map of reused and harvested materials, technical standards, and environmental legislation are integrated into one platform. A well-developed intermediary platform should also allow contracting authorities to conduct tendering activities directly through it.

2.4.4 Contracting stage

Multiple advanced digital technologies can be adopted during the contracting stage of circular procurement to automate, track, and streamline the contracting process (see Figure 2.5). Innovative contracting methods and Design-Build-Maintain contract forms are suggested to extend the lifecycle of building materials and to stimulate the incorporation of circular economy strategies.

Actors and activities in the contracting stage

Adoption of innovative and flexible contracting methods

Previous studies have shown that the type of contract could influence the environmental performance of construction projects (Shooshtarian et al., 2022). Thus, it will be critical to effectively use contract agreements to facilitate the achievement of circular ambitions (Shooshtarian, et al.; 2022, Sanne et al., 2019). An innovative contracting method based on the collective goals of supply chain partners should be developed to achieve value creation for all partners (Leising et al., 2018). Since investment in circular procurement(e.g., the adoption of digital technologies and cost prediction tools) normally increases the initial cost of circular projects, the incorporation of a shared co-invest and co-benefiting model in the contracting method will help to share responsibilities and risks among supply chain partners (Azcarate-Aguerre et al., 2022, Bao et al., 2019). Moreover, in circular construction projects where maintenance operations play a significant role, special provisions and requirements regarding the maintenance of buildings should be included in the contracts before the commencement of construction as a standard rule (Zulkifly et al., 2021).

However, transitions that require innovation are typically accompanied by challenges and uncertainties. Therefore, flexibility and adaptation in the contracting method, which ensure that actors can adapt to different strategies when confronting uncertainties, will also be crucial to achieving the best technical solutions (Sparrevik et al., 2018). In an innovative practice like circular transition, it is normal for contractors not to be able to comply with all contract requirements at the outset. They should be allowed to spend extra time to meet the requirements after receiving the award (Kadefors et al., 2021). The early handing over of projects to contractors and early contractor involvement would facilitate stakeholder collaboration and the achievement of sustainability and circularity in projects (Xia et al., 2014; Ferme et al., 2018).

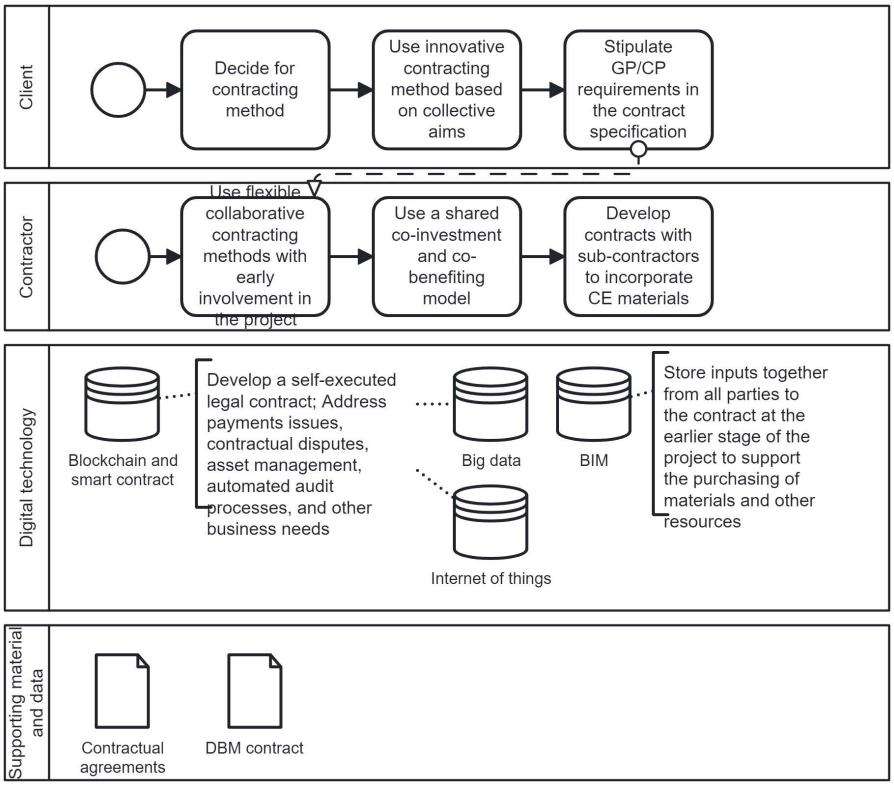

FIG. 2.5 The analytical framework for the contracting stage in circular procurement

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Resources in the contracting stage

The use of functional contracts and Design-Build-Maintain contracts to procure services

Functional procurement contracts, or performance-based contracts, in which services are procured rather than products, could be a more suitable contract type for sustainable projects due to their ability to provide incentives and the freedom to find solutions (Aho, 2013). Circular projects could employ Design-Build-Maintain (DBM) contracts that include a whole lifecycle view, including building maintenance (Lingegard et al., 2021a). Besides, it will also be necessary to integrate the effective arrangements of actors, activities, and resources in DBM contracts (Lingegard et al., 2021a).

The use of advanced digital technologies in the contracting stage

Digital technologies, such as blockchain, smart contracts, and BIM, also have huge potential to support the development of innovative contracting methods for CE. Blockchain-based smart contracts are commonly employed to generate self-executing legal contracts. The decentralized nature of the system can ensure transparency in the supply chain (Rodrigo et al., 2020; Shojaei et al., 2021), enhance asset management, promote automated audit processes, and fulfill other business requirements (Sadeghi et al., 2022). On the other hand, BIM, as a centralized information integration model, can integrate inputs from all supply chain parties at the early stage of the contracting process. It can also help align information on building materials, equipment, and other resources, thereby facilitating the acquisition of construction resources (Eze et al., 2022).

2.4.5 Design stage

An integrated collaboration process is required to design circular construction projects with stakeholders of different roles in the supply chain (see Figure 2.6). In addition to the regular design plan, a waste management plan also needs to be developed and integrated under the lead of the contractors.

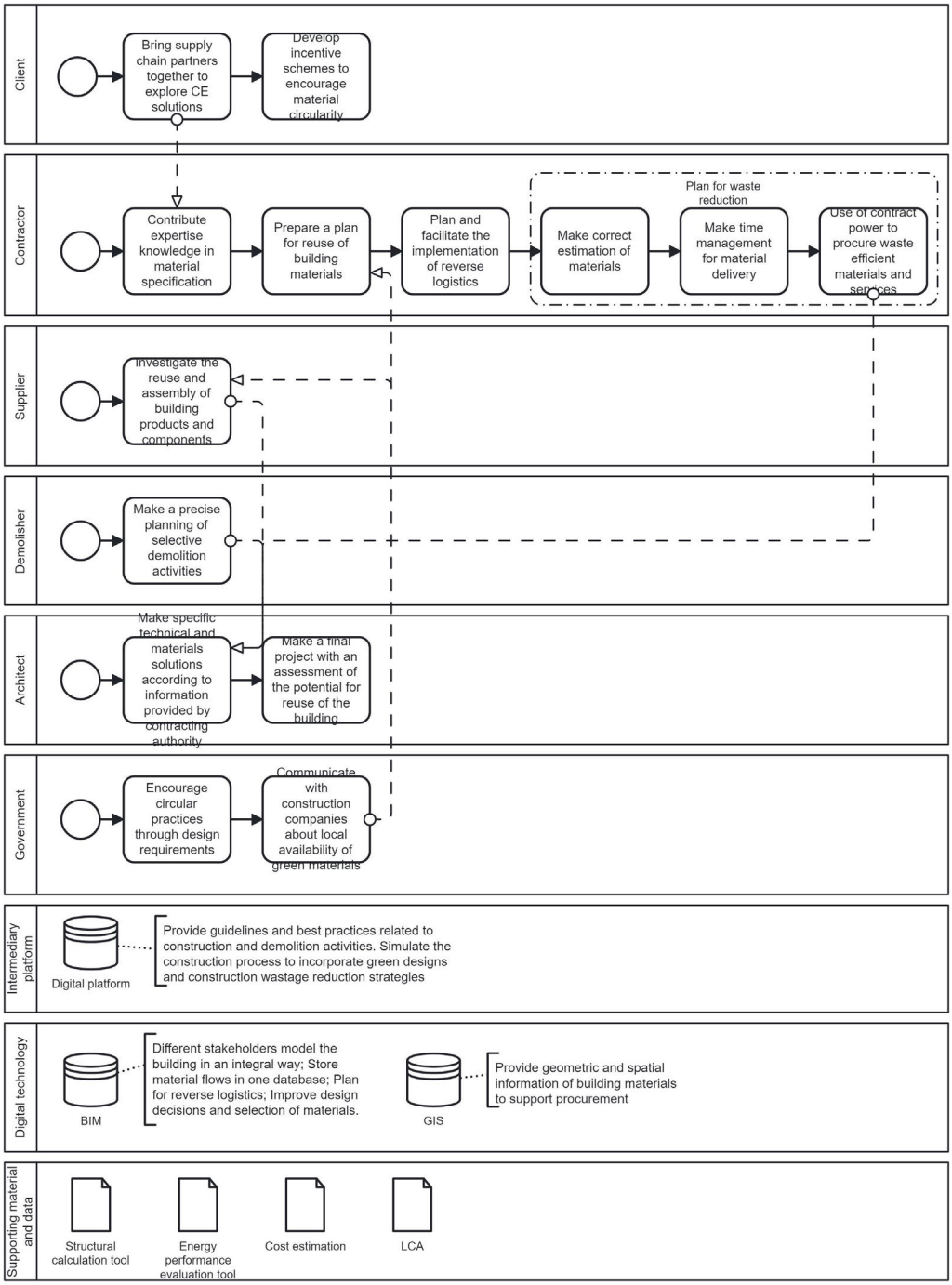

FIG. 2.6 The analytical framework for the design stage in circular procurement

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Actors and activities in the design stage

An integrated collaboration process in project design

An integrated collaboration process with supply chain partners needs to be established to jointly develop plans for circular projects. Clients should bring supply chain partners together to explore circular economy at the design stage (Hartwell et al., 2021). Contractors need to get involved early at the design stage to offer their expertise in material specification (Charef & Lu, 2021), decide on reuse strategies in circular projects, and make a reuse plan (Shooshtarian et al., 2022). Suppliers are expected to investigate circular materials and products during the design stage that are easy to repair, reuse, and disassemble. Demolishers also need to join the early dialogue to make a precise plan for the demolition and deconstruction of circular projects (Pellegrini et al., 2021). As for architects and engineers, they are supposed to make design projects with other partners by translating and integrating information from other parties into specific, comprehensive, and practical solutions (Luciano et al., 2021; Knoeri et al., 2011). The final project developed by architects is supposed to meet the requirements of the circular economy and to motivate future potential in the reuse or recycling of building components and materials (Luciano et al., 2021). Besides the design plan, reverse logistics also needs to be planned together at an early stage, with consideration of the whole lifecycle of construction products, as it will be challenging to make the necessary changes to support reverse logistics once projects have commenced (Pushpamali et al., 2021).

Resources in the design stage

The use of digital technologies in the design stage

Existing studies have identified various digital technologies that support circular construction design, among which BIM has been the most extensively studied. The adoption of BIM can provide an integrated environment for stakeholders to work collaboratively by integrating all workflows and material streams, for instance, into a single BIM model. The information recorded in the BIM model could help stakeholders make design decisions, decide on material selection, and plan for reverse logistics at an early stage (Eze et al., 2022; Chileshe et al., 2019). The materials inventory in the BIM model and the spatial and geometric information of materials flows in a Geographic Information System (GIS) could support stakeholders in making decisions regarding the reuse of materials (Eze et al., 2022). Besides, it is also possible to develop simulation platforms to simulate the construction process of circular design and materials reuse strategies before the actual execution of construction projects (Lanau & Liu, 2020).

2.4.6 Construction and delivery stage

The adoption of lifecycle-based strategies, such as take-back services and product-as-a-service, will finally be executed during the construction and delivery stage to purchase circular materials (see Figure 2.7). In addition to purchasing materials, contractors should effectively manage construction materials and waste on construction sites to reduce associated environmental pollution.

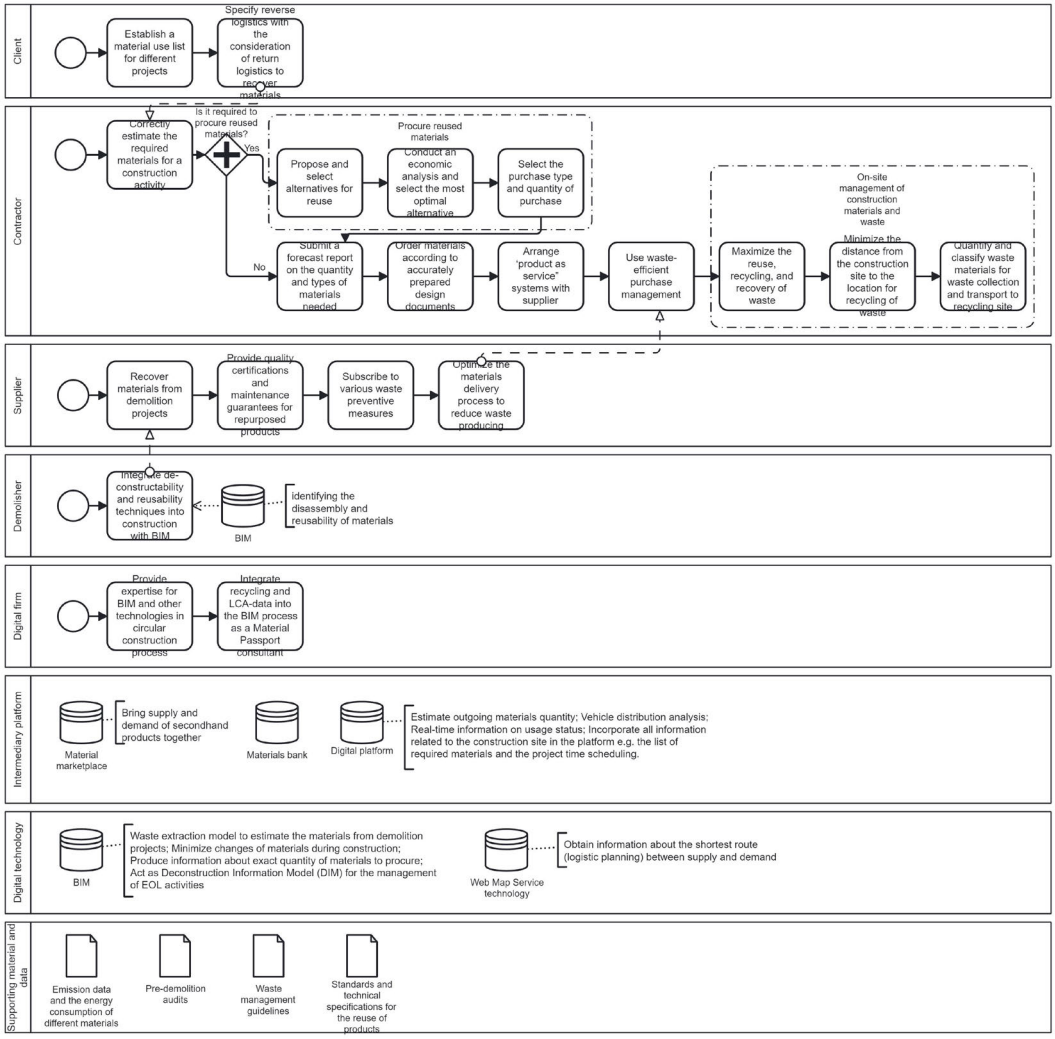

FIG. 2.7 The analytical framework for the construction and delivery stage in circular procurement

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Actors and activities in the construction stage

Adopt 'product as service' and 'take-back service' schemes

In a circular built environment, it is crucial to clarify ownership of materials and products to enhance maintenance and extend their lifespans. The adoption of a 'product as service' system and 'take-back services', therefore, is recommended when making agreements between contractors and suppliers by many researchers (Wuni & Shen 2022; Leising et al., 2018; Ajayi et al., 2017; Azcárate-Aguerre et al., 2018). By using 'product as service' and 'take-back service' schemes, contractors are procuring services from suppliers rather than products, and suppliers will keep ownership of their products and be responsible for the maintenance work and end-of-life activities (Ajayi et al., 2017).

Procurement of repurposed materials and products

The procurement of reused and recycled materials is a critical part of circular projects. Developing a stepwise procurement plan for reused materials and maintaining effective collaborations with supply-side stakeholders (i.e., suppliers and demolitions contractors) would be critical for contractors. To increase the availability of repurposed materials and products, demolishers need to transform their skills into the deconstruction and disassembly of buildings rather than simply demolishing them (Ganiyu et al., 2020). Besides, suppliers or retailers who buy demolished products and materials from demolishers, renew them, and resell them to the construction site, are acting as the intermediary between demolishers and contractors in some cases. Their capabilities in providing quality certifications and maintenance guarantees for repurposed products will influence the market for repurposed products (Knoth et al., 2022).

Reduce and prevent waste production

In order to reduce and prevent waste production in the construction stage, it is necessary to pre-plan for waste production before purchasing construction materials and products (Ajayi et al., 2017). Contractors are supposed to procure materials and products in accordance with documents designed and agreed upon by supply chain partners prior to the construction stage to avoid waste production (Ajayi & Oyedele, 2018). They should also adopt waste-efficient purchasing management, with priority given to the selection of pre-assembled or pre-cut materials (Ajayi & Oyedele, 2018). Besides, actively engaging in on-site management of materials and construction and demolition waste (CDW) is important for reducing construction waste (Luciano et al., 2021). In addition to contractors, suppliers must actively implement a range of waste prevention measures, including minimizing packaging and optimizing product delivery (Ajayi & Oyedele, 2018).

Resources in the construction stage

Intermediary platforms and digital technologies for the reuse of materials

Intermediary platforms and digital technologies are expected in the construction stage for purchasing circular products. There is a growing trend to adopt Material Bank and Material Passport, combined with the BIM model, to track and record information on reused materials (Honic et al., 2019). Future material maintenance may also benefit from the information stored in the BIM model (Cai & Waldmann, 2019). E-marketplaces can be used to share material information in the supply chain and automate the purchasing process of reused materials (Alarcón et al., 2009). The intermediary platform, which integrates information related to the construction site and materials into one model, will allow contractors to check the list of required materials, the status of material delivery, the schedule of projects, the vehicle distribution, etc., thus further supporting the decision-making process for the purchase of materials (Luciano et al., 2021; Han et al. 2009).

2.5 Discussion and Opportunities for Future Research

Based on the research findings in the last section, this section discusses the implications and future research opportunities to further theoretically and empirically develop the analytical framework of circular construction procurement from the perspectives of actors, resources, and activities.

2.5.1 Circular procurement from ‘actors’ perspective

Creation of an ecosystem of actors in circular procurement

From the analytical framework of circular procurement proposed in this study, it is evident that, compared with descriptions of activities for single actors, the interrelationships among different actors during the process are less elaborate due to a lack of relevant research. Nevertheless, the study of the relationships and interactions between actors is critical to promoting supply chain integration and thus facilitating the implementation of the circular economy (De Angelis et al., 2018;

Mishra et al., 2021). Previous studies have highlighted the importance of adopting an ecosystem-thinking approach to facilitate collaboration among actors in circular economy transition (Konietzko et al., 2020; Korsunova et al., 2021). The ecosystem approach involves bringing together different supply chain partners (e.g., clients, contractors, and suppliers) and other circular-driven actors (e.g., researchers, public institutions, and the government) in a shared environment with collective objectives (Stokke et al., 2023). Establishing the ecosystem of actors in circular procurement requires more research that focuses on the interactions and shared values among different actors. Therefore, future studies are recommended to explore the creation of an ecosystem of actors in circular procurement by analyzing relationships and interactions among actors and identifying shared values and objectives within the ecosystem. The relationships between actors are not stable during the building process, as actors are normally temporarily working together on a single building project (Hatmoko & Scott, 2010). A participatory co-design process involving researchers and various actors is recommended to create an actor ecosystem and overcome current barriers (Giorgi et al., 2022).

2.5.2 Circular procurement from 'resources' perspective

Integrate the lifecycle perspective in circular procurement

This study demonstrates that adopting a lifecycle perspective represents an important departure of circular procurement from conventional procurement approaches. Existing literature emphasizes that the integration of the lifecycle perspective requires consideration of the entire lifecycle of buildings, products, and materials in construction projects from the start of the circular procurement process (Alshboul et al., 2022; Lingegard et al., 2021b; Ruparathna & Hewage 2015a). Overlooking the lifecycle perspective in procurement will lead to valuing the lowest initial impacts over the lowest lifecycle impacts and to ignoring the maintenance and end-of-life phases of projects at the procurement stage (Ruparathna & Hewage, 2015a). However, as a project-based industry, the construction industry faces greater challenges in integrating a lifecycle perspective than the product-based industry, which involves a continuous production process (Lingegard et al., 2021b). Problems such as payment delays and over-focus on production make it difficult to value the maintenance and lifecycle perspective of buildings in procurement practices (Lingegard et al., 2021a). Although the lifecycle perspective has been discussed conceptually in existing studies, how to integrate it consistently into the activities, actors, and resources across different stages of circular procurement remains underdeveloped.

Therefore, future studies in circular construction procurement should focus on how the lifecycle perspective can be operationalized across different activities, actors, resources, and projects of the procurement process and how its impact is delivered throughout the entire process. Case studies with a longitudinal lens, from the initial phase of construction projects through the maintenance and end-of-life phases, are recommended to identify the full lifecycle impacts of projects (Lingegard et al., 2021a).

Innovation and adaptability as critical requirements for circular procurement

The findings of this review indicate that the procurement process requires a high level of innovation and transformation to support the circular transition (Kadefors et al., 2021; He et al., 2022). The procurement strategies and requirements in circular projects should encourage innovation and create value for supply chain partners, as well as support the development of environmental solutions (He et al., 2022; Koc et al., 2023). He et al. (2022) categorized innovation in procurement into three types: product innovation, process innovation, and technique innovation. Compared to product innovation (i.e., investigation of circular products and the adoption of circular strategies) and technology innovation (development of technologies) identified in this study, process innovation should receive more attention in circular procurement. This is because, instead of focusing on an isolated aspect, process innovation has the potential to reconfigure supply chain relationships and coordinate actors, activities, and resources (Ferrández et al., 2026).

To implement these procurement innovations, a significant transformation in current construction practices is required (He et al., 2022). Nevertheless, as innovative transformation always entails risks and uncertainties, adaptability and incentives will be critical for organizations to navigate the uncertainties that accompany it (Sparrevik et al., 2018). Therefore, it is not only essential to study the innovation capability of actors or organizations in circular transition, but also critical to study the adaptability and incentives of organizations for circular transition (Kadefors et al., 2021). Future research could focus more on the process innovation of circular procurement and test the impacts of organizations' innovation and adaptation capabilities on the performance of circular transition.

The use of digital technologies and intermediary platforms in circular procurement

In the scope of this review, multiple studies have identified the use of digital technologies and intermediary platforms to facilitate the circular procurement process (e.g., Chileshe et al., 2019; Eze et al., 2022; Sadeghi et al., 2022). The integration of circular procurement with digital technologies will be mainstream in this digital era (Bag et al., 2020, Rejeb & Appolloni, 2022). To promote the implementation of circular procurement through digital technologies and intermediary platforms, two recommendations are proposed here. First, intermediary platforms are powerful tools for circular procurement due to their ability to synthesize and integrate diverse functions, information, actors, etc. (Luciano et al., 2021). Future research is recommended to integrate digital technologies, especially BIM, with intermediary platforms to increase their use in the decision-making process in circular procurement.

Second, although most studies have clarified the use of digital technologies and platforms to support circular procurement, more in-depth knowledge is still required to implement these technologies and platforms in practice (Kosmol et al., 2019). The implementation of digital technologies is a complex process that can be influenced by various factors, such as stakeholders' roles, circumstances, organizations' digital maturity, regulations and policies, and organizations' incentives and capabilities (Luciano et al., 2021). Therefore, it is suggested to study the factors influencing the adoption of digital technologies in circular procurement and to establish more real-world practices for implementing digital technologies.

2.5.3 Circular procurement from 'activities' perspective

Enhance the decision-making process in circular procurement

As shown in the analytical frameworks of circular procurement proposed above (Figures 2 to 7), the decision-making points are not as clearly defined as they should be in real practice, as little research identifies the decision-making process in circular procurement. Thus, this study summarizes the need for a more comprehensive understanding of the decision-making process from multi-actor perspectives in circular procurement. This also aligns with the argument made by Azcárate-Aguerre et al. (2018). An in-depth understanding of the decision-making process requires identifying when actors make decisions in circular procurement, the factors that influence their decisions, how they make decisions, and the consequences of

different decisions under different circumstances (Qazi & Appolloni, 2022; Xu et al., 2022). Conversely, most current studies focus on proposing strategies and guidelines for implementing circular procurement. As a result, the effects of adopting these guidelines and how to do so remain ambiguous. Therefore, future studies should focus on identifying decision-making points in circular procurement from multi-actor perspectives to better understand the decision-making process.

The differences between circular procurement for renovation and new construction

In today's construction industry, a large share of activity still involves the renovation of existing buildings (Housing Europe, 2022). Renovation represents an important intervention point for implementing the circular economy to improve material efficiency and environmental value (Çetin et al., 2022; van Stijn & Gruis, 2020). However, almost no academic articles currently focus specifically on circular procurement for renovation projects. This is mostly because many existing studies on circular procurement treat maintenance and renovation as one phase of the construction supply chain and integrate them with other project phases (e.g., Abadi et al., 2021; Ajayi & Oyedele, 2018; Pushpamali et al., 2019). There is also no clear definition of the differences between circular procurement in renovation projects and circular procurement in new construction projects. However, it is still necessary to distinguish circular procurement for new construction and renovation projects since the stakeholder involvement and procurement functions, such as bid evaluation criteria and service and product requirements, may be different in these two cases (Salcedo Rahola & Straub, 2016). Therefore, future studies are suggested to identify the processual and requirement differences for circular procurement in renovation and new construction projects and facilitate the implementation of circular procurement in renovation projects.

2.5.4 Development of an integrated supply chain to synthesize actors, resources, and activities in circular procurement

Beyond the future research potential summarized from the actors, resources, and activities perspectives above, the essence of a successful transformation toward circular procurement in the built environment lies in synthesizing actors, activities, and resources in the procurement process through the development of an integrated supply chain. Current construction procurement consists of a separate and one-way supply chain with a demand-driven scheme (Azcarate-Aguerre et al., 2022). The demand-driven supply chain means that circular strategies are incentivized only by

the requirements of demand-side stakeholders or by regulatory needs (Azcarate-Aguerre et al., 2022). This will limit economic investment in circular strategies by other actors in the supply chain, since some circular strategies (e.g., design for disassembly) may not be attractive to demand-side actors but are beneficial for service providers, who can capture more residual value from these circular products (Azcarate-Aguerre et al., 2022). Besides the one-way demand-driven supply chain, the fragmented supply chain, with weak information-exchange mechanisms and limited availability of circular materials, has been also been identified as a critical challenge to the adoption of circular procurement (Ruparathna & Hewage, 2015a; Oyedele et al., 2014).

Existing circular procurement research increasingly extends procurement from purchasing at the firm level towards decision-making at the supply chain level (Farooque et al., 2024). Stakeholder collaboration in the supply chain could also facilitate knowledge and information exchange, joint objectives, and coordinated circular initiatives (Zhou & Xu, 2024b). In the construction industry, procurement can play an integrating role by coordinating supply chain actors and activities and influencing design, material, and production choices (Ababio et al., 2025). Supply chain integration can therefore provide a mechanism for connecting the actors, resources, and activities identified in this review. From the perspective of integrated supply chain development, the aspects mentioned above, including stakeholder ecosystem, integration of lifecycle perspective, innovation and adaptability in circular procurement, digitalization of circular procurement, procurement decision-making process, and renovation management, should not be treated as separate research topics or objectives but interconnected components of a broader transformation. Therefore, future research could focus on how to coordinate actors and their interactions, technological innovations, lifecycle-based processes, procurement strategies, and stakeholder decision-making as an integrated approach to facilitate circular procurement implementation.

2.6 Conclusion

This study systematically and critically reviewed 65 articles on circular procurement in the built environment. An analytical framework, based on six stages of the circular procurement process, was developed according to practices and recommendations from current studies. This study suggests several directions for future research to support the creation of an integrated supply chain and synthesize actors, resources, and activities to facilitate circular procurement. From the perspective of actors, developing an ecosystem that includes not only supply chain partners but also key circular-driven actors (e.g., researchers and the government) is recommended. From a resource perspective, exploring the integration of a whole-lifecycle perspective with the process of circular procurement, investigating organizations' innovation and adaptation capabilities in the circular transition, and developing and implementing digital technologies and intermediary platforms are proposed as potential future research opportunities. From an activity perspective, more in-depth knowledge of the decision-making process from a multi-stakeholder perspective is required; future studies should also focus more on procurement for renovation projects to identify differences between circular procurement of new construction and renovation.

This study contributes to the literature on circular transition and procurement management by providing a holistic review of circular procurement in the built environment, with an emphasis on the procurement supply chain. Meanwhile, integrating the ARA model with the integrated supply chain perspective in this study enhances the review's theoretical background and provides a critical lens for the study of circular procurement. The analytical framework for circular procurement developed in this study is generic and adaptable to different procurement types and contexts in the built environment. This study has strong practical implications by guiding researchers and practitioners on establishing circular procurement step by step. Actors who should be involved, activities and interactions they could conduct at different stages, and resources they could use are clearly defined for practitioners, governments, and consultants to implement circular procurement. Practitioners, governments, and consultants are strongly encouraged to refer to this study to promote the implementation of circular procurement through real-world practices, policies, and regulations.

However, several limitations remain in this study. First, the limited number of studies on circular procurement restricts the results of this review. A larger foundation of knowledge is established by including articles about green procurement and sustainable procurement in the scope of this study because of the similarity between these three concepts (Alhola et al., 2018). Nevertheless, although these three concepts share many similarities, circular procurement could still differ from the other two due to the utimate goal of retaining materials and products at their highest possible value and facilitating a closed-loop supply chain in the circular economy. These unique objectives in the circular economy may result in different supply chain configurations that influence the procurement process. Therefore, a holistic review of circular procurement, limited to studies in the circular economy context, should be conducted in the future, once the foundation of circular procurement studies has grown much larger. The second limitation of this research is that activities in circular procurement are strictly classified into the six stages identified in this study. However, in practice, some activities may occur at different stages in circular procurement due to the spontaneous and sophisticated nature of real-world operations. Future studies are recommended to validate the six-stages-based analytical framework developed in this study against real-world practices and adapt them to different situations.

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3 Integration of Circular Economy Principles into Dutch Social Housing Procurement

Technological, Organizational, and Environmental Practices, Challenges, and Development Potentials

Building on the conceptual understanding of circular procurement in the built environment, this chapter moves from conceptualization to empirical investigation by taking the Dutch social sector as the empirical context. Chapter 2 identifies recommendations for a circular procurement process and highlights the requirements to further explore circular procurement strategies implementation, capabilities of organizations in circular procurement transformation, the use of digital technologies, stakeholder collaborations, and procurement decision-making. This chapter examines how circular economy principles are actually integrated into procurement of Dutch social housing, the challenges associated, and the potential for future development of circular procurement.

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ABSTRACT

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. 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. 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. 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, and Environmental Framework

3.1 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 & Appolloni (2022, p. 347) define circular procurement in terms of organisations "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 and to highlight the activities taken by stakeholders to integrate circular economy principles in procurement, 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., 2019). Meanwhile, they are required to fulfil 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.

3.2 Theoretical Background

3.2.1 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 & 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 & Hewage, 2015a).

3.2.2 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 & 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 & 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 & 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 & Hild, 2021; Mojumder et al., 2022).

3.2.3 Technological, Organizational, and Environmental Framework

Previous studies have examined circular procurement from various aspects and theoretical lenses. For instance, Sönnichsen & 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 & De Brito Mello, 2021; Vrijhoef & 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 & 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, developed by Rocco et al. (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 & 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 & Jaafar, 2025; Singh et al., 2024).

3.3 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 approach 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 3.1.

TABLE 3.1 Case description. Source: Author's own work.

Case	Scale of the organization[1]	Circularity adoption scales	Circular strategies adopted	Informant Roles
Housing Association A	Large	Organizational scale	Reuse of materials, bio-based materials, reduce 50% of environmental impacts	Real estate manager
Housing Association B	Medium	Organizational scale	Reuse; concept house; bio-based material; reassembled building; removable building	Managing Director; Project manager; Contractor
Housing Association C	Large	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	Medium	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	Small	Project scale	Bio-based materials; use materials from the same area; circular demolition	Sustainability advisor; Real estate manager; Demolisher[2]; Consultant[2]; Digital firm
Housing Association F	Medium	Project scale	Reuse; transform existing buildings to other functions	Real estate manager; Supplier; Maintenance contractor
Housing Association G	Large	Project scale	Reuse; circular materials	Project manager; Architect and consultant

[1] *The scale of the housing associations is categorized based on the number of homes they manage: small (<10,000 homes), medium (10,000–25,000 homes), and large (>25,000 homes)*
[2] *Interview with this stakeholder was conducted in Dutch originally*

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. Within these five categories, questions are organized by stakeholder groups and specified according

to procurement stages identified in Chapter 2 when applicable, i.e., the planning and criteria specification stage, tendering stage, contracting stage, design stage, and construction stage. 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 Appendices B–H. 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 hours, totaling around 900 minutes. 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 about their procurement processes in circular procurement, 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. Two phases were followed in the thematic analysis. First, a within-case analysis was conducted, in which each case was analyzed individually to understand its circular economy transition, procurement and supply chain practices, stakeholder interactions, and challenges hindering the transition. Second, a cross-case analysis was performed by comparing the findings across cases to identify recurring patterns, similarities, and differences. This analysis enabled the identification of characteristics of current circular procurement practice in Dutch social housing, as well as key challenges and further development potentials. The findings are presented following the TOE framework, with cross-case patterns forming the primary focus and individual case examples to provide additional insight or illustrate unique practices. Detailed descriptions of each case are therefore omitted because the analytical focus of this study is on synthesis and comparison across cases rather than on the cases in isolation or explaining their practices by organizational characteristics.

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 3.1). 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.

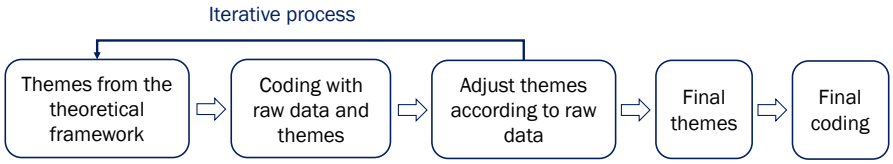

FIG. 3.1 Iterative coding process. Source: Adapted from Willumsen et al. (2019)

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 Table3.2, 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 3.2.

TABLE 3.2 Qualitative themes in Atlas.ti. Source: Author's own work

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) "We have an inventory scan, we make a scan of a building that needs to be demolished and we attach values to it. Both environmental value and monetary value." (Demolisher of Housing Association E)	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

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TABLE 3.2 Qualitative themes in Atlas.ti. Source: Author's own work

Example of raw data	Principal theme	Sub theme	Sub-sub-theme
"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
"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

3.4 Results

3.4.1 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 adopt circular economy at organizational level 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.

3.4.1.1 Technological lens

Adopt innovative construction methods

From the techno-centric perspective, Housing Associations B, E, and G employ 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 the projects optimized material flow by eliminating residual flows or by returning materials to suppliers. The transport movements of prefabricated houses in the project of of Housing Association B are around 25% lower than those of traditional constructions. Housing Association G 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.

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)".*

3.4.1.2 Organizational lens

Contract with consortia and program-based contracts

Supply chain integration is a goal for circular transformation of Housing Associations A, B, C, and E. 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.

Housing associations A, B, and C are also 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.

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.

Adopt Best Value Procurement and performance-based requirements

Housing associations A, B, and C 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. 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 and C delineate the expected performance for contractors to achieve, instead of specific requirements or indicators. *"I'd like to tender more because they come with a little bit more than you can ask from a housing corporation, and I think they're mainly to surprise you. If you have some specific (criteria) that you like put into the tender. Then they just make their plans according to what you asked for. But if you make it a little bit vague, or if you ask them to propose something, I think it's mainly a much better design plan. More outside the box as well. I think that's good (Housing Association C)."* 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.

Explore the circular economy with familiar contractors

In contrast to open bidding, Housing Associations D, E, F, and G adopted a different tender approach, which 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)."*

Adapt pricing method and apply shared investment

A fixed-price technique with room for adaptation is typically employed as the basis for pricing in circular social housing between clients and contractors for most housing associations. 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 the case of Houisng Associaiton A, 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)."*

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, most housing associations have different departments be 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. *"Then we make sure that we get it (circularity innovations) into the regular process. So that the regular process never gets disturbed... So, we always get the pilot out of the regular process, put a pilot with all different kinds of things, and everything may go wrong. It's no problem. Then the engine keeps running and after that pilot, we have to do an implementation phase (Housing Association C)."* Most 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.

Extend supply chain collaboration beyond the construction industry

Circular procurement may also require extending supply chain collaboration beyond the conventional boundaries of the construction industry to actors from other industries. For instance, Housing Association E established relationships with regional actors, including local farmers and manufacturers, to support the development and use of bio-based materials and products in circular construction projects. A regional value chain is established in this way to transform agricultural resources into construction products and subsequently applied in housing projects. *"And in the region to make a circle from a farmers industry, builders and contractors. So altogether we make a circle. And so the farmers have to plant their crops as building materials and industry have to make a products from it and our builders needed to make it in our homes, isolation or building materials so that they only use a biobased materials (Housing Association E)".*

3.4.1.3 Environmental lens

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. For Housing Association E, although residents' participation in decision-making was not deliberately planned from the outset, they were gradually involved throughout the process, and the housing association made efforts to incorporate their preferences into the circular renovation. *"At first people who lived in the houses, they didn't want to help. They thought that's what we have to do. It's not our job. But the more we go into the process, the more they see that. Hey, it's nice to talk with you and to have influence in the choices they made (Housing Association E)".*

Use regulatory and financial incentives for circular transition

Most 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 A, B and C 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.

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

3.4.2.1 Technological challenges

According to many interviewees, a major challenge in circular housing renovation 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)".*

3.4.2.2 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, as mentioned frequently by different interviewees, 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)"*.

3.4.2.3 Environmental challenges

Environmental challenges mainly consisted of contractual uncertainty, lack of regulatory support, and lack of market readiness. Contractual uncertainty presents a major challenge in circular procurement, as existing contractual arrangements are not designed to accommodate the collaborative and iterative nature of circular projects. 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 within existing governance and contractual frameworks. 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. *"That made it difficult to actually make the project more circular because the contract was so fixed and so the client couldn't do anything about it anymore, or else he would have paid a very large fine (Supplier of Housing Association F)."* Similar challenges arise when plans are established at the program level, as changes become difficult once the program has been decided on or commenced.

Beyond contractual uncertainty, insufficient governance and regulatory support also hinders housing associations from establishing clear objectives in circular transition and limits the development of standardized governance mechanisms, such as material certification. As emphasized by Housing Association D, *"I think we should have more rules on what we want to achieve with it, and that's what is missing at the moment. What do we want to achieve if we invest in circularity? We should have goals to achieve, and I think that should be more national so that everyone has the same goals."* At the operational level, stakeholders also highlighted the lack of standardized and generalized rules for circular material certification. Supply chain partners, primarily suppliers, manufacturers, and demolishers in this instance, contended over who should assume responsibility for providing material certification. The absence of regulations on circular material certification often causes suppliers to acquire substantial quantities of unusable materials from demolitions, resulting in significant waste.

Besides governance challenges, the limited market readiness also constrains the circular transition. Stakeholders argue that the current market often fails to deliver both environmental benefits and financial value. This makes it difficult for them to justify the investments in the circular economy. *"But it costs you more money and that's really strange because you really want to do circularity also, not only for the environment, but you also want to find a financial way to make it interesting. We haven't found that leverage yet. But we think that the market should be good enough, should be able to fulfill both needs. That's our dream that they would do both and be better for the environment and be profitable for us, grantees that cheaper to live in their building so (Housing Association F)."*

3.5 Discussion

3.5.1 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.

3.5.1.1 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.

3.5.1.2 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 & 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., 2021a).

3.5.1.3 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., 2024; Sajid et al., 2024). This study highlighted the importance of having market readiness not only for environmental benefits but also for financial value to stimulate circular procurement transformation. Specific solutions were identified for this, such as reducing taxes on circular materials and projects 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., 2019), 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, 2025), 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., 2021b). 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 limited, 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.

3.5.2 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., 2019). 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 & 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 & 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 3.3). When categorizing findings of this study under the TOE framework, it is noteworthy that relatively few circular procurement practices were identified within the environmental dimension, whereas a lot of challenges emerged in this dimension. This indicates that the institutional environment for circular procurement transformation in Dutch social housing currently functions more as a source of constraints than as an enabler. Therefore, future studies should focus more on the institutional, societal, and regulatory mechanisms required to support and stimulate circular procurement transformation. However, strengthening these external enabling conditions alone may not be sufficient. Recent research demonstrates that the effects of institutional pressures are contingent on how they are translated and enacted through organizational procurement structures and routines (Van Der Valk & Habes, 2026). Consistent with this argument, the findings of this study show that, although various approaches have been adopted at the organizational level to incorporate circular economy principles, significant organizational constraints continue to hinder their implementation. Future research should therefore adopt a more integrated perspective by investigating not only which institutional mechanisms are required, but also how organizational management can effectively translate and operationalize these mechanisms in procurement practice.

TABLE 3.3 Integration of circular economy principles in the procurement process of Dutch social housing. Source: Author's own work.

	Practice	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 • Extend supply chain collaboration beyond the construction industry	• 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 market readiness for circular transition • Lack of regulation and governance on responsibility division	• Develop associated business models • Increase financial incentives for circular transition • Industry and market nudging • Develop pertinent regulatory and governance frameworks • Standardize circular procurement • Facilitate residents' participation and associated societal value

This study also makes particular contributions to the societal and regulatory dimensions, broadening the comprehension of circular procurement in Dutch social housing. It contributes to the societal impacts of circular procurement by analysing 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 developments. This includes standardized circular procurement frameworks, tax incentives, and regulatory support for specifying contract contingencies.

3.5.3 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 3.3. 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.

3.6 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.

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4 Multi-stakeholder perspectives on circular economy transformation in procurement of Dutch social housing renovation

Chapter 2 argues that existing circular procurement research provides limited understanding of stakeholder relationships and interactions and calls for further investigation of procurement decision-making from multi-stakeholder perspectives. Building on findings from the literature review in Chapter 2 and the practice of circular procurement in Dutch social housing identified in Chapter 3, this chapter investigates how different supply chain actors perceive circular procurement, how their perspectives converge or diverge, and how the different perspectives may influence circular procurement implementation and stakeholder collaboration. The focus on renovation also responds to the limited attention to circular procurement in renovation projects as identified in Chapter 2.

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ABSTRACT

Procurement plays an essential role in the circular transition of the built environment by connecting the supply and demand sides' actors and resources. This study aims to identify the perspectives of key supply chain actors on circular procurement in Dutch social housing renovation to facilitate circular procurement transformation. A Q methodology was adopted to provide a holistic picture of stakeholder perspectives on circular procurement. A workshop was organized with relevant actors to collect data for the Q methodology. Three narratives representing the perspectives of stakeholders with similar patterns were generated from the Q-sorts. The three narratives encapsulate varying focuses and priorities in circular procurement transformation. Narrative 1 focuses on the requirements and criteria in circular procurement, narrative 2 emphasizes stakeholder relationships in circular procurement, while narrative 3 has more interest in the outcome and value creation and distribution in circular transition. The results show that while stakeholders' perspectives on circular procurement are inherently influenced by their roles, there is no absolute interrelationship between stakeholders' roles or affiliations and their perspectives. Consequently, rather than managing stakeholders according to their roles in circular transition, it is suggested to manage them based on their priorities and align their requirements. This study recommends that by taking these three narratives as starting points, the development of circular construction procurement should synthesize the three priorities from these narratives and identify pertinent interventions to realize these priorities.

KEYWORDS

Circular Procurement, Built Environment, Supply Chain Management, Q Methodology, Multi-Stakeholder Perspective

4.1 Introduction

A significant change is required in the construction industry to reduce CO2 emissions and other environmental impacts. The principles of Circular Economy offer a direction for this change by balancing environmental and economic values. As the central interface between supply chain partners, the procurement process is in a critical position to achieve the required flow and connections between supply and demand (Tennakoon et al., 2024). In recent years, the procurement functions have been expected to change from a cost-driven solution to a result-oriented approach to promote quality, innovation, and societal and environmental transformation in the construction industry (Xu et al., 2022). By driving the demand for circular services and products, circular procurement could accelerate the overall transition (EIT Climate-KIC, 2019; Ababio et al., 2023). Circular procurement has been defined by various organizations and academic researchers. For instance, the European Union declares circular procurement is "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" (European Union, 2017). Qazi & Appolloni (2022) defined circular procurement as: "the integration of circularity into the procurement process whereby organizations seek to purchase regenerated biological materials toward a zero end-of-life concept. 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." This study synthesized multiple existing definitions and, for the purpose of this research, defines circular procurement as: the procurement process of circular solutions in which organizations anchor their circular ambitions in the business processes, put the circular objectives in the market, and implement interactions with the market and supply chain partners internally and externally to facilitate stakeholder collaboration and close the material and energy loops of the supply chain.

The construction supply chain is an intricate process that encompasses various stakeholders and functions throughout various phases of the construction process, which increases the complexity of circular procurement transformation (Ababio et al., 2025). Research has shown that supply chain collaboration and stakeholder alignment are critical for the successful implementation of innovative transitions such as the circular economy transition (De Angelis et al., 2018; Mishra et al., 2021). Effective collaboration and information sharing within and across organizations can maximize value creation and optimize product and service utility (Farooque et al., 2019; Lahane et al., 2020). A close relationship in the supply chain also indicates greater dependence among supply chain partners, which encourages them to

sacrifice their short-term interests but work jointly towards the shared objectives if the circular economy is set up as the shared objective (Esposito et al., 2024).

Nevertheless, there is a lack of studies on circular construction procurement that emphasize supply chain collaboration and multi-stakeholder perspectives, while the divergence of stakeholder perspectives creates challenges for circular economy transition (Bostancı et al., 2024). The majority of previous studies about circular construction procurement emphasize the client perspective, with little consideration given to the viewpoints of suppliers and other supply chain stakeholders (Adjei-Bamfo et al., 2023). For instance, Ababio et al. (2025) examined the barriers for buyers to implement circular procurement in the global construction industry, while Lingegard et al. (2021) investigated the circular transition of public clients' procurement strategies through integrated contracts in the infrastructure sector; Alhola et al. (2019) exploited the circular procurement potential in public sector through the selection criteria, performance-based procurement, and associated business concepts. A circular transition cannot be realized if stakeholders address the issues in isolation (Evertsen and Knotten, 2024). Involving all stakeholders along the whole supply chain, from the initial stage to the end of the lifecycle of projects, is crucial for effective collaboration to close the material loops, enhance information flows, and redevelop supply chain forms (Leising et al., 2018). Currently, there is a lack of research on the perspectives and roles of different stakeholders and how they should collaborate vertically and horizontally in the value chain of circular transition (Evertsen and Knotten, 2024).

To address complex matters like circular transition and enhance supply chain collaboration, it is essential to establish structured stakeholder dialogues and articulate various perspectives to help stakeholders understand their values, beliefs, and positions in the process, as well as those of others (Cuppen et al., 2010). Therefore, this study takes a holistic and heterogeneous approach to understand the perspectives of different stakeholders on circular procurement of Dutch social housing renovation by using a Q methodology with stakeholders engaged in circular social housing renovation. Q methodology is particularly valuable in this context because it enables distinct stakeholder perspectives to be systematically identified while revealing areas of consensus and contention among them (Forrester et al., 2015). Importantly, it allows shared perspectives to emerge across formal stakeholder roles rather than assuming that stakeholders with the same roles and positions in the supply chain necessarily share similar perspectives (Cuppen et al., 2010). Besides identifying the divergence and convergence of stakeholder perspectives, the merit of Q methodology also lies in matching stakeholders' choices with their underlying values, attitudes, and beliefs (Forrester et al., 2015), thus providing insights into where stakeholders are aligned, where tensions exist, and how these differences may influence circular procurement implementation and multi-stakeholder collaboration.

This study takes circular Dutch social housing renovation as a case study to further explore multi-stakeholders' perspectives in the construction procurement process to enable further collaborations. A large proportion of European building stock consists of social housing stocks. There is a greater demand for social housing in Europe after COVID-19 due to the predicted increase in poverty and inequalities. However, many European countries are unable to meet the need for housing, and social housing in particular. Therefore, more social housing needs to be built and renovated in the coming decades. The practice of Dutch social housing renovation involves a multi-stakeholder environment, primarily driven by housing associations as the clients who obtain the ownership of their housing stocks and are responsible for the renovation (van Zoest et al., 2019). Meanwhile, governments, residents, and other supply chain stakeholders, such as contractors, architects, and consultants, also play important roles in this process. As semi-public and non-profit enterprises, the Dutch social housing sector is not obliged to adhere to the public procurement policies (Straub & Mossel, 2007), hence granting each housing association greater autonomy and flexibility to manage its circular procurement processes. Taking Dutch social housing renovation practices as the context for discussion, this study aims to contribute to the future development of circular procurement and value creation in the construction industry from both scientific and practical standpoints. The following research questions will be asked to achieve the objectives:

- **What are the perspectives of different stakeholders on circular procurement in social housing renovation, and where do their perspectives align, and where do they differ?**

- **What recommendations can be made to facilitate circular transformation of construction procurement by understanding multi-stakeholder perspectives?**

The remainder of the paper is structured as follows: The key concepts in this study, including construction procurement, multi-stakeholder environment in circular procurement, and multi-stakeholder perspectives, will be addressed in Section 2. Section 3 elaborates on the methodology adopted in this study. The outcomes and narratives generated from the Q methodology and the analysis of these narratives will be described and summarized in Section 4. After that, the interrelationship between stakeholder perspectives and their roles in the supply chain, recommendations for future development of circular procurement, as well as theoretical and practical implications of this study, are discussed in Section 5. Section 6 summarizes the principal findings of this study and addresses the limitations of this study.

4.2 Theoretical Background

4.2.1 Construction procurement

Construction procurement refers to the structured processes used to secure resources and services required for delivering a construction project (Ruparathna & Hewage, 2015). It involves functions such as materials and equipment sourcing, partners engaging, tendering and bid evaluation, contracting, and establishing pricing strategies (Martins, 2009; Ruparathna & Hewage, 2015; Clough et al., 2000). Eriksson & Westerberg (2011) summarized the key stages in construction procurement pathway as: project design, selection of procurement and tendering approaches, bids evaluation, selection of subcontractors, determination of payment mechanisms, application of collaborative tools, and assessment of performance outcomes. Rather than being a single phase, procurement spans over the full construction supply chain, from project conception and planning phase until the final project completion phase (Ruparathna & Hewage, 2015). Because of this broad scope and influence, effective management and organizational strategies in procurement are critical to achieving overall project success (Bower, 2010; Ruparathna & Hewage, 2015). In innovative transitions such as circular economy transition, the procurement process requires to adapt to support resource efficiency, material lifecycle extension, and long-term value creation (Qazi & Appolloni, 2022a; Xu et al., 2022).

4.2.2 A multi-stakeholder environment in the circular transformation of construction procurement

Implementing circular procurement practices is challenging due to the complexity of construction procurement and supply chains, which involve different stakeholders with diverse roles and expertise across different project stages (Ababio et al., 2025; Sarpin et al., 2016). Effective stakeholder engagement is therefore crucial for circular transformation, as stakeholders must balance both individual and collective interests to advance circular economy objectives (Marcon et al., 2023; Marjamaa et al., 2021). Moreover, the circular transition also requires the development of a complex ecosystem involving multiple actors operating across different scales and levels (Evertsen and Knotten, 2024).This ecosystem extends beyond project team members directly engaged in the decision-making to include actors that may contribute indirectly to circular implementation, such as consultants and digital

technology providers (Gerding et al., 2021; Wielopolski and Bulthuis, 2023). Consequently, circular economy implementation depends on the decisions and interactions of different stakeholders across different stages of the construction process (Kaya and Monsù Scolaro, 2023).

4.2.3 Multi-stakeholder perspectives on circularconstruction procurement

However, the involvement of multiple stakeholders does not necessarily imply that they share the same understanding on how circular economy should be implemented. The emergence of diverse perspectives from different stakeholders creates challenges for circular economy implementation (Bostancı et al., 2024). Understanding the viewpoints, capabilities, and requirements of multiple stakeholders in the supply chain is crucial while navigating the complex procurement process. (Ababio et al., 2023; Sajid et al., 2024). In circular procurement, the needs of stakeholders and the dynamics of power and influence are undergoing swift transformations, resulting in challenges related to communication, information exchange, and collaborative workflows among various parties (Ababio et al., 2025; Chen et al., 2020). Previous studies have indicated that cognitive biases, including information bias and misinterpretation of the existing situation, impede the effective execution of circular procurement (Ababio et al., 2025; Berardi and de Brito, 2021). Such biases may result in the misalignment of stakeholders' objectives in circular procurement, hence obstructing their interests and activities (Ababio et al., 2025; Berardi and de Brito, 2021). Almeida et al. (2022) argued that a clear definition of stakeholder roles, the distribution of their responsibilities across various activities, and mutual understanding among stakeholders in circular procurement are lacking. Many other researchers have addressed that there exists a deficiency in understanding how stakeholder capabilities in different roles can proficiently promote collaboration in circular construction procurement (Ababio et al., 2025; Qazi and Appolloni, 2022; Nogueira et al., 2019). Therefore, to facilitate the implementation of circular procurement and effective multi-stakeholder collaboration, it is crucial to first understand the diverse perspectives, requirements, and interests of different stakeholders involved in circular procurement.

4.3 Methodology

4.3.1 Q methodology

A Q methodology was used in this study to understand the perspectives of different stakeholders on circular procurement. Q methodology was originally developed to study people's subjectivity in the 1930s in a 'structured and statistically interpretable form' (Stephenson, 1935; Barry and Proops, 1999). Since then, it has been applied to various fields of social science to identify shared patterns of subjective viewpoints, including beliefs, values, and experiences (Cuppen et al., 2010; Kerr et al., 2018). To achieve this, a concourse of statements on a particular topic is gathered for individuals to rank according to their agreement level or importance level, for instance. The outcomes of the arrangement of the statements by individual participants are their Q-sorts. The gathered Q-sorts become quantitative data in a factor analytic procedure to create a collection of shared viewpoints on this particular topic (Kerr et al., 2018). In Q methodology, participants are typically selected purposively to capture a diverse range of perspectives relevant to the research topic, and relatively small samples are generally sufficient because the objective is to identify and characterize shared viewpoints rather than generalize the results to larger population (Raadgever et al., 2008; Steelman and Maguire, 1999).

Q methodology fills the gap between qualitative and quantitative research, positioning itself between closed and open research methods (Ramlo & Newman, 2011). It is used to have a holistic understanding on the whole pattern and the interrelationship between individual components in the whole system (Kerr et al., 2018). The position or the rank of each individual statement only has meaning when they are related and compared to other statements (Kerr et al., 2018). This aligns with the aim of this research, which is to have a holistic understanding on circular procurement rather than shed light on any single argument. It is also important to reflect the diversity of perspectives in the dialogue by incorporating statements focusing on different aspects and gathered from different sources (Cuppen et al., 2010). Therefore, both literature review and interviews with different stakeholder roles were used to elicit the concourse of statements in this study. Besides the dialogue, a diverse perspective of participants who will sort the statements is also required (Cuppen et al., 2010). Research on group decision-making suggests that heterogeneous groups can enhance decision-making by bringing together diverse information and perspectives, thereby stimulating divergent thinking and the consideration of information that may not otherwise be shared within the group (Cuppen, 2012; van Knippenberg et al.,

2004). Incorporating divergent perspectives into the dialogue ensures the inclusion of both prevalent and marginal viewpoints, as marginal perspectives are more likely to yield novel insights compared to the frequently reiterated dominant perspectives (Cuppen et al., 2010). To ensure this, participants included in the Q-sorting of this study are aimed to be as diverse as possible, encompassing not only stakeholders inside the project team but also stakeholders in consulting or intermediate roles, such as consultants and firms specialised in digital technologies.

4.3.2 Gathering and refining the concourse

This study takes the Dutch social housing renovation as a case study to examine and understand multi-stakeholder perspectives on circular procurement. A concourse of statements related to circular procurement in Dutch social housing renovation was used to examine individual perspectives of stakeholders with different roles in the construction supply chain. The concourse comprises a collection of statements that enclose a sum of discourse on the research issue (Kerr et al., 2018). The statements in this study were gathered from both literature review study on circular procurement in the built environment and 28 semi-structured interviews on circular procurement in Dutch social housing. Interviewees of these 28 interviews consisted of a range of stakeholders with diverse roles and experiences in circular economy transition, including housing associations, contractors, architects, demolishers, suppliers, government representatives, manufacturers, consultants, and digital solution providers. Literature and transcripts of the 28 interviews were first coded in Atlas ti. with the qualitative themes under three categories, i.e., actors, resources, and activities. Specific qualitative themes within each category were generated empirically according to the data. Themes under ‘actors’ include client, contractor, architect, demolisher, supplier, consultant, digital firm, government, manufacturer, and residents. Themes under ‘resources’ include budget, business model, circular indicator, contract type, digital technologies, evaluation criteria, intermediary platform, material, policy, and standards. Themes under ‘activities’ include contracting method, integrated project delivery, integrated supply chain, lifecycle perspectives, period of contract, pricing method, material purchasing, reverse logistics, stakeholder interactions, take-back service, and tendering method

Based on this coding, an initial pool of 231 statements was derived from interviews and literature. Statements were selected to provide broad coverage of the actors, resources, and activities identified through the qualitative analysis and pertain to the pivotal concerns regarding circular procurement, which may provoke diverse disputes and perspectives among many stakeholders. Afterward, to further refine

the 231 statements to a smaller set that represent the full volume of the discourse (Kerr et al., 2018), they were subsequently organized into six dimensions reflecting the major issues addressed in the statement pool: contracting method, tendering method, value creation and distribution, stakeholder interactions, materials use, and circular challenges. This categorization is the outcome of the empirical study instead of a pre-defined theoretical framework to maintain the diversity of the statements (Cuppen et al., 2010). Subsequent to categorization, statements with comparable or overlapping meanings were combined, while those not directly pertinent to the core concerns of circular procurement were eliminated to ensure that all selected statements adhere to the fundamental arguments of circular procurement. After combination and elimination, 55 statements were refined and pre-tested with 11 researchers who work on circular economy transition through a trial workshop. During the trial workshop, 11 researchers completed the whole process of Q-sorting the 55 statements, validated the six categories of statements, and gave suggestions on how to reduce the number of statements and condense the content of each statement. According to the feedback from the trial section, 35 statements were ultimately selected for the final Q-sorting, with the consideration that statements in each category are distributed in a relatively balanced way.

4.3.3 Selecting participants

Participants (P-set) sort statements (Q-set) in a pre-defined grid (see Figure 4.1). Participants were selected from practitioners who were employed in the construction sector in the Netherlands with expertise or knowledge in circular social housing projects. A diverse type of stakeholders was targeted, including housing associations, contractors, architects, demolishers, suppliers, consultants, digital firms, etc. The P-set was deliberately chosen using a combination of purposeful selection, snowball sampling, and random sampling methods to encompass a range of perspectives interesting to the research. The assumption behind the combination of different sampling approaches is that participants with diverse knowledge, interests, expertise, experiences, etc. in circular procurement can be evenly selected rather than strongly focus on particular aspects without the assumption that particular knowledge, interests, expertise can be found in a particular group of people (Cuppen et al., 2010). In the end, 15 participants were selected, with 7 of them included randomly, 6 of them were purposely selected, and 2 of them were included by snowball sampling. Five participants who were purposely selected are also the interviewees who previously engaged in interviews for the elicitation of statements in this study. All of the participants possess expertise, interests, and experiences in circular social housing or circular construction procurement.

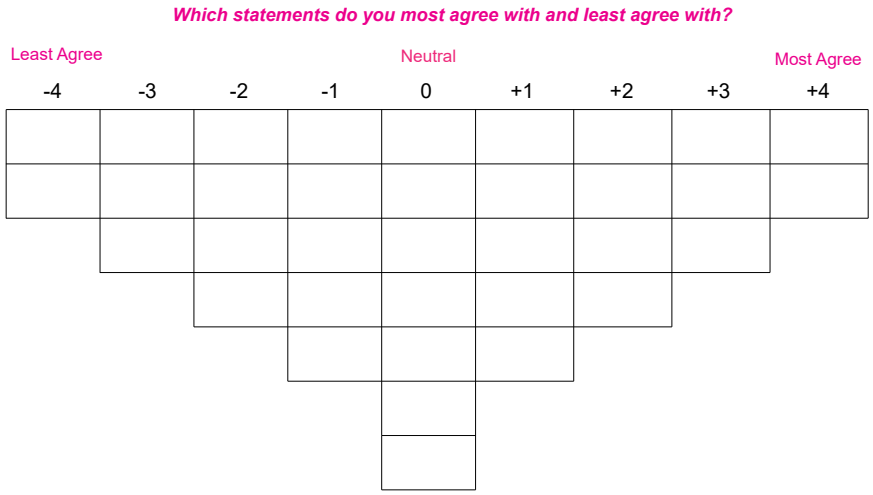

FIG. 4.1 Answer sheet and the umbrella question

Due to the adoption of purposeful selection and snowball sampling, some of the participants know each other or joined the same supply network. This creates a potential risk that shared professional experiences and interactions may contribute to similarities in their perspectives. However, some degree of network overlap was difficult to avoid in the context of this study. The Netherlands is a small country, and circular economy implementation in Dutch social housing renovation remains limited in scale. Consequently, the pool of stakeholders with sufficient experience and expertise to qualify for the P-set of this study is relatively restricted. Although belonging to the same supply network may expose participants to shared practices and experiences, it does not necessarily imply that they hold identical perspectives, particularly when they occupy different organizational and supply chain roles. Besides, all participants completed the Q-sort independently; therefore, participants who knew or had worked with one another did not influence each other's rankings directly. Another potential bias is that five participants in the P-set had previously participated in the interviews used for statement elicitation. However, its potential influence on this study is considered limited. The Q-set was selected from a large initial concourse derived from both the literature and 28 interviews and subsequently refined through several stages. Therefore, the final Q-set did not directly represent the views of any individual interviewee. More importantly, Q methodology focuses on the relative ranking and configuration of statements across the entire Q-sort, rather than interpreting responses to individual statements in isolation (Cuppen et al., 2010). Prior familiarity with a particular statement would therefore not, by itself, determine the result of participants' Q-sorts.

4.3.4 Q-sorting

The Q-sorting process was carried out in a workshop that lasted more than four hours in this study. During the workshop, participants first individually sorted 35 statements related to circular procurement in social housing renovation that were elicited from previous studies based on the level of agreement. The umbrella question for the Q-sorting is 'Which statements do you most agree with and least agree with?' Since the 35 statements can be interpreted differently in different situations, a real-case scenario about Dutch social housing renovation (see detailed information in Appendix I) was presented to participants before they started the Q-sorting to ground their responses. During the Q-sorting, they were asked to base and restrict their ranks on this scenario. This scenario is a typical Dutch social housing case which ensures that everyone can easily resonate with it. The six categories of the statements were only marked as an abbreviation at the end of each statement, and the participants were asked to rank without considering the category. The 35 statements were numbered in a random sequence to reduce any potential influence on participants' choices. After they finished the Q-sorts, the 15 participants were split into three small groups to articulate their sorting rationale and discuss with others on their perspectives under the instruction of at least one moderator in each group. A diverse array of stakeholders in each group is ensured to stimulate conversation and comprehension among various roles. In the small group, the moderator asked participants one by one to rationalize their choice for the five least agreed and five most agreed statements on the polarized sides of the grid and any other statements in the middle, which they have a special interest in. To save time in the workshop and stimulate interactions between participants, when one participant is explaining his or her choice, other participants who have the same or opposite choice are encouraged to join the discussion. Besides the Q-sorts, participants in the workshop also got the opportunity to share their insights and experiences of the various challenges, barriers, and bottlenecks of circular practice with each other.

4.3.5 Factor analysis and interpretation of narratives

After the workshop, PQMethod was used as the software to conduct a factor analysis of Q methodology. Factor analysis classified Q-sorts into different groups according to the similarities of the outcomes. A Varimax rotation was used to rotate factors according to the statistical criteria of the outcome, and maximize the variance between each factor (Kerr et al., 2018; Krueger et al., 2021). An iterative approach was employed in this process to discern meaningful factors. Different types of factor extraction and rotations were tried with two, three, and four factors over 15 Q-sorts

and compared with the qualitative data regarding the rationale behind their choices. The allocation of Q-sorts into three factors was determined to be the most suitable method for analyzing and categorizing data, ensuring an optimal number of classifications that are sufficiently diverse to characterize each factor. Of the 15 Q-sorts, one (Q-sort of a contractor) was excluded from these three factors as it did not align with any of them. The distribution of stakeholders and their roles in each factor can be seen in Table 4.1, in which the digital platform refers to the company that provides digital support, particularly a digital platform for circular economy transition in the Netherlands.

TABLE 4.1 Distribution of stakeholders and their roles in each factor

Factor	Client	Contractor	Architect	Consultant	Digital platform	Total
1	2	1	2	2		7
2		3		1		4
3		1	1		1	3

The three factors were interpreted as three narratives according to the sorting outcomes of the statements. Each narrative is represented by a group of participants with similar patterns in their sorting outcomes. To interpret the three narratives, participants' discussion of the rationale underlying their Q-sorts during the workshop was analyzed using qualitative analysis. Each rationale was coded with four levels of themes as shown in Table 4.2. Factor analysis identified the most agreed statements, the least agreed statements, and the distinguished statements automatically in PQMethod for each factor. Then, the characteristics of each narrative were summarized from the qualitative analysis of these three types of statements under each factor.

TABLE 4.2 Coding themes for qualitative analysis

Factors	Agreement level	Stakeholder type	Categories of circular procurement
Factor 1; factor 2; factor 3.	Least agree; neutral; most agree.	Housing association; contractor; architect; consultant; digital platform.	Contracting method; tendering method; value creation and distribution; stakeholder interactions; materials use; circular challenges.

4.4 Results

A factor array was generated with PQMethod (see Table 4.3), which shows the score of each statement for each factor (from -4 to 4, representing the least agreement to the most agreement), to create narratives. The outcome of the Q method has been classified into three narratives, each of which obtains a different focus on circular procurement.

TABLE 4.3 Factor Q-Sort Values for Each Statement

No.	Statement	Factor 1	Factor 2	Factor 3
1.	I believe the type of contract could influence the environmental performance of projects.	2	0	3
2.	I believe it is important to keep it local for circular renovation by discussing the possibilities with partners who are familiar with the properties.	-2	-2	-3
3.	I believe supply chain partners being paid by revenues of circular innovation instead of the fixed price will facilitate the circular transition.	-1	-1	1
4.	I believe it is critical to adopt a whole lifecycle-based contract in which circular renovation and maintenance are integrated before the commencement of construction.	-1	3	-1
5.	I believe instead of relying on cheap materials from a far distance, the business case should change to adopt more circular materials from the locals.	1	2	0
6.	I believe it is critical to create an integrated collaboration process early with supply chain partners.	4	4	4
7.	I believe demolishers should adapt their role to investigate materials in existing buildings and deliver reused materials from the beginning of a project in circular renovation.	-1	0	1
8.	I believe it is critical to share the risks and profits among different parties.	-2	2	0
9.	I think calculating the environmental impacts of materials and the circular performances of projects is a big challenge.	0	-4	-3
10.	I believe circular renovation and maintenance will make a real difference instead of circular new constructions.	-2	0	2
11.	I believe resident participation in decision-making is critical for circular renovation.	-4	0	2
12.	I believe soft factors, such as the stakeholder's experiences in circular projects and their capabilities for innovation and collaboration, are critical criteria in circular bid evaluation.	1	0	1
13.	I believe by not taking the total cost of ownership and lifecycle costs in mind, you start doing the wrong things.	3	3	0
14.	I believe increasing the cost and tax for non-circular materials and labour can facilitate circular transition.	0	0	0
15.	I believe supply chain partners (e.g. contractors) should be allowed to spend extra time to meet the requirements after receiving the award.	-3	-2	-1

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TABLE 4.3 Factor Q-Sort Values for Each Statement

No.	Statement	Factor 1	Factor 2	Factor 3
16.	I believe it is important to develop an innovative contracting method based on the collective goals of supply chain partners.	2	-2	2
17.	I believe the leadership and motivations of clients are critical for circular transition.	4	-1	3
18.	I believe the consultants' role in setting up the stage for different stakeholders and guiding the whole process is critical for circular transition.	0	-2	-1
19.	I believe it is important to have an open bid in circular (renovation) projects.	-2	-1	-4
20.	I believe stakeholders should be paid for the extra work in circular innovation.	-3	-3	3
21.	I believe it is critical for both the clients and the contractors to invest in long-term relationships with a program-based contract instead of a project-based one.	2	3	0
22.	I believe a standardized and objective bid evaluation method is critical for circular projects.	0	1	-2
23.	I believe it is important for different stakeholders to collaborate in different roles and responsibilities instead of at a hierarchy level.	3	1	2
24.	I believe it is important for clients to ask for both technical requirements and performance-based requirements in the tender of circular projects.	2	1	-1
25.	I believe the procurement strategies or requirements should encourage supply chain partners' long-term innovations.	3	-1	-2
26.	I believe flexibility and adaptation in the contracting method are important.	1	-1	1
27.	I believe it is essential for different housing associations and developers to collaborate in the circular transition.	1	1	1
28.	I believe the evaluation criteria in the tendering process shouldn't be too strict to exclude too many potential participants.	-4	-3	-2
29.	I believe it is important to contract for the performance or qualities of materials for certain years instead of the ownership of materials.	0	2	-4
30.	I think making agreements first without having a specific plan creates uncertainties in circular projects.	-1	2	-1
31.	I think circular renovation is more difficult compared to circular new construction.	-3	4	-3
32.	I think it is not effective if every decision needs to be made together in circular projects.	0	0	-2
33.	I believe when procuring materials, reclaimed materials should not be more expensive than new materials.	0	-4	0
34.	I believe it is critical to leverage environmental and economic benefits and develop financial values in the circular transition.	1	1	4
35.	I think who should provide certifications and guarantees for the reused materials is a big challenge.	-1	-3	0

4.4.1 Narrative 1: Focus more on the requirements in circular procurement

Narrative 1 (see Table 4.4) includes almost half of the participants in total and a variety of stakeholder constitutions, including the client (housing association), contractor, architect, and consultant. This suggests that despite the differing roles and positions of stakeholders throughout the supply chain, there is a tendency for convergence regarding discussions on circular procurement.

TABLE 4.4 Narrative 1 relevant statements

Most agreed statements	
6.	I believe it is critical to create an integrated collaboration process early with supply chain partners.
17.	I believe the leadership and motivations of clients are critical for circular transition.
13.	I believe by not taking the total cost of ownership and lifecycle costs in mind, you start doing the wrong things.
25.	*I believe the procurement strategies or requirements should encourage supply chain partners' long-term innovations.*
23.	I believe it is important for different stakeholders to collaborate in different roles and responsibilities instead of at a hierarchy level.
Distinguished and more agreed statements	
24.	*I believe it is important for clients to ask for both technical requirements and performance-based requirements in the tender of circular projects.*
Least agreed statements	
11.	*I believe resident participation in decision-making is critical for circular renovation.*
28.	I believe the evaluation criteria in the tendering process shouldn't be too strict to exclude too many potential participants.
31.	I think circular renovation is more difficult compared to circular new construction.
15.	*I believe supply chain partners (e.g. contractors) should be allowed to spend extra time to meet the requirements after receiving the award.*
20.	*I believe stakeholders should be paid for the extra work in circular innovation.*
Distinguished and less agreed statements	
10.	*I believe circular renovation and maintenance will make a real difference instead of circular new constructions.*
8.	*I believe it is critical to share the risks and profits among different parties.*

Most distinguishing statements printed in italics.

Narrative 1 believes that rigorous contracting and tendering methods with explicit standards, requirements, and expectations are essential for circular projects. If the evaluation criteria and requirements are not strict enough in the tendering process, it will result in increased disarray since each participant may submit divergent proposals. It is essential to ensure that standards are not diminished in circular tendering by adhering to rigorous contractual and tendering methods. For a similar reason, this narrative also does not align with the idea of giving stakeholders, especially contractors, extra time to meet the requirements after receiving the rewards. This narrative is also less in agreement with the idea of integrating circular renovation and maintenance in the contracts before the execution of projects. It

believes that while the lifecycle of projects is considered significant at all stages, it is not essential to incorporate renovation and maintenance inside the same contract as new constructions, as these remain distinct entities in most current construction projects.

Narrative 1 also recognizes the importance of leadership and motivations from the clients as critical facilitators for circular transition. Clients possess both the capacity to spearhead and facilitate the circular transition, as well as the obligation to effectuate transformations. The motivation and enthusiasm of clients to realize circular transition will also attract more stakeholders to participate and make the change. *"I have experienced that when you are really inspiring and want what everyone wants in this project, people want to stick on your project and your success. So, I really think it's good (Architect from narrative 1)"*. While the role of clients is being recognized in circular procurement, this narrative has a doubtful opinion about the impacts residents' participation can make in the decision-making process of circular projects. They believe that at certain points, especially in circular renovation, understanding residents' requirements is essential; yet, the decisions and their implementation should be determined by professionals. This differs somewhat from other narratives. *"You get their opinions very early in the process and take their opinions into account, but not on what you are going to do or how you are going to do it (Contractor from narrative 1)". "So it's really about storytelling. The residents tell you what their requirements are, and then you try to find a circular solution within that requirement (Architect from narrative 1)"*.

This narrative, in contrast to others, emphasizes the necessity of both technical and performance-based requirements in circular procurement. It is posited that technical requirements enable the precise identification and measurement of the circularity of materials and projects, thereby ensuring effective project execution and informed decision-making. Meanwhile, performance-based requirements leave space for other partners to be creative in the long run. *"I believe that with both technical requirements and performance-based requirements you can really identify and measure what effective sustainable options are for materials. You can quantify all processes in a number. Then you can make the right decisions. You can start with one thing you should guarantee (Contractor from narrative 1)"*. It also believes more in the long-term relationship between partners and the adoption of lifecycle perspectives, including total cost of ownership and product as a service strategies, for instance. *"Especially because circularity is quite new. You're learning throughout the process, and I think it's very valuable if you can use the lessons learned in new projects. We optimized them together. And then also in the next projects you know the risks and the benefits with each other. I think that's when all the good relationships work (Contractor from narrative 1)"*. Nevertheless, this narrative has

less agreement on sharing risks and benefits among different parties in circular procurement when compared to other narratives.

4.4.2 Narrative 2: Focus more on the relationship among stakeholders in circular procurement

Narrative 2 (see Table 4.5) comprises the highest number of contractors (N=3) along with a consultant. This narrative appears to be particularly associated with contractor perspectives in this study. However, it should not be interpreted as representative of contractors more broadly.

This narrative strongly advocates for establishing long-term relationships between clients and contractors through program-based contracts, as contractors often employ a result-oriented approach and assume responsibility for the maintenance of the building stocks for a longer period. However, there is also an opinion that the current business model is unprepared to incorporate third parties (such as contractors and architects) in this long-term collaboration alongside the primary stakeholders (namely municipalities, building owners, and residents), and to share revenues and risks with them over the long run. *"The problem is that the business model of only three parties is based on the actual value: the owner of the building, the municipality, and the user. They have a long-term perspective, and all the others have a short-term contract. Then you cannot make a construction company making long term responsibility. So what they do is a short-term intervention, and they get paid for that. They can give guarantees. But they cannot, in their business model, be rewarded during the lifetime of a product. It's not financially viable (Consultant from narrative 2)".*

This narrative acknowledges the significance of the total cost of ownership, lifecycle cost, and the integration of them in a lifecycle-based contract. It emphasizes that the lifecycle impact, encompassing both environmental and social dimensions, must always be considered in circular initiatives. This narrative also has an optimistic perspective towards the challenges of calculating the environmental impacts of materials circular projects, as well as providing reclaimed materials certifications. They contend that sufficient tools for calculation exist in the market; nevertheless, there is a deficiency in the integration among various tools and their owners. Another inhibition is that a lot of companies use different tools that conduct distinct calculations. A centralized solution is urgently needed to synthesize the various tools and organizations.

TABLE 4.5 Narrative 2 relevant statements

Most agreed statements	
6.	I believe it is critical to create an integrated collaboration process early with supply chain partners.
31.	*I think circular renovation is more difficult compared to circular new construction.*
21.	I believe it is critical for both the clients and the contractors to invest in long-term relationships with a program-based contract instead of a project-based one.
4.	*I believe it is critical to adopt a whole lifecycle-based contract in which circular renovation and maintenance are integrated before the commencement of construction.*
13.	I believe by not taking the total cost of ownership and lifecycle costs in mind, you start doing the wrong things.
Distinguished and more agreed statement	
30.	*I think making agreements first without having a specific plan creates uncertainties in circular projects.*
8.	*I believe it is critical to share the risks and profits among different parties.*
29.	*I believe it is important to contract for the performance or qualities of materials for certain years instead of the ownership of materials.*
22.	*I believe a standardized and objective bid evaluation method is critical for circular projects.*
Least agreed statements	
33.	*I believe when procuring materials, reclaimed materials should not be more expensive than new materials.*
9.	I think calculating the environmental impacts of materials and the circular performances of projects is a big challenge.
35.	*I think who should provide certifications and guarantees for the reused materials is a big challenge.*
20.	I believe stakeholders should be paid for the extra work in circular innovation.
28.	I believe the evaluation criteria in the tendering process shouldn't be too strict to exclude too many potential participants.
Distinguished and less agreed statements	
17.	*I believe the leadership and motivations of clients are critical for circular transition.*
26.	*I believe flexibility and adaptation in the contracting method are important.*

Most distinguishing statements printed in italics.

Narrative 2 has less tolerance for making agreements first between clients and contractors without a specific plan compared to other narratives, since contractors from this narrative believe that they cannot proceed without a concrete plan, which will result in ambiguity. It also has a strong disagreement on reclaimed materials should be less expensive than new materials. They accept that the initial cost of reclaimed materials can be higher, although the lifecycle cost of reclaimed materials is expected to be more economically and environmentally sustainable in the long-term. They also accept that the utilization of reclaimed materials frequently encompasses labor expenses, thus justifying a somewhat elevated cost.

Compared to other narratives, Narrative 2 has less agreement with the significance of clients' impact in circular transition. They believe that equivalent efforts must be exerted by both parties; otherwise, it may result in high risks and potential failures if mutual commitment or shared values is lacking. *"Because that (leadership from clients) is the commissioner's side of view, but we need it from the other side in the same way. It has to be both. So it doesn't get it if it's mostly built up from the other side. That's why I don't agree with it. Because if the other one doesn't exist, you are getting nowhere. Even worse, you get punished for taking this risk. That's why I think if the difference between the two sides is too huge, it's a waste of time (Consultant from narrative 2)"*. This narrative also has less acknowledgment of flexibility and adaptation in the contracting method. They assert that the objectives in the contracts should remain unchanged; however, the approaches employed to achieve the goals can be adaptive and flexible to a certain degree according to actual practices. There is also a consensus that circular renovation is more challenging compared to circular new construction when compared with other narratives.

4.4.3 Narrative 3: Focus more on the outcomes of circular procurement

Narrative 3 (see Table 4.6) includes three stakeholders: one contractor, one architect, and one digital platform provider.

This narrative has a belief in the balance between financial value and environmental value. One possible solution to keep the equilibrium between economic sustainability and environmental sustainability can be reflected in the tax strategy in a circular economy, by adjusting labor and CO2 taxes for both circular and non-circular projects, for instance. Narrative 3 also believes the type of contract will have a significant impact on the circular transition. It argues that currently, the majority of market contracts are predicated on pricing; nevertheless, it is essential to integrate environmental considerations and other factors, such as the utilization of circular materials, into the contract. Moreover, the existing contract is deficient in a systematic design and management approach that can support the successful implementation and achievement of circular projects.

Narrative 3 is strongly against the idea of having an open bid as a mandatory requirement in circular projects. If circular projects consistently necessitate an open bid, small and medium enterprises, which have limited chances of competing against large corporations, would struggle to participate. Moreover, numerous players will invest considerable effort in securing the bid is perceived as a waste of time and resources. This narrative is also less optimistic about contracting for qualities of

materials rather than ownership, as they believe it will be challenging to forecast future outcomes after several decades and to lease the service. However, it also emphasizes that if this discussion is related to a full portfolio rather than individual projects, it will be more convinced to contract for performances and qualities and integrate circular renovation and maintenance in contracts at the beginning.

TABLE 4.6 Narrative 3 relevant statements

Most agreed statements	
34.	I believe it is critical to leverage environmental and economic benefits and develop financial values in the circular transition.
6.	I believe it is critical to create an integrated collaboration process early with supply chain partners.
1.	I believe the type of contract could influence the environmental performance of projects.
20.	*I believe stakeholders should be paid for the extra work in circular innovation.*
17.	I believe the leadership and motivations of clients are critical for circular transition.
Distinguished and more agreed statements	
10.	*I believe circular renovation and maintenance will make a real difference instead of circular new constructions.*
11.	*I believe resident participation in decision-making is critical for circular renovation.*
3.	*I believe supply chain partners being paid by revenues of circular innovation instead of the fixed price will facilitate the circular transition.*
Least agreed statements	
19.	*I believe it is important to have an open bid in circular (renovation) projects.*
29.	*I believe it is important to contract for the performance or qualities of materials for certain years instead of the ownership of materials.*
9.	I think calculating the environmental impacts of materials and the circular performance of projects is a big challenge.
31.	I think circular renovation is more difficult compared to circular new construction.
2.	I believe it is important to keep it local for circular renovation by discussing the possibilities with partners who are familiar with the properties.
Distinguished and less agreed statements	
13.	*I believe by not taking the total cost of ownership and lifecycle costs in mind, you start doing the wrong things.*
21.	*I believe it is critical for both the clients and the contractors to invest in long-term relationships with a program-based contract instead of a project-based one.*
24.	*I believe it is important for clients to ask for both technical requirements and performance-based requirements in the tender of circular projects.*
32.	*I think it is not effective if every decision needs to be made together in circular projects.*

Most distinguishing statements printed in italics.

In contrast to earlier narratives, Narrative 3 exhibits greater consensus that stakeholders should receive compensation for the additional efforts they contribute to generating circular impacts. It believes that rewarding supply chain partners for the circular impact they create can generate additional financial resources and investment opportunities for circular innovation, thereby driving further change. *"You will be willing to do the investment with revenue sharing; otherwise you will never get anywhere. You will never always get the return, so the extra pay can probably make the difference (Contractor from narrative 3)".* This contrasts with other narratives,

as others assert that stakeholders have been compensated upon receiving the award; it is unnecessary to pay them additionally for circular innovation and impacts. This narrative also has more beliefs on once the circular construction projects are completed, the benefits should be separated between the clients and the contractors. Other narratives think that, it is still distant from addressing revenue distribution in circular initiatives as we still remain in the preliminary stages of circular transformation. "*I think for us, it's not really interesting because we already do so much research, and it's not that you always see the result because sometimes the solution is too expensive or sometimes there is no time. But that presumes that there are revenues. We are not there yet. (Architect and Consultant from narrative 1)".*

4.5 Discussion

4.5.1 Interrelationship between stakeholder perspectives and their roles in the supply chain

This study presumed that stakeholders' perspectives are influenced by their roles and positions in the supply chain and the value composition of their organizations (Ababio et al., 2025; Leising et al., 2018). However, the results of this study indicate a lack of definitive interrelationship between stakeholders' roles or affiliations and their perspectives. Each narrative comprises distinct stakeholder roles, and stakeholders with the same roles are categorized into different narratives. There is a certain level of shared values among different actors' perspectives on circular procurement. This can be explicitly identified from Narrative 1 as it incorporates a diversity of stakeholder roles. Additionally, the findings suggest that stakeholders with the same roles may possess divergent viewpoints on certain subjects. This is particularly evident for contractors, consultants, and architects in this study. The lack of definitive interrelationship between stakeholder roles and their perspectives enhances the argument that stakeholder positions are multidimensional, which can be influenced by different factors, criteria, and values (Cuppen et al., 2016). Besides, since different stakeholders in the same narrative can have a shared perspective on circular procurement transition, it indicates that shared perspective alone cannot guarantee successful circular procurement implementation. However, when developing circular procurement implementation, it is still important to consider each stakeholder's standpoint and align their different requirements to effectively achieve the shared goals (Ababio et al., 2023; Sajid et al., 2024).

Nevertheless, despite the outcome of the Q-sorts and factor analysis suggesting no essential interrelationship between stakeholder perspectives and their positions and roles, when they are addressing the rationale behind their choice, there is a clear indication that their motivations are still derived from their roles in the supply chain. For instance, both clients, contractors, and architects may believe that it is important to keep technical requirements in circular procurement. However, clients seek assurance that deliverables from contractors at the end of the project are controllable and measurable, whereas contractors and architects value a measurable framework to assess project standards when different stakeholders hold different opinions on decisions in circular projects. Therefore, identifying the underlying motivations of different stakeholders can facilitate the development of effective circular procurement strategies that simultaneously address the needs of various stakeholders (Cuppen et al., 2016).

4.5.2 Future development of circular procurement in the construction industry

Circular procurement requirements

Stakeholders' debate on whether to have rigorous or flexible requirements in circular procurement reflects a tension between the desire for legally secure, standardized procurement procedures and the need for adaptable processes that accommodate inherent uncertainties in circular transition. Performance-based requirements and soft criteria are essential for bid evaluation in circular procurement, as indicated in previous studies (Sparrevik et al. 2018). However, some stakeholders in this research raised the concern that performance-based requirements may create a risk of a lack of standards to evaluate circularity and performance of projects. Besides, they are also worried that the emphasis on performance-based requirements and previous experiences over measurable requirements as evaluation criteria in circular projects may inadvertently marginalize small and medium enterprises from the bidding process, as they may possess substantial innovative potential but lack sufficient experiences with large-scale projects. Therefore, the key is to strike a balance between establishing rigorous evaluation criteria and leaving sufficient space for innovation, while ensuring the involvement of not only large companies but also small and medium-sized enterprises.

While open bids are favorable for their accountability, price comparison, and stimulation for competition and project quality (Adedokun et al., 2013), some stakeholders in this study are strongly against open bids in circular projects and argue that the use of a small-scale pre-selection can be a better choice. They argue that while an open bid may stimulate competition and accountability, it will disqualify smaller firms that possess innovative capabilities but may lack competitiveness compared to larger corporations. Besides, the same as argued in previous studies, open bids will also consume significant time and financial resources from all parties involved (Favié et al.,2009; Mbachu, 2008). Consequently, implementing a pre-selection process to identify contractors or consortia from a limited pool of candidates is considered a potential approach to regulate costs within a defined scope. Nevertheless, the findings also reveal potential advantages of open bidding. Occasionally, clients prefer to conduct open bids in their pilot projects to communicate their aspirations to the market. It is also argued that the open bid presents opportunities to engage new stakeholders in the projects. Open bids may therefore serve not only as a mechanism for partner selection but also as a means of market engagement and communicating demand for circular solutions (Berkhout et al., 2026). Therefore, the choice between open bidding and limited pre-selection involves a trade-off: open bids and broader competition can facilitate market engagement and communication of circular solutions, while limited pre-selection can reduce transaction costs and increase opportunities for small and medium enterprises' participation.

Stakeholder relationship

All participants in the Q sorting of this research agree that stakeholder collaboration plays a pivotal role in the circular procurement process. This can be demonstrated by the result that all three narratives have the strongest agreement on statement 6: “I believe it is critical to create an integrated collaboration process early with supply chain partners.” However, the way to achieve such collaboration differs across stakeholders’ perspectives. Some stakeholders believe clients should take the leadership in circular transition, while others assert the significance of stakeholders collaborating on an equal approach driven by responsibilities and roles without hierarchy and equal commitment from both sides in the supply chain to facilitate innovation and reduce potential risks. This indicates that agreement on the importance of collaboration does not necessarily imply agreement on its structure. Rather, questions of leadership, responsibility, and power remain important in determining how collaboration is organized in circular procurement. The existing literature also argues for a lack of knowledge about the specific forms of collaboration in the circular built environment transition (Chan et al., 2023). Previous research has posited the importance for stakeholders to understand

each other's roles and capabilities to facilitate multi-stakeholder collaboration in circular procurement (Ababio et al., 2025). The findings of this study indicate that understanding stakeholders' roles and capabilities alone is insufficient to facilitate effective collaboration. Attention must also be given to how leadership and decision-making authority are distributed among stakeholders. Future research should therefore investigate under what circumstances client-led, shared leadership, or more non-hierarchical forms of collaboration are appropriate for circular procurement, and how different arrangements influence innovation, risk sharing, decision-making, and circular performance.

Previous studies argued the importance of establishing long-term collaboration among various stakeholders within a complex circular ecosystem and extending stakeholder collaboration to various lifecycles and scales beyond individual projects (Chan et al., 2023; Evertsen and Knotten, 2024). This argument is supported by some stakeholders in this study, who confirmed the significance of long-term stakeholder collaboration through program-based contracts across multiple lifecycles. However, the findings also reveal that the value of building long-term collaboration at the program level rather than at the project level is not equally recognized by all stakeholders. This suggests that extending stakeholder collaboration beyond single projects remains a challenge in current circular procurement practices. Adoption of lifecycle-based contracts and lifecycle-based strategies (such as Total Cost of Ownership) may potentially facilitate long-term transformation by enabling stakeholders to consider lifecycle costs, responsibilities, and value creation beyond individual projects.

Besides, institutional and policy supports are also required to facilitate collaboration and fundamentally change stakeholder interactions (Ababio et al., 2025). Research has shown that countries with robust policies to support and promote collaborative stakeholder leadership, such as the Netherlands, have demonstrated better performance in the implementation of circular procurement (Ababio et al., 2025; Kristensen and Mosgaard, 2020). Therefore, this study suggests that stakeholder collaboration in circular procurement should be considered across multiple scales, including within projects, across projects, across lifecycles, and at the broader institutional level. Future collaborative frameworks can be designed to integrate stakeholder collaboration at different scales and explore how program-level procurement and institutional support can promote the circular economy transition on a larger scale.

Moreover, the collaboration in social housing renovation can go beyond the project team and experts to engage residents in the story. Residents' involvement is important in circular renovations because their preferences on living environment

should be considered in the decision-making process (Broers et al., 2022). However, it remains debatable about the extent to which residents should be involved in the decision-making of circular procurement. Stakeholders believe that decisions on how to accomplish the circular economy transition and deliver circular projects should be made primarily by experts with knowledge on circular economy and project management. Therefore, the most crucial consideration in the debate regarding residents' participation in circular renovation may not be whether residents should share decision-making authority with experts, but how their preferences, needs, and opinions are actively acknowledged and incorporated into the decision-making and whether they are adequately informed about the principles of the circular economy. Meanwhile, the appropriate form and level of residents' participation may vary across different types of decisions (Broers et al., 2022).

Circular Economy outcome

Some stakeholders place a particular emphasis on the risk and benefit sharing in circular projects, both during the execution of the projects and post-completion. Previous studies have also asserted the importance of sharing risks and benefits between supply chain partners (Bao et al. 2019; Goh et al., 2023). However, the findings of this study reveal a considerable gap between this theoretical principle and its practical feasibility in current practice. Currently, most of the stakeholders believe it is premature to develop mechanisms for revenue allocation in the circular economy. Under current practice, being paid by fixed-price payment arrangements is generally regarded as sufficient because the long-term revenues and residual values expected from circular projects have not yet been clearly realized or quantified. Nevertheless, stakeholders acknowledged that, if such benefits materialize in the future, mechanisms will be needed to distribute them appropriately among relevant parties. The findings further suggest that risk and benefit sharing cannot be addressed solely through contractual allocation at the project level but needs to be connected to the underlying business models and inter-organizational relationships. Stakeholders state that existing development of business models in Dutch social housing often focuses on the benefits of housing associations, municipalities, and residents, while excludes supply chain partners, such as contractors and architects. This will create challenges when different parties want to aim for the common objective and share risks and benefits (Lambrechts et al., 2021). Previous studies also highlighted the significance of building profitable business models with financial incentives aligned with the collective objectives of circular transition and appropriately shared risks among partners (Leising et al., 2018; Sajid et al., 2024). Therefore, future research is required to address the distribution of risks and benefits among stakeholders in circular building projects, particularly long-term benefits

such as residual value and revenue from circular transition, and integrate them into inter-organizational business models.

4.5.3 Theoretical implications

The adoption of Q methodology in this study provides a holistic perspective on multi-stakeholders' beliefs with multiple influences on circular procurement in Dutch social housing renovation (Kerr et al., 2018). It enhances stakeholder analysis in circular procurement with a nuanced understanding of stakeholder perspectives, transcending simple comprehension of their agreements and disagreements (Cuppen et al., 2016). This study also contributes to identifying the interrelationship between stakeholder perspectives and their roles in the supply chain. It reveals shared perspectives among stakeholders with different roles and identifies the underlying motivations for stakeholders' decisions in circular procurement. Furthermore, this study reinforces the significance of multi-stakeholder collaboration in the transition to circular procurement and contributes to stakeholder collaboration literature by nurturing the understanding of it with specific and empirical evidence. Previous studies indicate that stakeholder collaboration needs to be realized in the combination of a multi-scale, multi-level, and multi-actor environment (Chan et al., 2023; Evertsen and Knotten, 2024). This study adds to this argument by further discussing that the effective realization of circular procurement requires extending collaboration across lifecycle and individual project boundaries, appropriately distributing power and leadership, allocating risks and benefits among stakeholders, and incorporating different stakeholder knowledge and participation at different levels. It therefore conceptualizes stakeholder collaboration in circular procurement as a multi-dimensional and context-dependent process that needs to align stakeholders' requirements, power dynamics, inter-organizational relationships, and value creation, while adapting to specific situations.

4.5.4 Practical implications

The three narratives generated in this study have revealed three different priorities for stakeholders in circular procurement transition, which are circular procurement requirements, stakeholder relationships, and circular economy outcomes. This study suggests that practitioners who aim to realize circular procurement transition start from these three priorities as different starting points and synthesize them later. Meanwhile, this study pointed out that stakeholders' perspectives are not always

aligned with their positions in the supply chain and can be driven by their different priorities. It is essential for project managers to manage stakeholders in circular projects according to their priorities rather than their positions in the supply chain. They should also monitor stakeholder perspectives and their values, criteria, and priorities as the project proceeds as a continuous process rather than a one-time thing (Cuppen et al., 2016). Pertinent policies and regulations on circular procurement should also cover the diversity of stakeholder perspectives and integrate them into policy design. However, designing specific policies for different narratives will not be necessary (Kerr et al., 2018). Policymakers and practitioners should also not concentrate exclusively on one priority while neglecting others, as an integrated system encompassing all priorities from different stakeholders is essential. Of course, the three priorities identified in this study cannot cover all perspectives in circular procurement. Examining the same collection of congruence of statements in this study with more stakeholders will yield more narratives (Kerr et al., 2018). Researchers are also encouraged to investigate the nuanced factors and values that influence stakeholder perspectives under the same context of this study or in a different context.

4.6 Conclusions

This study investigated the multi-stakeholder perspectives on circular procurement in social housing renovation in the Dutch context with a Q methodology. Q methodology was used as a research method to holistically understand the heterogeneity of stakeholder perspectives and stakeholder roles in a diverse and complicated construction supply chain environment and thus stimulate circular procurement transformation. Three narratives were produced based on the Q-sort results, with each narrative emphasizing different priorities in circular economy transition. Narrative 1 emphasizes the requirements of circular procurement, Narrative 2 focuses more on the relationships among various stakeholders, and Narrative 3 highlights the outcomes of circular procurement. Although this study presumed that stakeholders with different roles may have divergent perspectives on circular procurement, the results of Q-sorts indicate that there is no definitive interrelationship between stakeholder roles and their perspectives. Different stakeholders may share similar perspectives, while stakeholders with the same roles can also have distinct opinions. Nevertheless, it is worth noticing that the motivations and rationale behind stakeholders' perspectives still stem from their roles in the supply chain, despite shared perspectives. Therefore, it is important to

consider their priorities and motivations and align their requirements when designing and implementing circular procurement.

The conduction of Q-sorting in this study has its limitations and requires consideration for future studies with the same research method. First, including participants from the same network may create potential risks that they may share similar perspectives. Although belonging to the same network does not directly imply that stakeholders also obtain similar perspectives, especially when they are from different organizations and occupy different roles in the supply chain, this study did not explicitly examine the relationship between network membership and participants' perspectives. Future research could therefore examine whether and how membership in the same supply networks influences stakeholders' perspectives on a particular topic, for example by comparing Q-sorts across different supply networks or conducting network-based analyses with Q methodology. Second, despite the establishment of a real circular Dutch social housing renovation case as the setting for the Q-sorting, participants believe that the statements and context can be more precise to elicit clearer responses. They also indicated that they would assign varying ranks to several statements in this study depending on the situation. However, this limitation also to some extent reflects the complex and nuanced process in circular procurement practice in the real world, which influences stakeholders' perspectives in different contexts and situations. It also reveals the challenges in addressing and exploring this topic, as well as developing relevant strategies and guidelines at a generally comprehensive level. Third, participants indicated their concurrence with the majority of the statements, which makes the Q-sorting exceedingly challenging. On the one hand, this aligns with the structure and objective of Q-sorting, which is to compel participants to rank items and reveal their true priorities. On the other hand, this may create ambiguity over the reliability of the rankings if the decisions are too difficult to make.

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TOC

5 Examine the Gaps Between Theories and Practices of Circular Procurement in Dutch Social Housing

Chapter 2 provides a conceptual study of circular procurement in the built environment through a literature review approach, while Chapters 3 and 4 investigate circular procurement empirically in Dutch social housing. This chapter compares and synthesizes these two bodies of knowledge to examine where the practice lags behind the literature and how practice can contribute to the conceptualization of circular procurement. From this analysis, concrete and actionable propositions are derived to facilitate circular procurement implementation in Dutch social housing.

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5.1 Background

A growing body of literature has examined circular procurement in the built environment, identifying procurement strategies such as performance-based tendering, early stakeholder involvement, and lifecycle-based evaluation criteria as crucial enablers of circular construction (e.g., Neessen et al., 2021; Qazi & Appolloni, 2022; De Angelis et al., 2018). In addition to academic research, multiple practical guidelines have been published on the development of circular procurement in the construction industry. The Netherlands, in particular, has developed several practical guidelines and proposed implementation strategies for circular procurement, reflecting its relatively advanced efforts to promote circular procurement in the construction industry. A 'Circular Procurement Guideline' was published by PlatformCB'23 (2021), which was a platform based in the Netherlands with the ambition of connecting construction-wide parties with circular goals. The Dutch Transition Team for a Circular Construction Economy published guidelines for circular procurement in residential and non-residential construction in 2021 (van Oppen et al., 2021). The Buyer Group (2022), in which the private and public clients work together on sustainability, reported a market vision on purchasing strategies in the renovation of social housing in the Netherlands. At the European level, EIT Climate-KIC (2019) published a report about the challenges and potential of circular procurement in public construction projects.

However, the application of scientific research and practical guidelines on circular procurement needs to be examined in practice. Taking the Dutch social housing sector as an example, its practice of circular procurement is still under investigation. There remains a limited understanding of how theoretical recommendations correspond with the realities of procurement practices in social housing. Previous chapters of this thesis have conducted a literature review study and two empirical studies on circular procurement in Dutch social housing. The empirical studies indicate that housing associations and their partners face a range of technological, organizational, and environmental challenges in implementing circular strategies. Additionally, circular procurement in social housing involves various stakeholders across the construction supply chain, each with distinct roles, interests, and perceptions of circularity. These dynamics suggest that literature-derived understanding of circular procurement may not fully reflect the complexities of its practical implementation. Comparing literature and empirical findings may therefore reveal where existing theoretical assumptions are challenged, qualified, or further refined by insights from practice.

Therefore, this chapter aims to examine the gap between theories and practices of circular procurement in social housing by reflecting on and synthesizing insights from the literature review study and empirical studies in Chapters 2, 3, and 4. To do so, propositions have been derived and validated with housing associations and their partners to provide concrete and actionable recommendations on circular procurement implementation. The research questions are as follows:

- **What are the points of divergence between the literature review and the empirical studies of circular procurement in Dutch social housing?**
- **What insights on circular procurement development can be generated by synthesizing and comparing the findings from both the literature review and empirical studies?**

5.2 Synthesize literature review and empirical studies

In Chapter 2, we conducted a systematic literature review to examine theories and prior literature on circular procurement in the built environment and developed a conceptual framework to guide its development and implementation. A supply chain perspective was adopted to identify the actors, their activities, and the resources required at different stages of circular procurement. After the literature review study, the next step was to understand the application of circular procurement in the practice of the Dutch social housing sector, which consisted of two empirical studies. The first empirical study examined the integration of circular economy principles into the procurement process and associated challenges, thereby identifying potential for future development. A case study approach was adopted, including desk research and semi-structured interviews. The second empirical study aimed to understand the perspectives of supply chain stakeholders on circular procurement and how it can facilitate multi-stakeholder collaboration and the development of circular procurement. A Q methodology and workshop were conducted to study stakeholder perspectives and generate the consensus and contradictions of their perceptions on circular procurement.

In Sections 5.2.1 to 5.2.3, we first summarize the key findings from the literature review study in Chapter 2 and two empirical studies in Chapters 3 and 4. Then we compare and synthesize the key findings from these two types of studies and identify the main divergences between them. The comparison focuses on two types of divergence: 1) areas in which the practice of circular procurement in Dutch social housing lags behind what is suggested in the literature; and 2) areas in which the practice challenges or extends our literature-driven conceptualization of circular procurement and can further inform and recalibrate the current conceptualization. The summary of the key findings and the identification of main divergences were interpretive rather than based on predefined analytical frameworks. The relevance of the identified divergences was assessed through the author's accumulated understanding of the literature and empirical material developed throughout the preceding studies, with particular attention to topics that recur in both types of studies.

5.2.1 Key findings from the literature review study

Our literature review has revealed that circular procurement is not just about purchasing, sourcing, or tendering activities; rather, it is a system-level transformation of organizational structures and working processes. To realize an innovative transition to a circular economy, it is crucial for the traditional procurement process to shift from a transactional, project-based mindset to a lifecycle-based and integrated-supply-chain orientation that synthesizes materials, information, value, and stakeholder responsibilities across multiple projects over time. For instance, early stakeholder collaboration, a systematic information system, and joint decision-making in the procurement process are crucial for developing an integrated supply chain and facilitating the circular transition (Pellegrini et al., 2021; Luciano et al., 2021; Hartwell et al., 2021). Besides, compared to prescriptive specifications, performance-based procurement aligns better with circular economy goals, allowing more space for contractors and suppliers to propose innovative solutions (Sparrevik et al., 2018). Existing studies have also identified the importance of embodying lifecycle thinking, such as Total Cost of Ownership, residual value, product-as-a-service, and maintenance plan, in the tendering and contracting stages (e.g., Ruparathna & Hewage, 2015; Lingegard et al., 2021; Alshboul et al., 2022). Meanwhile, flexible contract types are required to support the implementation of lifecycle thinking (Kadefors et al., 2021). Moreover, the use of digital technologies and platforms to support circular transition has also been emphasized in theoretical studies (e.g., Luciano et al., 2021; Eze et al., 2022).

Based on previous studies, we have outlined a circular procurement framework that includes the activities, resources, and actors at different stages to guide the transition to circular procurement in the built environment. Nevertheless, this conceptual framework stays theoretical and lacks validation in real practice.

5.2.2 Key findings from practical studies

The two empirical studies with housing associations and supply chain stakeholders show that circular procurement implementation in Dutch social housing is still in the emerging phase, and that its practice is fragmented across different social housing organizations, lacking systematic and standardized embedding. Different stakeholders can share perspectives on circular procurement, while stakeholders with the same roles may hold divergent perspectives. Rather than understanding stakeholder perspectives on circular procurement by role, it is more reasonable to categorize them based on their priorities regarding the circular economy transition. In some of the pilot projects, innovative procuring methods and supply chain integration are deliberately applied through approaches such as Best Value Procurement and contracting with consortia. Early-stage collaboration and cross-supply chain collaboration have received high consensus among different stakeholders. However, the distribution of responsibilities among stakeholders, their roles and collaboration mechanisms, and risk-and-benefit-sharing rules, for instance, remains unclear. Meanwhile, organizational capacity constraints limit the ability to scale up circular procurement, which is mainly reflected in the separation of departments within housing associations and a lack of internal readiness in knowledge and capabilities for the circular economy transition. Besides, the pertinent policies and regulations on circular procurement lag behind practice, leading to uncertainties in practice. Social value and resident participation are addressed in practice, but not yet consistently. Regarding digital and information solutions in the circular procurement transition, our empirical studies have shown that digital tools exist, but their use is fragmented and lacks an integrated approach; data governance is still underdeveloped and lacks shared vocabulary and standards.

5.2.3 Comparison of literature review and empirical studies

By comparing one literature review and two empirical studies, we first identified the aspects in which the practice lags behind scientific literature.

1 Our literature review study has emphasized the importance of supply chain integration, ecosystem-thinking, and a lifecycle perspective across project boundaries in circular procurement. In practice, although several housing associations that are advanced in their circular transition are intentionally targeting supply chain integration and contracting with consortia, these efforts mostly remain at the project-based and pilot level.

2 Existing literature has conceived an ideal situation to adopt lifecycle-based pricing methods in circular procurement, including Life Cycle Cost (LCC), Total Cost of Ownership (TCO), residual value, and take-back service. The pricing practice in current circular social housing projects remains relatively traditional, with a fixed-price approach as the predominant method, and occasional combinations of flexible pricing and shared investment in circular economy innovation with supply chain partners. The use of LCC, TCO, and residual-value monetization is inconsistent in practice, and there is ongoing debate over how to share risks and benefits among stakeholders.

3 Literature has tackled and proposed the use of advanced digital technologies and platforms throughout the whole lifecycle of the construction process to facilitate innovative transitions such as the circular economy. In practice, there is still a long way to go before the thorough application of advanced digital technologies in the procurement process is realized. Stakeholders are challenged by uncertainty about the quality, interpretation, and ownership of data, as well as by the lack of interoperability among different digital tools.

4 Ecosystem thinking and systematic stakeholder collaboration are proposed as essential in the literature review study, which has also received consensus from different stakeholders in practice. However, despite the shared perspective on the importance of stakeholder collaboration and early engagement, there remains a lack of concrete actions in practice. Meanwhile, the distribution of responsibilities among stakeholders in circular innovation remains unclear.

5 Our literature review study has identified the need to develop renovation-specific guidance on circular procurement and distinguish the requirements and actions required between renovation and new construction. The empirical studies show that the procurement approaches for large-scale renovation and new construction often overlap.

However, large-scale renovation and small-scale maintenance differ markedly in social housing. There is a lack of pertinent guidance and distinct approaches to structurally support procurement for these two types of projects in the circular economy transition.

Simultaneously, the practice of circular procurement in Dutch social housing also contributes to the literature review and recalibrates some of its presumptions.

1 In our literature review study, we suggested a six-stage framework for circular procurement that includes planning, criteria specification, tendering and selection, contracting, designing, and construction and delivery, to help develop a consistent approach in construction. In practice, however, the process is more iterative and relational, significantly influenced by the context and specific situations. According to findings from our empirical studies, a pre-selection stage is required before tendering in circular procurement. The criteria specification stage is hardly mentioned separately by practitioners and is more often incorporated with other stages such as planning or pre-selection.We therefore simplified and refined the original six stages from the review study into five stages: planning, pre-selection, tendering, contracting, and design and construction.

2 Our literature review study assumes that stakeholder collaboration is a technical coordination problem that can be addressed by a designed structure with a distribution of stakeholder responsibilities and interaction forms. However, our empirical studies have indicated that this assumption underestimates the complexity of collaboration in the real world, which is multi-dimensional, contested, and context-specific. Effective stakeholder collaboration requires an appropriate distribution of power among stakeholders, collaboration across project and lifecycle boundaries, the integration of diverse stakeholder knowledge and participation at different levels, and appropriate allocation of risks and benefits.

3 Our literature review study demonstrated the need for digital tools to facilitate circular procurement development and implementation. In practice, we have found that digital tools will not have a real effect unless data quality, data interpretation, data-driven decision-making, and clear distribution of responsibility for developing and maintaining data and digital technologies can be guaranteed first.

4 The literature review study primarily addresses governance and regulation as enablers for the circular procurement transition. In practice, the lack of pertinent regulations and policies to support and guide the implementation of circular procurement in the non-public and semi-public sectors creates more hurdles than positive support.

5 The literature review study assumes that risk and profit allocation can be designed rationally and reasonably. However, this is not merely an economic question in practice; it is much more contentious and profoundly influenced by stakeholders' incentives and behaviors.

6 The literature review study rarely mentions the social value of circular procurement. Our empirical studies touched on this by examining residents' participation in circular procurement and how societal benefits are generated, thereby contributing to current circular procurement theory. Further research is needed to assess the social value of implementing circular procurement.

In general, the identified divergences reveal a broader discrepancy between the systematic conceptualization of circular procurement in the literature and the complexities of its implementation in practice. Our literature review on circular procurement tends to propose an idealized, systematic mechanism for circular procurement development, while circular procurement in social housing practices is more experimental, context-dependent, and shaped by a complex organizational and institutional environment. Rather than simply understanding circular procurement as a functional system in which predefined approaches can be implemented directly, it is crucial to recognize the behavioral, organizational, and institutional realities in which procurement decisions are made. Furthermore, the coordination of supply chain stakeholders, policymakers, residents, and knowledge institutions is also crucial for circular procurement practice. There is a need to complement literature-derived conceptualizations of circular procurement with a more integrated understanding of the practical conditions under which circular procurement is implemented.

5.3 Propositions on circular procurement development and its validation

5.3.1 Original propositions and validation

According to the comparison results of one literature review and two empirical studies in section 5.2, we derived eight propositions to guide housing associations and their partners in implementing circular procurement in Dutch social housing. The eight propositions were generated with the consideration that they: 1) address the most critical arguments from the comparison between literature study and empirical study; 2) address arguments that are identified as critical but lack of implementation in real practice; 3) include different stakeholders; 4) collectively cover the five stages (planning, pre-sections, tendering, contracting, and design and construction stages) as mentioned before. The generation of the propositions was also interpretive rather than the outcome of a formalized analytical procedure. We considered the key literature-and-practice gaps and the empirical findings alongside the author's accumulated understanding of circular procurement developed through the preceding studies. The propositions are primarily formulated from the perspective of housing associations as the commissioning organizations that initiate and manage the procurement process. Their implementation, however, surely requires participation of other supply chain partners. Therefore, we validated the potential implementation and applicability of the propositions with housing associations and contractors, the core stakeholders who participate in the procurement process for social housing, through focus group and interview sessions. One focus group with one housing association and one contractor, and two interviews with one housing association and one contractor, were prospectively organized (as shown in Table 5.1). Two practitioners with different roles from Housing Association 1 joined the validation session together and made decisions and arguments jointly. Therefore, we also consider their response jointly as H1.

TABLE 5.1 Validation design and participants

Validation session	Participant	Informant Role
Focus group	Housing Association 1 (H1)	Sustainability advisor; Procurement manager
	Contractor 1 (C1)	Program manager
Interview	Housing Association 2 (H2)	Director
Interview	Contractor 2 (C2)	Program manager

The validation process followed a pre-designed structure. Eight propositions were sent to participants beforehand for them to get familiar with the content. During the validation sessions, an introduction of the background of this study, the key findings from this study, and the objective of the validation session were presented to participants. After the presentation, eight propositions were presented to participants one by one and participants were asked to answer four questions regarding each proposition:

1. Do you find it desirable to apply this proposition?
2. How easy is it to apply this proposition?
3. How would you overcome the challenges to apply it?
4. What do you need to do to apply it?

Participants were asked to indicate the degree of the first two questions on the bandwidth first, as shown in Figure 5.1. Then they addressed the rationale for their choices regarding the first two questions, as well as the last two, in discussion. The positions along the bandwidth should be interpreted as indicative rather than as precise quantitative measurements of the strength of participants' responses or the distances between them. It provided a straightforward means of displaying the overall distribution and tendencies of participants' responses and supporting subsequent discussion. For example, it helped illustrate whether participants generally tended towards agreement or disagreement, whether particular tendencies appeared among stakeholder groups, and whether substantial differences in views existed among participants.

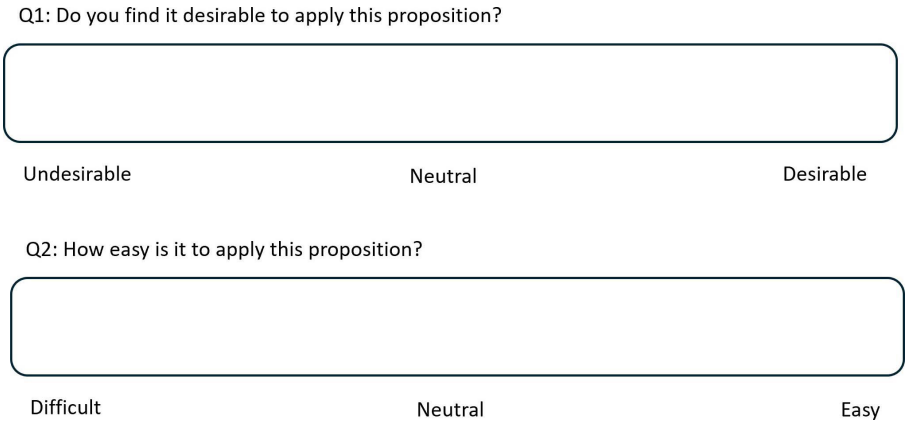

FIG. 5.1 Bandwidth to indicate the answers to the first two questions

Proposition 1: Portfolio-based procurement design

Renovation and new construction departments jointly develop a circular procurement transformation plan at the portfolio level and procure for multiple projects simultaneously. Coordinate material, value, and information flows across projects.

Most participants find it desirable to apply portfolio-based procurement in circular transition (see Figure 5.2), mostly because they believe it will reduce costs and increase efficiency in the circular economy transition. However, they also acknowledge the potential challenges to realizing portfolio-based procurement in practice. The predominant challenge for housing associations is coordinating multiple partners and more complex material flows at the portfolio level, impeded by insufficient competence and knowledge on the use of existing materials and their associated supply chains and logistics. Material inventory is crucial when the new construction and renovation departments in a housing association want to develop procurement plans together regarding the availability and use of existing materials. Besides, maintaining flexibility in portfolio-based and long-term procurement planning is also essential to ensure the plan remains up to date with the latest market innovations and material availability. Moreover, housing associations consider it crucial to work with other housing associations and to build a centralized materials inventory depot in a larger market. The circularity market would be stimulated if housing associations adopted uniform procurement methods and presented the same demands to the market.

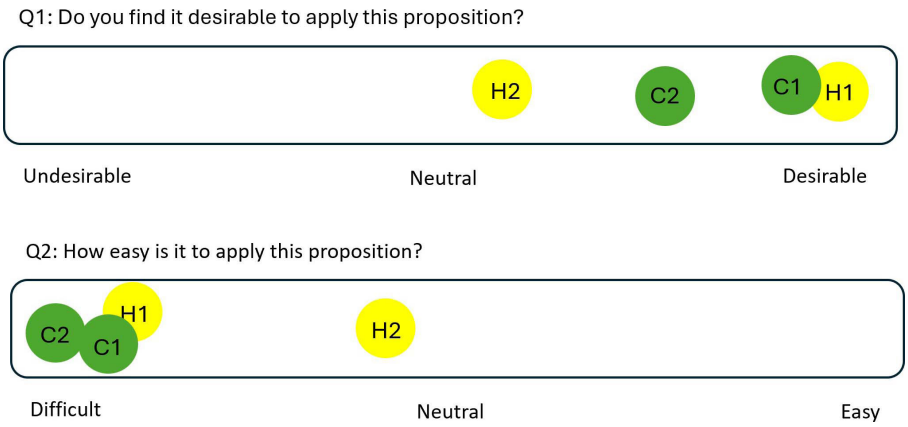

FIG. 5.2 Answers to the first two questions on Proposition 1

Proposition 2: Market dialogue and co-design procurement strategies at the initial phase

Invite stakeholders from the market with different roles to design procurement objectives and strategies together. Develop a procurement plan that aligns with market demand and readiness, as well as the requirements of different stakeholders.

Most participants believe it is desirable and easy to have market dialogue at the initial stage of circular projects if housing associations take the lead (see Figure 5.3). Sharing knowledge on circular transition and information on the budget situation will facilitate stakeholder collaboration in subsequent stages. Contractor stated that it is essential to invite stakeholders with strategic decision-making authority and expertise in procurement design to this market dialogue. However, some participants are concerned that market dialogue alone can't guarantee innovation, as other obstacles, such as pricing constraints and insufficient governance over the circular economy, may continue to impede the transformation.

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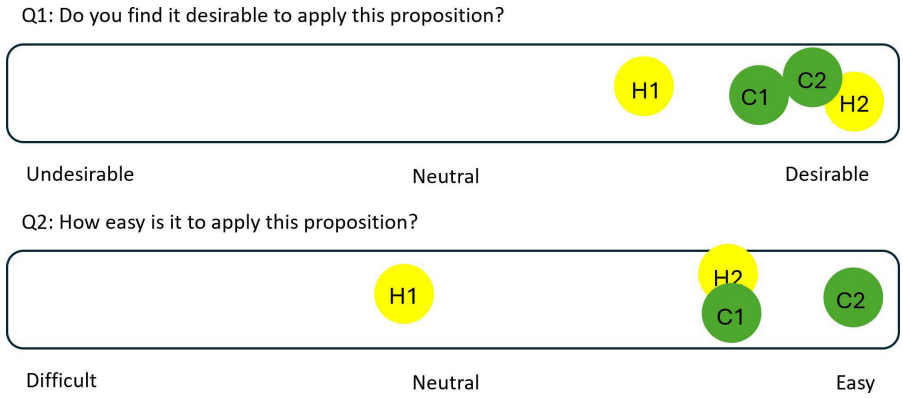

FIG. 5.3 Answers to the first two questions on Proposition 2

Proposition 3: Pre-selection as consortia for long-term collaboration

Encourage stakeholders to team up as consortia and join the pre-selection stage, and pre-select a small number of consortia as potential long-term collaboration partners at this phase, based on their expertise and experience as consortia.

Participants' perspectives on joining pre-selection as a consortium are somewhat contradictory (see Figure 5.4). Contractor 1 and Housing Association 2, who remain neutral about this proposition, express concerns that coordination within the consortium may be too time-consuming and question the feasibility of maintaining efficient collaboration, especially when the ambition is high in the circular tender. Although they believe that engaging with a consortium may not be the optimal decision for a robust commitment to circular economy transformation, it represents a more accessible initial approach. Participants also confirmed that joining tenders as consortia is already happening in certain social housing projects, which could contribute to a circular transition. It is essential to allocate sufficient time for new consortia to form and establish long-term relationships as a consortium.

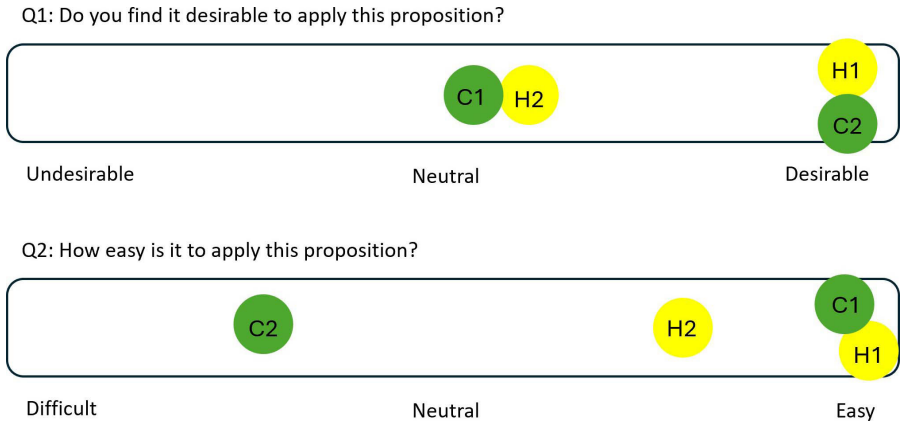

FIG. 5.4 Answers to the first two questions on Proposition 3

Proposition 4: Tendering with ambition plans and evaluated by a circular scoring system

Invite pre-selected consortia to submit an ambition plan that meets both performance-based and technical requirements and evaluate the consortia and their stakeholders using a circular scoring system that fairly distributes weight across these aspects.

Proposition 4 has already been applied in some circular social housing projects, and most participants find it desirable to apply and stimulate the circular transition (see Figure 5.5). The primary requirement is to establish uniform evaluation standards and an effective measurement mechanism for circularity and stakeholder performance, both of which remain significant challenges.

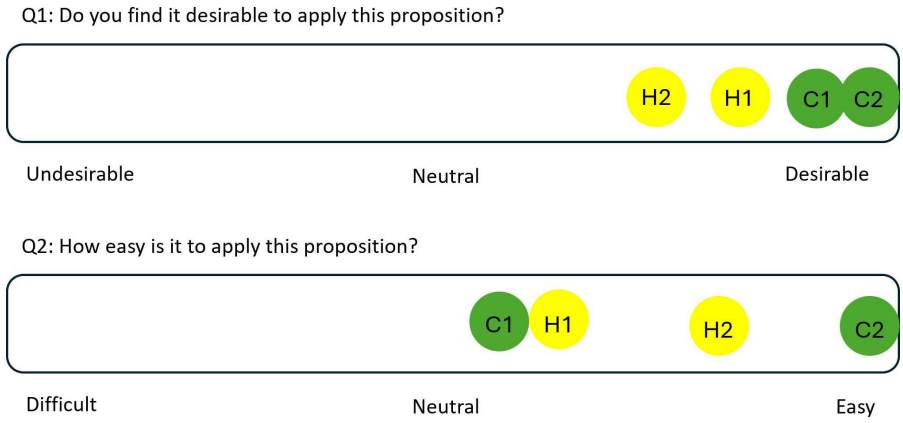

FIG. 5.5 Answers to the first two questions on Proposition 4

Proposition 5: Integrate maintenance and renovation with the new construction contract

Plan for the renovation and maintenance of new construction before project execution and integrate these into the contract. The contract should specify the responsibilities of current stakeholders for future renovation and maintenance after project delivery, provide instructions on how the construction should be renovated and maintained, and specify how to include new parties for renovation and maintenance when necessary.

Although participants find integrating renovation and maintenance with new construction desirable (see Figure 5.6), they also acknowledge the significant difficulty of implementing it in practice. In the Dutch social housing sector, renovation, maintenance, and new construction are separate operations carried out by different parties at different stages. Renovation refers to large-scale enhancements to existing housing stock aimed at improving it. Maintenance consists of minor tasks performed to prevent the deterioration of the building. Housing associations are challenged by facilitating communication between their renovation and new construction departments. Contractors and housing associations are also engaged in a critical debate regarding this proposition. Primarily, most contractors in the Netherlands specialize in either renovation or new construction, with few possessing skills in both domains. This implies that for new construction, renovation, and maintenance to be incorporated into circular projects, various contractors must collaborate from the beginning to facilitate circular design and plan for future renovations and maintenance collaboratively. Material use, responsibility distribution, renovation and maintenance plans, for instance, must be planned before project execution.

Meanwhile, housing associations want to make long-term plans and maintain long-term relationships with a group of contractors responsible for different project phases, rather than relying on a single contractor for all aspects, in order to mitigate risk. However, large contractors argued that being able to claim for both renovation and long-term maintenance would enable them to apply Total Cost of Ownership and assume responsibility for the whole lifecycle of buildings. They believe this will facilitate the transition to a circular economy, as they possess the expertise to maintain buildings in a circular manner, while balancing renovation and maintenance costs. Given the dependency concerns and potential risks that housing associations face when establishing a long-term relationship with a single contractor, the contractors in this case are willing to assume greater risk and financial accountability. Nonetheless, this remains a contentious issue for housing associations regarding whether to engage multiple contractors, each specializing in different stages of construction and encouraging their collaboration from the project's inception, or to forge a long-term relationship with a single contractor to maintain a consistent circular strategy from new construction to maintenance.

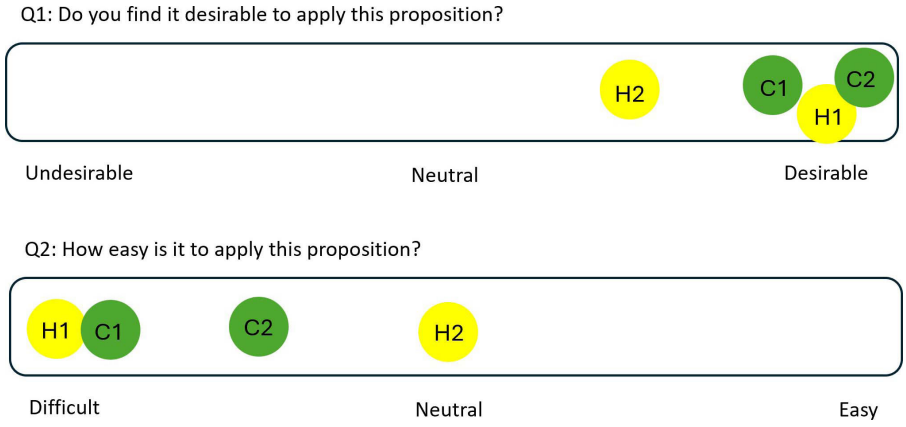

FIG. 5.6 Answers to the first two questions on Proposition 5

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Proposition 6: Implement a monitoring system and flexible contracts

Set up eligibility check criteria at specific intervals and monitor whether the circular implementation aligns with the circular objective throughout the process. Leave flexibility in the contract to allow adjustments to both implementations and objectives when misalignments occur.

The monitoring system and flexible contract have already been applied in most cases in social housing projects, and are desirable and easy to apply according to all participants (see Figure 5.7). The key aspect is to agree at the contract management stage on the types of changes that can be made when future misalignments between objectives and implementation occur. Contractors also believe that when such misalignment occurs, adjustments should be made by both the housing association and the contractor.

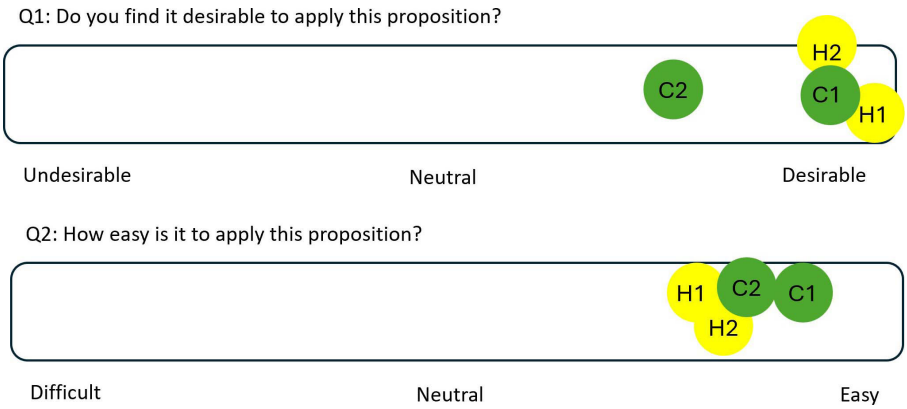

FIG. 5.7 Answers to the first two questions on Proposition 6

Proposition 7: Co-invest in circular transition with supply chain partners and share benefits and risks

Develop a co-investing and benefit- and risk-sharing system to invite supply chain partners to co-invest in circular economy transition (such as circular design, digital technology development, innovation, and collaboration) with housing associations, and to share revenue and risks with them.

Participants hold contentious opinions on co-investment in the circular economy among supply chain partners, while they all recognize the difficulty of realizing this proposition (see Figure 5.8). Housing association 1 and contractor 1 contend that, as semi-public and non-profit entities, housing associations are prohibited from co-investing with other partners. However, housing association 2 believes it depends on the specific part to be co-invested in and expresses a willingness to explore new economic opportunities, as long as they comply with legal restrictions. Contractor 2 confirmed that co-investment already exists in current projects, where supply chain partners collaboratively invest in circular innovation. This investment includes not just capital but also time and knowledge. They also believe the revenue from this co-investment encompass several forms beyond monetary gain, including recognition and long-term commitments.

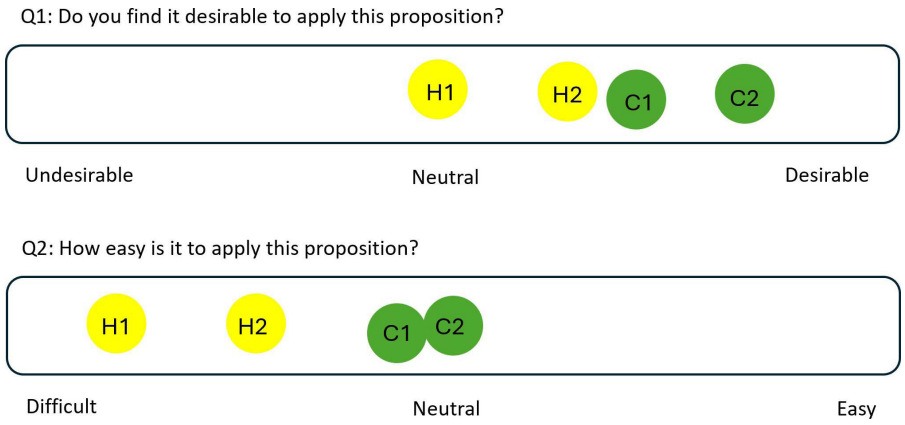

FIG. 5.8 Answers to the first two questions on Proposition 7

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Proposition 8: Residents' participation

Include residents at the planning stage of circular projects and ask for their opinions. Keep them informed about circular economy implementation decisions regarding their housing throughout the process.

The participants' perspectives on residents' participation are quite contradictory (see Figure 5.9). Those who are less supportive of involving citizens in the planning phase and keeping them informed do so because they believe that most residents lack interest in the circular economy. However, Housing Association 2 changed its mind on the desirability of this proposition during the validation process as it recognized the importance of influencing residents' mindset and enhancing their awareness on circular economy. The essential factor is to keep open communication with residents and be selective about when to involve them. Currently, the significant challenge in implementing this proposition is changing the mindset of housing associations and their partners and convincing them of the necessity of involving residents in the story. Once their perspectives are broadened, facilitating residents' involvement in circular initiatives will be straightforward, as they possess prior experience in similar non-circular projects.

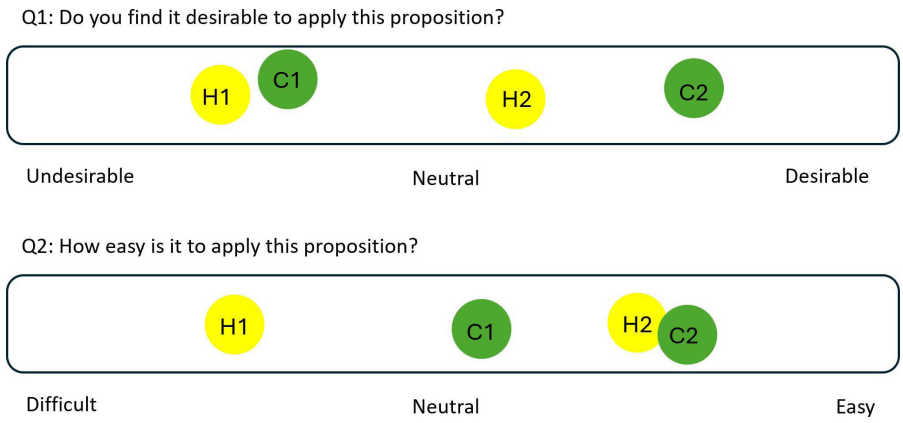

FIG. 5.9 Answers to the first two questions on Proposition 8

5.3.2 Final propositions

Subsequent to the validation sessions with practitioners regarding the eight propositions. We improved the proposals based on participant comments. Proposition 6 has been excluded from the final version because it has already been implemented in the social housing sector, and its contribution to the transition towards a circular economy is not deemed significant. Ultimately, we delineated seven propositions as follows:

Proposition 1: Portfolio-based procurement design

Renovation and new construction departments jointly develop a circular procurement transformation plan at the portfolio level and procure for multiple projects simultaneously. Coordinate material, value, and information flows across projects, and potentially with material inventories from other housing associations.

Proposition 2: Market dialogue and co-design procurement strategies at the initial phase

Invite stakeholders from the market with different roles to share knowledge, financial situation, and other information on the circular economy and **to design procurement objectives and strategies together. Develop a procurement plan that aligns with market demand and readiness, as well as the requirements of different stakeholders.**

Proposition 3: Pre-selection as consortia for long-term collaboration

Encourage stakeholders to team up as consortia and join the pre-selection stage, and pre-select a small number of consortia as potential long-term collaboration partners at this phase, based on their expertise and experience as consortia. Allow enough time for stakeholders to establish an efficient collaboration framework within the consortium and to encourage long-term collaboration.

Proposition 4: Tendering with ambition plans and evaluated by a circular scoring system

Invite pre-selected consortia to submit an ambition plan that meets both performance-based and technical requirements and evaluate the consortia and their stakeholders using a standardised **circular scoring system that fairly distributes weight across these aspects.**

Proposition 5: Integrate maintenance and renovation with the new construction contract

Stakeholders responsible for new construction, renovation, and maintenance of circular projects collaborate from the outset. **Plan for the renovation and maintenance of new construction** from a whole-lifecycle perspective **before project execution and integrate these into the contract. The contract should specify the responsibilities of current stakeholders for future renovation and maintenance after project delivery, provide instructions on how the construction should be renovated and maintained in a circular manner, and specify how to include new parties for renovation and maintenance when necessary.**

Proposition 6: Co-invest in circular transition with supply chain partners and share benefits and risks

Develop a co-investing and benefit- and risk-sharing system to invite supply chain partners to co-invest in circular economy transition (such as circular design, digital technology development, innovation, and collaboration) with housing associations, and to share revenue and risks with them. Forms of investment and revenue can extend beyond money, including knowledge, time, and recognition.

Proposition 7: Residents' participation

Include residents at the planning stage of circular projects and ask for their opinions. Keep them informed about circular economy implementation decisions regarding their housing throughout the process and increase their awareness of the circular economy.

As previously stated, circular construction procurement was analytically divided into five stages: planning, pre-selection, tendering, contracting, and design and construction. Subsequently, we sought to distribute the original eight propositions across these five stages and engaged in discussions with practitioners during the validation sessions. The discussions showed that the propositions cannot be exclusively assigned to individual stages. Although particular activities associated with a proposition may be more prominent at certain stages, their preparation, implementation, and effects often extend across multiple stages. In particular, many propositions need to be initiated or anticipated during the planning stage to enable their implementation later in the procurement process. For instance, to apply Proposition 5, 'Integrate maintenance and renovation with new construction contract', renovation, maintenance, and new construction contractors must

collaborate and strategize from the planning phase rather than coming together only when contracts are developed. Stakeholders involved in this proposition, such as contractors for different construction activities, also need to be managed and cooperated with from the beginning. Meanwhile, propositions implemented early in the process may continue to influence subsequent stages. For example, Proposition 1 'Portfolio-based procurement design' is initiated at the beginning stage but shapes procurement decisions and activities throughout the subsequent process.

The five stages should therefore be understood as an analytical structure for describing circular procurement rather than as a rigid sequential process, with activities assigned exclusively to individual stages. Propositions proposed here constitute interconnected approaches whose preparation, implementation, and effects may span several stages. Their effective implementation requires alignment and coordination across the procurement process rather than the isolated application of individual propositions at particular stages.

This also recalibrates the results from the literature review study in Chapter 2, in which our initial assumption was that the circular procurement process can be conceptualized into an ideal framework and represented by different stages. The six stages identified in Chapter 2 are displayed in a linear sequence, with activities associated with a particular stage. The synthesis of the literature review and empirical studies, however, shows that the circular procurement process should be understood as an iterative and interconnected process. Activities may recur, overlap, or extend across stages, and decisions and interactions in one stage may influence or require reconsideration of activities in another. Stakeholder management should also be coordinated across different stages. The stages therefore remain useful for analytically structuring the procurement process, but they should not be interpreted as fixed boundaries that determine when particular circular procurement activities or stakeholder interactions occur.

5.4 Conclusion

This chapter compares literature review and empirical studies on circular procurement from previous chapters and proposes actionable, ready-to-use propositions for housing associations and their partners to implement circular procurement. This comparison reveals the complexity of circular procurement, which is shaped by governance, societal culture, people's recognition and behaviors, organizational structures, management mechanisms, etc. It demonstrates the necessity of synthesizing the literature review and empirical studies, highlighting a reciprocal relationship in which they mutually contribute to, complement, and critique one another. Propositions derived were validated with practitioners from the social housing sector on their potential implementation and applicability. The validation process also indicates the nuance of each proposition under varying circumstances and preconditions. There is never one solution that fits all answers. However, by proposing seven propositions at the end, we provide concrete recommendations for circular procurement implementation in Dutch social housing, enabling practitioners to align circular economy principles with real-world practices. Beginners can use these propositions as starting points on the circular economy transition, while experienced organizations can use them to reflect on and improve their current practices. Future studies should verify these propositions through longitudinal validations and conduct cross-sectoral comparisons of circular procurement implementation. Pertinent policies and regulations are required to facilitate and support the implementation of these propositions.

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6 Conclusion

This thesis concludes in this chapter by summarizing the research findings and implications from the previous chapters, reflecting on the entire research process, and indicating the societal, policy, and practical relevance of this PhD project.

6.1 Answers to research questions

— **Q1: What recommendations do existing studies give about circular procurement in the built environment to conceptualize a circular construction procurement process, and what directions for its further theoretical and empirical development emerge from this conceptualization?**

Studies suggest that it is important to define circular ambitions and engage supply chain stakeholders at the early stage of procurement to ensure a smooth implementation of the circular economy later in the design and execution phases. It is important for clients to ask for performance-based and functional requirements in tendering rather than solely technical requirements, and to adopt collaborative and integrated contracting methods that incorporate early stakeholder involvement, risk and revenue sharing, and lifecycle perspectives. Integrating lifecycle perspectives for building projects, products, and materials is crucial throughout the procurement process. Techniques such as take-back services, total cost of ownership, and product-as-a-service can be used to integrate lifecycle perspectives. Digital tools and platforms will also significantly facilitate the implementation of circular procurement by synthesizing information, workflows, and actors throughout the process and keeping information up to date. Overall, public authorities should set guidelines, standardize circular criteria, and provide financial incentives for circular transition.

Several future research opportunities to further empirically and theoretically develop circular procurement in the built environment have been identified as well from three perspectives: actors, resources, and activities. Through an actor lens, an ecosystem of actors is important for facilitating collaboration and for incorporating circular-driven actors, such as government bodies, researchers, and public institutions, into the same environment as practitioners for circular transition. However, there is

a lack of studies on the interactions and interdependencies among stakeholders in the ecosystem. Future research is required to support the establishment of the ecosystem and create shared values and objectives among stakeholders. Through a resource lens, the construction industry faces greater challenges in integrating a lifecycle perspective into supply chain management due to its fragmented nature. Besides, the development of innovative and adaptable procurement approaches and pertinent digital technologies requires more attention in circular procurement. Future studies are recommended to conduct case studies with a longitudinal lens throughout the entire process of circular procurement to validate lifecycle impacts, investigate organizations' innovation capabilities, adaptabilities, and incentives for an innovative transition, and explore the practical potential and barriers to the implementation of digital technologies. Through the activity lens, the decision-making process of multi-stakeholders in circular procurement remains unclear, which lacks a deep understanding of stakeholders' behaviors and perceptions, and external support, such as policies and regulations. Future studies should focus on identifying decision-making points in circular procurement from multi-actor perspectives. In the end, it is also suggested to develop an integrated supply chain that synthesizes actors, resources, and activities across different stages, projects, and sectors.

— **Q2: What are the current practices, associated challenges, and possibilities for development to integrate circular economy principles into the procurement process of social housing?**

The second research question has been addressed from the perspectives of technological, organisational, and environmental contexts. Dutch social housing organizations are gradually experimenting with circular procurement, but their practices remain diverse and fragmented. Circular economy principles are primarily integrated through pilot projects, which can provide some good practice benchmarks for future research and practice. From a technological perspective, modular and prefabricated building methods are increasingly prevalent to be adopted to streamline the construction process and improve material detachability and reuse potential. Selection criteria in circular projects emphasise material detachability, reusability, CO_2 reduction, and supply chain collaboration capability, for instance. From an organizational perspective, innovative contracting and tendering methods are applied in pilot projects, including performance-based agreements, Best Value Procurement, consortia-based collaboration, for instance. Negotiation with familiar contractors as a tendering approach is sometimes adopted by some housing associations, especially in renovation projects, to reduce risks and increase mutual trust. Although costs still play a role, many circular pilots deliberately downplay price as a dominant criterion and focus instead on learning from experiments, building partnerships and trusts, and testing new approaches and techniques.

From the environmental perspective, societal value is created by including residents in the process. Regulatory incentives and supports for circular economy investment exist but are limited. Collaborations beyond the construction supply chain is possible to include stakeholders from other industries and close the material loop.

Challenges and bottlenecks are associated when integrating circular economy principles. Technological barriers arise from reverse logistics issues, data ambiguity, and fragmented digital tools and ownership. Internally, social housing organisations often face organisational challenges, including siloed departments of different functions, limited circular economy knowledge and experience, and a lack of options for circular procurement approaches. Externally, supply chain stakeholders are struggling with the ambiguous responsibility allocation in circular innovations and digital technology development and maintenance, the inefficiency of collaboration, and a risk-avoidant tendency for most stakeholders currently. Finally, the lack of adequate regulatory support from the environmental and policy context, the contractual uncertainty in circular projects, and the lack of market readiness impede the circular procurement transition.

Future development of circular procurement in social housing requires the development of integrated information systems that align material flow, information flow, and stakeholder interactions in the supply chain and reduce uncertainties. Tailored circular procurement frameworks should be created for varying circular transition levels, organisational structures, and capacities across housing associations. Multi-stakeholder collaboration models are required to define roles, responsibilities, and benefit-and-risk-sharing mechanisms within circular projects. Moreover, regulatory and governance supports and financial incentives (e.g., tax reductions) are required to accelerate the market readiness for circular construction and regulate circular procurement procedures.

— Q3: **What are the perspectives of different stakeholders on circular procurement in social housing renovation, and where do their perspectives align, and where do they differ? What recommendations can be made to facilitate circular transformation of construction procurement by understanding multi-stakeholder perspectives?**

Stakeholders have different priorities and focus on circular procurement in Dutch social housing renovation. Their perspectives are more likely influenced by their priorities in circular procurement and not necessarily by their roles in the supply chain. Therefore, different stakeholders can share the same perspectives, while stakeholders with the same role may have distinct beliefs on circular procurement.

First, stakeholders show varying orientations toward the rigidity of contracting and tendering requirements and procedures in circular procurement. Those who align with a structured viewpoint in circular procurement tend to prefer clear and transparent evaluation rules and circular criteria. Those who value flexibility argue for negotiated procedures and room to propose innovative circular solutions without strict restrictions. These different perspectives reflect a tension between the desire for legally secure, standardized procurement procedures and the need for adaptable processes that accommodate inherent uncertainties in circular transition. Second, regarding stakeholder interactions, almost all stakeholders acknowledge the importance of early stakeholder collaboration in circular procurement, but their understanding on the collaboration forms and approaches to realize collaborations differs. Some stakeholders prioritize leadership from the client's side, while others argue for the equivalent contribution and mutual commitment from both sides, with non-hierarchical collaboration driven by responsibilities and roles of different parties.

Third, concerning value creation and distribution, some stakeholders believe that circular transition will be stimulated if benefits are shared among supply chain partners. While others believe it should accrue primarily to the asset owner and the current business model is not designed to support benefit sharing with third parties. These diverging perspectives highlight the absence of established financial models and risk-reward mechanisms to support circular procurement. Fourth, in terms of material use, most of the stakeholders are aligned with the idea that they would like to pay more for circular materials compared to non-circular ones, which shows their relatively high commitment level to realizing a circular transition. Fifth, regarding circular goals and challenges, there is a divergence between recognition on the importance and difficulties of circular renovation compared to new construction. Some think circular renovation is more urgent and difficult, while others retain an equal mindset over these two types of projects.

Future development of circular procurement is suggested to develop hybrid procurement strategies that balance performance-based requirements and rigorous evaluation criteria; replace large-scale open bids with pre-selection approaches that include small and medium enterprises; develop stakeholder collaboration frameworks across multiple projects and lifecyles, and considering power and leadership distribution and different engagement levels for different stakeholders; and improve institutional and contractual mechanisms for distributing risks and benefits.

— Q4: **What are the points of divergence between the literature review and the empirical studies of circular procurement in Dutch social housing? What insights on circular procurement development can be generated by synthesizing and comparing the findings from both the literature review and empirical studies?**

The practices of circular procurement in Dutch social housing currently remain scattered and experimental without standardized and structured approaches being embedded in organizational routines. Compared to what theories have indicated in literature studies, the practices are lagging behind in some respects. Nonetheless, the practices also add more nuanced dynamics to the literature review study and rehabilitate its assumptions with real-world complexities. In general, integration of lifecycle perspectives, residual value monetization, the use of digital technologies, stakeholder collaboration, and systematic guidance and integration of renovation, maintenance, and new builds are predominantly lagging behind in practice. Meanwhile, the literature review study has simplified circular procurement to a linear and structured process, while the real-world practice is iterative and dynamic. It also underestimates the complexity of stakeholder collaboration and risks and benefits sharing, overlooks the organizational issues in the digitalization process and the hurdles generated by a lack of regulatory support, and ignores the societal value of circular procurement.

By synthesizing and comparing theoretical and practical studies on circular procurement, seven actionable and concrete propositions have been proposed to support housing associations and their supply chain partners in circular procurement transition: 1. Integrate portfolio-based procurement design; 2. Set up market dialogue with different parties and co-design procurement strategies at the initial stage; 3. Pre-select consortia for long-term collaboration before real tendering; 4. Tender with ambition plans and evaluate tenders with a circular scoring system; 5. Integrate renovation and maintenance with new construction contracts; 6. Co-invest in circular transition with supply chain partners and share benefits and risks; 7. Include residents in the story. These propositions should be implemented as an continuous approach that spans the whole procurement process in an iterative way.

After summarizing our findings for the four research questions, we can turn to the main research question now:

— **How can procurement be transformed to facilitate circular transition in the built environment?**

Transforming procurement to facilitate circular transition in the built environment requires a shift from a linear, project-based, and price-driven purchasing procedure to a strategic, lifecycle-focused, and integrated management approach (Chapter 5). This integrated approach should align environmental goals, economic incentives, organizational capabilities, and societal expectations by coordinating stakeholders, resources, activities, decisions, information, and values across the construction lifecycle (Chapters 3, 4, and 5). Circular procurement should not be understood as the addition of circular criteria to conventional tendering, but as a broader transformation of how value is defined, how stakeholders collaborate, how responsibilities are distributed, and how decisions are made across the whole building lifecycle (Chapter 2, 3,4, and 5). The findings of this thesis show that procurement becomes circular only when it is able to connect material flows, information flows, value creation, and stakeholder interactions across planning, tendering, contracting, design, construction, maintenance, and end-of-life to integrate 9R strategies in the construction process and slow, narrow, and close the material loop (Chapters 2, 3, 4, and 5).

In general, procurement is a complex process that is strongly sector- and context-based. There is no one universal answer and procurement framework that fits all the construction sectors in all different regions around the world. This means that circular procurement frameworks and mechanisms need to be customized in different sectors, organizations, and regions according to the local policies, regulations, institutional environment, and organizational competencies (Chapter 3). Its transformation should consequently be understood as a multi-dimensional process, including organizational, institutional, technological, behavioral, regulatory, and economic transformation (Chapters 3 and 4). Taking Dutch social housing as an example, it is essential for housing associations to balance their sustainable objectives with affordability responsibilities, tenant requirements, and regulatory compliance, which implies the deep embodiment of their circular procurement in a broader institutional and societal context (Chapters 3 and 4). At the organizational level, housing associations need to overcome internal fragmentation between different functions and between new construction, renovation, and maintenance, and integrate them under a lifecycle perspective (Chapter 3). At the inter-organizational level, procurement must evolve from competitive, short-term contracting toward longer-term collaboration with supply chain partners (Chapters 3 and 4). At the economic level, new economic models are required in circular procurement to recognize long-term benefits and lifecycle value, enable shared investments in innovation, and distribute risks and benefits reasonably among supply chain stakeholders (Chapters 3, 4, and 5). At the institutional levels, regulatory and institutional support becomes particularly important where challenges are not able to be addressed by individual organizations or supply chains alone (Chapters 3, 4, and 5).

Although housing associations act as commissioning authorities that initiate circular procurement in social housing projects, implementation depends on the joint efforts of multiple supply chain stakeholders (Chapter 4). Stakeholder collaboration and shared values do not, however, imply that stakeholders necessarily share the same priorities. The findings show that stakeholders have different priorities in circular procurement implementation, which is not necessarily related to their roles but will influence their focuses, values, and requirements in circular procurement (Chapter 4). Circular procurement transformation therefore requires both the development of shared values and mechanisms for accommodating different stakeholder priorities and managing power dynamics (Chapter 4).

Overall, the findings of this thesis suggest that transforming procurement to facilitate circular transition requires coordinated change at both system and operational levels (Chapter 5). At the system level, lifecycle thinking, portfolio management, stakeholder interactions, economic incentives, digital information systems, and institutional support need to be aligned with an integrated approach. At the operational level, implementation must account for practice complexities related to operational management, stakeholder behavior, material availability and reuse, logistics planning, and supply chain dynamics. The challenge is therefore to connect high-level system transformation with the realities of implementation. Further empirical research is required to understand the complexities of the practice across different contexts and to integrate these complexities with the high-level, integrated system of circular procurement mentioned above.

6.2 Contributions and policy recommendations

6.2.1 Theoretical contributions

This thesis investigated the necessary transformation of procurement to facilitate the circular economy transition. Within this context, circular procurement is conceptualized as the procurement approach that integrates circular economy principles into procurement decisions, strategic planning, supply chain management, and stakeholder interactions. In this sense, circular procurement is understood as the outcome of procurement transformation. The research scope, therefore, took a broad perspective on circular procurement, including supply chain management and wider value chain integration.

A core theoretical contribution of this thesis lies in its reconceptualization of circular procurement as a system-level transformation encompassing procurement processes, organizational structures, and supply chain relationships, rather than merely a procurement technique or a collection of circular purchasing criteria. Circular procurement literature frequently frames circular procurement primarily as an extension of sustainable or green procurement (Alhola et al. 2018). Recent research demonstrates that even with strong circular ambitions and technical solutions, adhering to conventional procurement routines may not merely fail to facilitate circular transition but may actively reproduce linear practices by translating circular ambitions through established cost, risk, certification, evaluation, and compliance logics (Van Der Valk & Habes, 2026). In recent years, an increasing number of scholars have recognized circular procurement as a strategic or market instrument to drive a sustainable future from environmental, economic, and societal dimensions (e.g., Neessen et al., 2021; UNEP, 2021). Circular procurement in the built environment has also been understood beyond adding circular economy to traditional tendering and purchasing activities, but as a profound transformation involving lifecycle thinking, integrated supply chains, and long-term stakeholder collaboration (Bernd, 2024). Building on insights from circular economy theory, supply chain management, and procurement studies, and further developing these insights through empirical investigation, this thesis advances the conceptualization of circular procurement as an integrated management approach. This approach translates circular economy ambitions into practice by aligning environmental objectives, economic incentives, institutional conditions, organizational capabilities, and societal responsibilities, while coordinating decision-making, supply chain activities, stakeholder interactions, and value creation across the building lifecycle.

This thesis further contributes to circular procurement theory by providing empirical insights into organizational, technological, institutional, regulatory, and societal dimensions that have been recognized as important to circular procurement but remain insufficiently investigated empirically (Ababio et al., 2023; Xu et al., 2022). Importantly, this thesis examines these dimensions not only at the system level but also in relation to operational implementation, including context-specific procurement approaches, material flows, reverse logistics, stakeholder behaviors, and decision-making practices. The connection between system-level change and operational routines is important because enabling conditions and institutional pressure at the system level do not translate into procurement practice automatically (Van Der Valk & Habes, 2026). Building on this understanding, the thesis argues that the transformation of circular procurement depends on aligning system-level changes with operational practices. This extends the conceptualization of circular procurement as an integrated management approach by showing that high-level circular ambitions and enabling conditions need to be translated into, and continuously aligned with, the realities of procurement implementation. Meanwhile, the complexities and experiences of circular procurement implementation should also inform and refine system-level strategies.

Moreover, this thesis also refines the analytical framework of the circular construction procurement process from a sequential process with structured stages proposed in Chapter 2 to a more iterative and context-dependent process as discussed in Chapter 5. The process in reality is shaped by organizational conditions, stakeholder incentives and interactions, and institutional constraints. This means that for most procurement activities, rather than being distributed to a specific stage, their realization should be understood as an iterative process that may be initiated at an early stage, then executed in one or several stages, and whose impact will continue to be delivered even after the actual execution.

This thesis contributes to supply chain management theories and literature by applying the supply network perspective to the investigation of circular construction procurement in both theoretical and empirical studies. The investigation of supply chain management in circular procurement has been identified as crucial in previous studies (e.g., Ababio et al., 2023; Sajid et al., 2024). This thesis argues that successful integration of the circular economy requires integrated coordination throughout the construction supply chain, rather than relying solely on the initiatives of individual organizations. By analysing circular procurement through a supply network lens, the research highlights the importance of aligning actors, activities, resources, values, and cross-organizational collaboration in circular procurement. Moreover, it also touched upon the interrelationship between procurement approaches and supply chain dynamics in the circular economy transition, which has been argued to be crucial to facilitate the circular economy transition (Stokke et al., 2023).

This thesis contributes to the built environment literature by adding circular economy to construction procurement and highlighting the role of housing owners as demand-side actors to stimulate the circular economy transition through procurement management, which lacks attention in existing literature in the built environment (Çetin et al., 2022; Rejeb and Appolloni, 2022; Qazi and Appolloni, 2022). Through a systematic literature review, this thesis helps to consolidate fragmented insights from existing literature and provides a structured basis for understanding the operation of circular procurement in the built environment. Through empirical studies on Dutch social housing, this thesis provides important empirical evidence on circular construction procurement from multi-stakeholder perspectives. Procurement has a strong context-specific nature (Ababio et al., 2025). Procurement in the construction industry, as a project-based industry, has significant differences compared to other product-based industries, which makes it difficult to directly transfer experience and theories from procurement in other industries to construction procurement (Behera et al., 2015; Dubois & Gadde, 2002). Although this thesis uses circular procurement theories in general as the theoretical foundation and draws on them with both theoretical and empirical findings, the boundary setting and knowledge gaps of the literature review and empirical context of this thesis are mainly grounded in the built environment. In this way, it provides a direct theoretical and contextual contribution to construction procurement.

This thesis contributes to stakeholder analysis and stakeholder collaboration by investigating multi-stakeholder perspectives on circular procurement and reinforces the importance of stakeholder collaboration as stated by many researchers (e.g., Ababio et al., 2025; Esposito et al., 2024). This thesis enhances the argument made by Cuppen et al. (2016) that stakeholder positions are multidimensional and are influenced by different factors, criteria, and values in the context of circular procurement. Instead of categorizing stakeholders according to their roles, this thesis classifies them according to their priorities and focuses on circular procurement, which is not directly determined by their positions in the supply chain. This thesis also reveals the lack of a definite interrelationship between stakeholder roles and their perspectives, which does not quite align with previous studies that stakeholder perspectives are influenced by their positions in the supply chain and the value composition of their organizations (e.g., Ababio et al., 2025a; Leising et al., 2018). However, although no definitive interrelationship was identified between stakeholder roles and their perspectives in circular procurement, the findings also show that their motivations underlying their procurement choices are still implicitly related to their roles. This thesis further argues that identifying stakeholder motivations underlying their procurement decisions is essential to facilitate circular procurement implementation while addressing the requirements of various stakeholders. Furthermore, this thesis enhances the understanding of stakeholder collaboration

from a multi-dimensional perspective, as indicated in previous studies (Chan et al., 2023; Evertsen and Knotten, 2024) and argues that stakeholder collaboration requires appropriate power distribution, collaboration across project and lifecycle boundaries, the integration of diverse stakeholders and their knowledge at different levels of participation, and appropriate allocation of risks and benefits.

Dutch social housing organizations (housing associations) are recognized as housing owners and managers with dual roles who decide their own procurement strategies while fulfilling their societal responsibilities and responding to public policies (Lambrechts et al., 2021; van Zoest et al., 2019). This thesis contributes to social housing literature by advancing the understanding of housing associations as active demand-side actors in the circular economy transition. By investigating circular procurement from organizational and inter-organizational perspectives, this study highlights the capabilities for housing associations to stimulate the circular economy transition through procurement management, organizational capabilities, supply chain management, and stakeholder collaboration. It also contributes to the circular procurement study in the non-public sectors by examining the Dutch social housing sector as a semi-public sector. While most of the existing studies on circular procurement focus on the public sector and public procurement (Rainville, 2021; Xu et al., 2022). Compared to public procurement, the procurements for non-public sectors are more fragmented and unorganized, with a lack of a systematic approach and a governance mechanism to guide their development (Xu et al., 2022). This thesis highlights the importance of institutional support for circular non-public procurement when there is no obligation to follow the public rules. Moreover, this thesis proposes to extend circular procurement in social housing from individual projects towards the portfolio level. As long-term owners and managers of substantial housing portfolios, housing associations have the potential to coordinate procurement decisions, information and material flows, organizational learning, and supply chain relationships across multiple projects (Eikelenboom et al., 2021; van Zoest et al., 2020). This portfolio-level perspective extends the predominantly project-based understanding of construction procurement and provides direction for future research on the role of housing associations as not only as demand-side actors, but also active actors that coordinate and influence supply networks to facilitate the circular economy transition at scale.

6.2.2 Practical contributions

Through the conduction of in-depth empirical studies and the synthesis of theories and practices of circular procurement, this study has provided concrete recommendations to the practice of circular procurement in Dutch social housing.

For practitioners, especially housing associations, contractors, consultants, and other supply chain partners, this thesis shows that circular procurement should be treated as a broader transformation of procurement rather than as an add-on to conventional tendering and purchasing. They can follow the propositions developed and the findings of this thesis to translate circular ambitions in to operational procurement routines and improve their procurement practice in circular projects. Another key benefit for practitioners is that this thesis makes clear where implementation tends to fail in practice by identifying the barriers and challenges in existing practices. It helps practitioners diagnose why circular ambitions are difficult to scale up and where organizational and inter-organizational changes are required. Through comparing theories and practices on circular procurement and validating the results in practice, it also offers a more realistic and context-sensitive understanding of circular procurement implementation.

Importantly, circular procurement transformation does not require organizations to replace all existing practices. Given that the circular economy transition in the Dutch social housing sector is at an early stage, a more realistic approach is to build on existing ways of working while introducing changes and innovations where needed. Several practices identified in this thesis as supporting circular procurement, such as supply chain integration, early stakeholder involvement, and long-term collaboration, may already be applied in conventional projects. Their existing use does not diminish their relevance to circularity. Instead, it indicates that established practices can provide a foundation for the circular transition. However, circularity may change their objectives, scope, resources, actors, and configuration. For instance, supply chain integration in circular procurement may extend beyond conventional actors to incorporate emerging actors involved in deconstruction, material recovery, reuse, maintenance, and reverse logistics. It may also require these actors to be involved earlier and to collaborate across project and lifecycle boundaries. Thus, the transformation towards circular procurement does not necessarily lie in developing entirely new procurement practices, but also in reconfiguring established practices through different combinations of actors, activities, resources, and lifecycle considerations. Similarly, established sustainable strategies, such as waste management, remain necessary even if they are not explicitly included in the 10 R strategies of the circular economy. The practical challenges are therefore not simply to introduce new circular practices, but to identify what can be retained,

what needs to be adapted, and where more fundamental innovations are required. In this way, this thesis provides practitioners with a pragmatic pathway for gradually transforming procurement towards circularity.

Housing associations, in particular, can translate the results from this thesis to concrete and specific circular procurement implementation plans in their circular projects. They can follow the instructions of the integrated propositions that cover different stages in the whole process of circular procurement. Contractors and other supply-side practitioners can position themselves more effectively in circular tenders and circular project planning and understand where they need to build competencies and partnerships. Policymakers can use the findings of this thesis to design clearer guidance, standardized procurement frameworks, and supportive regulations for semi-public and private clients such as housing associations. This thesis helps practitioners and policymakers see how circular procurement can be integrated into their existing responsibilities and practices, rather than treated as a separate sustainability agenda.Moreover, for both practitioners and policymakers, this thesis makes an important practical contribution by showing that circular procurement should not be understood only in environmental and technical terms. It also involves governance, economic incentives, organizational capacity, and social value. This broader perspective helps practitioners and policymakers make better-informed decisions by comprehensively considering the multilateral factors in circular procurement.

Finally, this thesis also contributes to existing circular procurement guidance and grey literature on circular procurement transformation in the construction industry (e.g., Buyer Group, 2022; EIT Climate-KIC, 2019; PlatformCB'23, 2021; van Oppen et al., 2021). These reports are mostly used to provide practical guidance and tactical actions for practitioners to adopt circular economy strategies. This thesis validates many of the strategies of circular procurement from the current reports, such as Total Cost of Ownership, early stakeholder involvement, functional procurement requirements, and portfolio-based procurement. It validates these strategies not only with scientific research but also with practice in Dutch social housing. Besides, instead of pointing out what should be done as in existing circular procurement reports, this thesis provides systematic analysis on what has been done in practice, what can facilitate the circular transition, what the different stakeholders' perspectives are on circular procurement strategies, and what challenges the transformation. Therefore, instead of proposing definite guidance for circular implementation, this thesis adds more nuances and debates for circular procurement transformation and expands the understanding of it across different situations and perspectives. Furthermore, current grey literature examines circular procurement from the organizational and operational perspectives. This study, however, highlights

the understanding of circular procurement more than procurement functions but as an integrated management approach which aligns environmental, organizational, societal, economic, and institutional conditions and objectives.

6.2.3 Policy Recommendations

Although this thesis studied the Dutch social housing sector as a semi-public sector without obligations to follow the public procurement rules (Lambrechts et al., 2021), its autonomy in procurement does not mean that circular procurement can be realized independently without support from the broader institutional environment. This thesis shows that several barriers to circular procurement arise beyond the boundaries of individual organizations and supply chains, including regulatory ambiguity and insufficient guidance on circular procurement, unclear responsibility distribution, underdeveloped contractual arrangements, lack of universal certification of reused materials, and limited financial and market incentives. Therefore, this thesis argues the importance of institutional support for housing associations and their supply chains to address these challenges.

The policy implication of this thesis is not that public procurement rules should be extended to housing associations or that government should prescribe how they procure. Instead, policymakers and the central organization of social housing should create enabling conditions within which housing associations retain procurement autonomy while being better supported in their circular economy transition. Policymakers can benefit from this thesis by using it as evidence that circular procurement in Dutch social housing requires enabling institutional conditions, not just high-level policy goals. The specific policy recommendations have been listed below, with Dutch social housing as the main empirical reference point, but are able to extend to a broader context in the built environment.

First, policymakers should create stronger financial, regulatory, and market incentives to make circular procurement a viable option rather than an experimental extra (Sajid et al., 2024). Incentives should be made at the regulations and governance level to make circular procurement implementation economically and institutionally feasible. Such incentives could include subsidies and tax reduction for circular materials and circular projects, the promotion of lifecycle value approaches, such as take-back services, product-as-a-service, and Total Cost of Ownership, and funding schemes for circular transition experiments and research (Wong et al., 2016).

Second, a standardized but adaptable framework should be developed to provide housing associations with a common reference for developing their own procurement approaches and facilitate lateral collaborations among different housing associations. This thesis shows that fragmentation is one of the biggest hurdles in circular procurement implementation in Dutch social housing, which stems from the fragmented approaches taken by different housing associations and the separation of new construction, renovation, and maintenance within housing organizations. Besides, the evaluation criteria in circular projects also need to be standardized across different housing associations. This standardized framework should not prescribe a rigid one-size-fits-all model, but establish shared objectives, terminology, principles, evaluation criteria, and guidance that individual organizations can adapt to their organizational culture, capabilities, circular maturity, and project context. Furthermore, to stimulate the market and create joint demand in circular procurement, collaboration among housing associations regarding circular transition should also be encouraged through shared market dialogues, central information and material depots, and joint learning platforms, for instance.

Third, the findings of this thesis indicate that there is a requirement for monitoring and coordination mechanisms for circular activities beyond individual projects and supply chain relationships. This coordination and monitoring mechanism should support responsibility distribution among supply chain stakeholders, regulate contractual activities, and evaluate long-term circular performance. However, this thesis does not specifically investigate which actors should assume the responsibility to establish and maintain this coordination and monitoring mechanism. Future research is required to investigate the respective roles of government, the central organization of social housing, housing associations, and other supply chain partners in this.

6.3 Limitations and future research

It is important to critically reflect on the limitations encountered in this thesis in order to ensure transparency and maintain scientific integrity. Like any research project, this thesis is subject to several limitations. Acknowledging these limitations helps to provide a basis for outlining future research directions, which is addressed later to enhance scientific research on circular procurement.

6.3.1 Limitations

First, this thesis is context specific. Its empirical focus is the Dutch social housing sector, which is a distinctive setting with housing associations as private, non-profit organizations with public responsibilities, long-term housing portfolios, and a strong role in renovation (Priemus, 2003; Eikelenboom et al., 2021). This makes the findings highly relevant for Dutch social housing, but it also means that they cannot be automatically generalized to other construction sectors, other client types, or other national contexts without further validation.

Second, the empirical studies in this thesis mainly examine organizations that are already relatively advanced in circular transition. This happens in both the two empirical studies in Chapters 3 and 4 and in the validation of the propositions in Chapter 5. Although the aim is to generalize experiences and insights that may inspire others on circular procurement development, this introduces a degree of selection bias, because the findings reflect frontrunners and experienced actors rather than the full diversity of the sector. As a result, the findings of this thesis cannot be used to represent the general situation of current circular procurement implementation in the Dutch social housing sector.

Third, in the literature review study in Chapter 2, an analytical framework about circular procurement was developed without validation in practice. Although it was refined in Chapter 5 after comparing and synthesizing with empirical studies, it still has limits in capturing the full nuance of circular procurement. Besides, due to the limited amount of research on circular procurement in the built environment at the time when the systematic review was conducted, studies on sustainable procurement and green procurement were also included in the literature pool. The results generated may be different from a systematic review purely on circular procurement.

Fourth, this thesis is limited by the qualitative and exploratory nature of its research design. The empirical studies are conducted with the methods of case studies, interviews, Q methodology, and workshops, which create an in-depth understanding of perceptions, practices, and complexity. However, these do not provide statistical representativeness on a larger scale. Consequently, this thesis offers deep insight into understanding systems and dynamics, yet it does not provide broad quantitative evidence on the practice of circular procurement in a widespread nature, the factors that influence decision-making, or the most effective interventions on a large scale.

Fifth, there are 10 R strategies (refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover) in the circular economy to slow, narrow, and close the material flows (Evertsen & Knotten, 2024). This thesis does not specifically consider the relations between the adoption of different circular strategies and circular procurement approaches. The primary reason is that circular procurement practices in the Dutch social housing sector are not distinguished by the circular strategies adopted, making it infeasible to design distinct circular procurement approaches for different circular strategies. Besides, this thesis understands procurement not as a functional technique but as a system-level transformation of process management, organizational structures, supply chain relationships, and institutional mechanisms. Specifying procurement techniques for different circular strategies shifts the focus to technical issues and does not align with the fundamental understanding of circular procurement in this thesis. Moreover, since this thesis does not focus on circular strategies, some of the results and recommendations identified in this thesis can be applied beyond the circular economy transition, with potential for other types of innovation. Depending on the context, this can be both a limitation and an advantage of this thesis.

Sixth, the empirical studies in this thesis are set in the Netherlands, where the primary language is Dutch. However, due to the researcher's language barriers, most of the empirical studies were conducted in English. Although the researcher and participants in this thesis can speak English fluently, conducting the interviews and workshops in a second language may still make the research less clear and reduce its depth somewhat compared to the first language. In addition, the language barrier constrained the feasibility of employing research methods requiring direct and sustained observation of participants in their working environments, such as ethnographic and observational approaches. Such approaches could have provided additional insights into how circular procurement practices, stakeholder interactions, and decision-making processes unfold in practice, complementing the interview-and-workshop-based approaches in this thesis.

6.3.2 Future research recommendations

This thesis takes the Dutch social housing sector as a case study to investigate circular procurement in the built environment. Future research is recommended to test the relevance and applicability of the findings with more participants, a wider range of housing associations, other construction sectors beyond social housing, and other regions. Comparative studies across regions, organization types, and project types would also help assess the generalization of the findings and identify where contextual adaptations are necessary (Ruparathna & Hewage, 2015; Xu et al., 2022).

An analytical framework of circular procurement in the built environment was conceptualized at the beginning of this thesis with the method of a systematic literature review. However, this framework is still developed on a linear/sequential basis, with an attempt to classify activities and supply chain interactions in sequentially designed stages. This thesis began by examining circular procurement from a process perspective with a literature review study but later demonstrates with empirical studies that transforming procurement for a circular economy requires a broader system-level transformation than process redevelopment. Therefore, future research is recommended to conduct another literature review of existing studies on circular procurement in the built environment or beyond to examine circular procurement as an integrated management approach from technological, organizational, inter-organizational, institutional, regulatory, societal, and economic perspectives.

Besides the literature review study, future research is also recommended to conduct comparative studies between circular procurement in project-based and product-based industries. Understanding circular procurement as an integrated management approach also broadens the focus from construction activities to broader organizational and institutional contexts, opening more opportunities to learn from other industries with more mature procurement systems. Besides, since circular construction procurement is suggested to transform towards portfolio-based procurement with coordination of material, information, and value flow across different projects, it will also be important and feasible to learn from product-based industries with experiences of more developed portfolio-based workflows and supply chains.

This thesis argues the importance of understanding circular procurement transformation from multi-dimensional perspectives, including technological, organizational, inter-organizational, institutional, societal, and economic dimensions. Among these dimensions, the societal and institutional dimensions are lacking attention in existing studies, while most of the current research focuses on economic and environmental benefits of the circular economy (Ababio et al., 2023; Xu et al.,

2022). Therefore, future research is recommended to enhance the examination of circular procurement from societal and institutional perspectives and test related arguments and recommendations proposed in this research with empirical evidence. Especially for the institutional perspective, many challenges are identified in this thesis where institutional and regulatory support is required. Future research should further investigate how to address these institutional and regulatory challenges with the assumptions made in this thesis, including developing monitoring and coordination mechanisms, establishing a standardized but adaptable circular procurement framework, and creating financial and market incentives.

This thesis provides rich and in-depth qualitative insights into the practices, perceptions, and challenges of circular procurement. Future research should make greater use of quantitative research methods to investigate this topic with a larger number of participants and organizations (Sparrevik et al., 2018). More specifically, quantitative research methods can be used to examine the widespread of certain practices, factors that most strongly influence implementation and decision-making, and the development of circular procurement over time (Will M. Bertrand & Fransoo, 2002). In addition, simulation methods could be used to predict future tendencies, for example regarding portfolio-level material flows, market development, lifecycle costs, or the long-term effects of different procurement strategies (Chandrasekaran et al., 2018). Longitudinal research designs are also recommended for future research to validate the results of this thesis and monitor circular procurement implementation over time and across different contexts, and identify whole lifecycle impacts of projects (Lingegard et al. 2021). Observation and ethnography research methods can be used to provide a deeper understanding of how procurement practices evolve in real-life settings, how stakeholders interact during implementation, and how circular ambitions are translated, adapted, or contested throughout the process (Meredith, 1998; Pratt, 2025). Since this thesis argues that circular procurement implementation requires combining system-level transformation with operational practices, observation and ethnography research methods can also help to further explore how to realize such a combination with in-depth and substantial empirical evidence.

This thesis argues that the lifecycle perspective is significant in circular procurement. New construction, renovation, maintenance, and deconstruction should be integrated in circular procurement and jointly planned from the outset of projects. In Dutch social housing practice, the circular procurement process for new construction, renovation, and maintenance is normally managed by people from different departments. Renovation in social housing has different constraints from new construction, especially regarding tenant presence, uncertainty about existing materials, and

selective dismantling (Çetin et al., 2022; van Stijn & Gruis, 2020). Future research should therefore investigate how to integrate renovation and maintenance in circular new build procurement from the initial phase. Similarly, if the project is about circular large-scale renovation, then the investigation should focus on how to integrate maintenance in circular renovation procurement from the initial phase.

Future research is also recommended to further develop on the seven propositions proposed in Chapter 5 and provide more specific and concrete guidance on circular procurement implementation. This means future research can focus on the investigation of portfolio-based procurement, the co-design process of multi-stakeholders on circular procurement, consortia formulation, standardized circular scoring systems, integration of renovation, maintenance, and new construction from the initial stage, co-investment from supply chain stakeholders, and residents' participation. Finally, future research should continue to build stronger bridges between theory and practice by combining conceptual work with empirical study, using action research and iterative designs that allow theory to be tested, refined, and recalibrated through practice (Bleijenbergh et al., 2021). In this way, circular procurement research can develop in a manner that is both scientifically rigorous and practically relevant.

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Appendices

Related to Chapter 2

Appendix A provides an overview of the conceptual framework of the circular procurement process developed in Chapter 2 and presents the sources for each element included in this framework.

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Appendix A. Overview of the circular procurement process.

Planning stage	Criteria Specification stage	Tendering stage	
Client			
Develop visions (Leising et al. 2018). Decide the procurement method (Zulkifly et al. 2021). Hire a consultant for procurement method advice (Zulkifly et al. 2021). Make an estimated timeline for the projects (Han et al. 2009).	Set up functional requirements for suppliers/contractors (Sparrevik et al. 2018). Organize early market dialogue (Stokke et al. 2023).	Procure for services (Granheimer et al. 2022). Introduce effective incentivizing schemes (Wijewickrama et al. 2021). Formulate and evaluate the awarding criteria. Share risk and responsibilities with partners (Granheimer et al. 2022).	
Contractor			
	Include circular expertise in the tendering teams (Stokke et al. 2023).	Incorporate circular elements into tender preliminaries (Wong et al., 2016). Make cost predictions about circular projects (Alshboul et al. 2022). Procure a demolisher for the project (Wijewickrama et al. 2021).	
Supplier			
	Conduct research on construction cost-saving by adopting GP/CIRCULAR PROCUREMENT. Adapt products to the CE requirements. Apply certification for the quality of the green materials (Wong et al. 2016). Invest in new technical solutions for CE (Azcarate-Aguerre et al. 2022).	Update and expand the categories of green alternatives Provide more performance details of green materials (Wong et al. 2016). Provide services instead of products (Leising et al. 2018).	
Demolisher			
		Provide a pre-demolition and pre-refurbishment audit of the project (Wijewickrama et al. 2021). Identify and include demolition costs in tender documents (Pellegrini et al. 2021).	
Architect			
Consultant			
Advise clients about the appropriate procurement method (Zulkifly et al. 2021).	Advise clients on selecting green materials and provide the associated costs and benefits through LCC (Wong et al. 2016).		

	Contracting stage	Design stage	Construction and delivery stage
	Use innovative contracting method based on collective aims (Leising et al. 2018). Stipulate GP/CIRCULAR PROCUREMENT requirements in the contract specification (Wong et al. 2016)	Bring together supply chain partners to explore CE solutions (Leising et al. 2018). Develop incentive schemes to encourage material circularity (Knoth et al. 2022).	Establish a material use list for different projects (Han et al. 2009). Specify reverse logistics with the consideration of return logistics to recover materials (Wuni and Shen 2022, Pushpamali et al. 2020).
	Incorporate rewards sharing and risk sharing with other partners in the contract (Sanne et al. 2019). Use a shared co-investment and co-benefiting model (Azcarate-Aguerre et al. 2022).	Identify material and technical specifications (Charef and Lu 2021). Identify reuse strategies (Pellegrini et al. 2021). Plan for waste management (Shooshtarian et al. 2022). Plan and facilitate the implementation of reverse logistics (Pushpamali et al. 2020	Arrange 'product as service" systems with suppliers (Wuni and Shen 2022, Ajayi and Oyedele 2018, Azcárate-Aguerre et al., 2018). Procure for reused materials (Luciano et al. 2021). Use waste-efficient purchase management , Shooshtarian et al., 2022). On-site management of construction materials and CDW (Pellegrini et al. 2021).
		Investigate circular materials and products that can be reused and disassembled easily (Wuni and Shen 2022).	Recover materials from demolition projects (Knoth et al. 2022. Adopt waste preventive measures (Ajayi and Oyedele 2018). Optimize the materials delivery process to reduce waste production (Shooshtarian et al. 2022).
		Make precise plans about demolition activities (Pellegrini et al. 2021).	Integrate de-constructability and reusability techniques into construction (Ganiyu et al. 2020).
		Translate project information provided by the contracting authority into specific technical and materials solutions (Knoeri et al. 2011). Make a specific final project with an assessment of the potential for reuse or recycling of the building (Luciano et al. 2021, Knoeri et al. 2011).	

TOC

Appendix A. Overview of the circular procurement process.

Planning stage	Criteria Specification stage	Tendering stage	
Digital firms			
		Provide technological support to construction firms (Eze et al. 2022).	
Government			
Initiate the implementation of GP/ CIRCULAR PROCUREMENT in all public projects (Wong et al. 2016). Develop guiding principles and monitor procedures (Hjaltadóttir and Hild 2021). Establish incentive schemes for green procurement implementation (Knoth et al. 2022, Hassan et al. 2023). Adopt public–private cooperation (Lingegard et al. 2021).	Set functional, performance-based requirements at the policy level (Kadefors et al. 2021). Standardize the adoption of green practices (Mojumder et al. 2022).	Encourage sustainable practices through the call for tenders of public clients (Pellegrini et al. 2021).	
Intermediary platform			
		Advise call for tenders through the platform. Provide real-time verification of the required standards (Luciano et al. 2021).	
Digital technology			
	BIM: Determine the resources for projects, such as materials, labours, and equipment; track the progress and time schedules of projects (Eze et al. 2022).	BIM: Support contract selection by providing data and information of contractors (Eze et al. 2022). Machine learning: Cost prediction for each building (Alshboul et al. 2022). Fuzzy inference system: sustainable supplier selection (Hoseini et al., 2021).	
Supporting material and data			
E-procurement, E-auction, reverse auction, sustainable materials and services procurement (Mojumder et al. 2022).	A demonstration of client demand (Densley et al. 2017). LCC, LCA (Sparrevik et al. 2018). Budget and additional costs for circularity-related initiatives (He et al. 2022).	Database of suppliers section availability (Densley et al. 2017). Bid evaluation method (Abduh et al. 2012). Selection criteria (Hoseini et al. 2021). Tender document (He et al. 2022). Green construction cost prediction model (Alshboul et al. 2022).	

	Contracting stage	Design stage	Construction and delivery stage
			A Material Passport consultant is required to integrating recycling and LCA-data into the BIM process (Honic et al. 2019).
		Encourage sustainable practices through design requirements (Pellegrini et al. 2021). Communicate with construction companies about the local availability of green construction materials (Mojumder et al. 2022).	
		Provide guidelines and best practices related to construction and demolition activities (Luciano et al. 2021). Provide information of material flow which can support the plan of waste management and reuse of materials (Lanau and Liu 2020).	Material market place (Alarcón et al., 2009). Material bank (Cai and Waldmann 2019). Estimate outgoing materials quantity; vehicle distribution analysis; Real-time information on usage status (Han et al. 2009). Incorporate all information related to the construction site in the platform (Luciano et al. 2021)
	Blockchain and Smart Contract: Develop a self-executed legal contract (Rodrigo et al. 2020); Blockchain, Internet of things, and Big data: deal with payment problems and contract conflicts (Sadeghi et al. 2022).	BIM: Store material flows in one database and improve design decisions and selection of materials (Cai and Waldmann 2019), plan for reverse logistics (Chileshe et al. 2019). GIS: Provide geometric and spatial information of building materials to support procurement (Eze et al. 2022).	BIM: Predict and estimate the materials extracted from demolition projects; Minimize the change of materials during construction (Huang et al. 2022).
	DBM contract (Lingegard et al. 2021).	Structural calculation tool, energy performance evaluation tool, Cost estimation, LCA (Luciano et al. 2021).	Emission data and the energy consumption of different materials (Wong et al. 2016). Pre-demolition audit (Condotta and Zatta 2021). Waste management guidelines (Shooshtarian et al. 2022). Standards and technical specifications for the reuse of products (Knoth et al. 2022).

Related to Chapter 3

Appendices B-H are interview protocols for housing associations, contractors, suppliers, demolishers, architects, consultants, and digital firms. Because the original protocol was semi-structured and iteratively refined, not every question was asked verbatim or to every participant.

Appendix B. Questions for housing associations

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** How do you make plans for circular renovation? **2.** What factors are important for you when planning for circular renovation? **3.** Will factor A influence factor B? How? **4.** What project delivery method do you use?	The planning stage and criteria specification stage	Visions for circular projects and the process. Procurement method	Client
Challenges: **1.** What are the challenges for you when planning for circular construction? **2.** What are the internal organizational challenges? **3.** What are the challenges to collaborating or not collaborating with other stakeholders? **4.** What are the challenges in the use of technologies and information? **5.** What are the regulatory and societal challenges?			
Objectives: **6.** What are the objectives in the procurement process of circular housing renovation? **7.** What are your expectations for the procurement of circular housing renovation?			
Stakeholder interaction and labor division: **8.** Are there any other stakeholders involved in making plans for circular renovation? **9.** If there are: What do they do/how do they support you to make plans? **10.** How frequently do you meet with each other? Is your communication with them efficient enough? **11.** What information do you need from other stakeholders? **12.** What information do you give them?			
Use of tools and digital technologies: **13.** Do you use any digital technologies in circular housing renovation? **14.** What digital technologies are you using, for what objectives? **15.** Why did you choose to use this digital technology? **16.** What digital technologies are being used in the procurement process of housing renovation, and for what purposes? **17.** Do your partners (other stakeholders) use any digital technologies in the procurement process?			

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Appendix B. Questions for housing associations

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** How do you select partners for circular renovation?/ What kind of methods are you using to select partners? **2.** What factors are important for you when you select partners?/ What are your requirements for partners/contractors? **3.** Will factor A influence factor B? How? **4.** What do you do to incentivize bidders to adopt circular strategies? **5.** Do you organize any meetings with potential bidders before the tendering process?	**Tendering stage**	Bid evaluation, criteria Incentive circularity, Share risks and responsibilities, LCA, BCI, LCC, MPG, CPR, GPR Total cost of ownership Platforms, tools, emails, meetings,	Client
Challenges: **6.** What are the challenges for you when tendering for circular construction? **7.** What are the internal organizational challenges? **8.** What are the challenges to interacting with other stakeholders? **9.** What are the challenges in the use of technologies and information? **10.** What are the regulatory and societal challenges?			
Objectives: **11.** What are the objectives in tendering for circular projects?			
Interaction with other stakeholders: **12.** How many bidders(contractors) are involved in the tendering process? What do they need to do during the tendering process? **13.** What information can they provide you? **14.** What means do you use to communicate with bidders? **15.** Are there any other stakeholders involved in the tendering process? **16.** What do they do?/How do they support you in the tendering process? **17.** How frequently do you meet with other stakeholders? How efficient are your communications? **18.** Is there anything that can be improved when you select partners in your opinion? **19.** What information do you give them?			
Use of tools and digital technologies: **20.** Do you use any digital technologies in tendering? **21.** What digital technologies are you using, for what objectives? **22.** Why did you choose to use this digital technology? **23.** Do your partners (other stakeholders) use any digital technologies in tendering?			

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Appendix B. Questions for housing associations

Questions	Rational	Options	Target People
General practice of circular procurement: 1. What kind of contracts are you using in circular renovation projects? 2. Are there anything different in making contracts for circular renovation compared to normal renovation? 3. Will factor A influence factor B? How?	Contracting stage	Design Build Maintain, Circular Contracting method, Share value, share risks, Collaborative contracting method Joint innovation process	Client
Challenges: 4. What are the challenges for you when contracting for circular construction? 5. What are the internal organizational challenges? 6. What are the challenges to interacting with other stakeholders? 7. What are the challenges in the use of technologies and information? 8. What are the regulatory and societal challenges?			
Objectives: 9. What are the objectives in contracting for circular projects?			
Interaction with other stakeholders: 10. Besides contractors, do you also make contracts with other stakeholders? 11. Are there any other stakeholders involved in the contracting stage? 12. What do they do? 13. What information do you need from other stakeholders? 14. What information do you give them?			
Use of tools and digital technologies: 15. Do you use any digital technologies in contracting? 16. What digital technologies are you using, for what objectives? 17. Why did you choose to use this digital technology? 18. Do your partners (other stakeholders) use any digital technologies in contracting?			

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Appendix B. Questions for housing associations

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** Do you have a plan for the circular project before the agreements are made or after? **2.** What do you do to design for circular housing renovation? **3.** How do you encourage your partners to adopt circular strategies? **4.** How do you decide what circular strategies to take or how to renovate the housing?	Design stage	Workshop, Incentive scheme	Client
Challenges: **5.** What are the challenges for you in the design stage? **6.** What are the internal organizational challenges? **7.** What are the challenges to interacting with other stakeholders? **8.** What are the challenges in the use of technologies and information? **9.** What are the regulatory and societal challenges?			
Objectives: **10.** What are the objectives in the design stage for circular projects?			
Interaction with other stakeholders: **11.** What stakeholders are involved in the design stage of housing renovation? **12.** How do you interact with them? **13.** How often do you meet with them? Can you communicate efficiently? **14.** What information do you need from other stakeholders? **15.** What information do you give them?			
Use of tools and digital technologies: **16.** Do you use any digital technologies in the design stage? **17.** What digital technologies are you using, for what objectives? **18.** Why did you choose to use this digital technology? **19.** Do your partners (other stakeholders) use any digital technologies?			

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Appendix B. Questions for housing associations

Questions	Rational	Options	Target People
General practice of circular procurement: 1. What do you do at the construction stage of circular renovation? 2. How do you make sure that circular strategies are being taken at the realization stage? 3. What factors are important to monitor and supervise the realization of circular renovation?	Construction stage	Monitor and supervise, Reverse logistics	Client
Challenges: 4. What are the challenges for you in the construction stage? 5. What are the internal organizational challenges? 6. What are the challenges to interacting with other stakeholders? 7. What are the challenges in the use of technologies and information? 8. What are the regulatory and societal challenges?			
Objectives: 9. What are the objectives in the construction of circular projects?			
Interaction with other stakeholders: 10. How do you interact with other stakeholders (contractors) at the construction stage? 11. How often do you meet with them? 12. How efficient are your communications? 13. Do you do anything to support them? 14. What information do you need from other stakeholders? 15. What information do you give them?			
Use of tools and digital technologies: 1. Do you use any digital technologies in the construction stage? 2. What digital technologies are you using, for what objectives? 3. Why did you choose to use this digital technology? 4. Do your partners (other stakeholders) use any digital technologies?			

Appendix C. Questions for contractors

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** When/How did you start to get involved in this project? **Challenges:** **2.** What are the challenges to involve early for circular projects? **Objectives:** **3.** What are the objectives to involve early in circular projects? **Interaction with other stakeholders:** **4.** How do you interact with other stakeholders during early market dialogue?	The planning stage and criteria specification stage	Early market dialogue	Contractor
General practice of circular procurement: **1.** How did you start to get involved in this project? **2.** Did you bid for this project? **3.** What did you do to bid for this project? **4.** What are you doing differently to bid for a circular renovation project compared to a normal renovation? **5.** Do you hire any demolishers or other stakeholders in circular renovation? Do you have your own architects? **6.** How do you select the demolishers/suppliers/architects? **7.** Do you use any digital technologies during the tendering process? **Challenges:** **8.** What are the challenges to bidding for circular projects? **Objectives:** **9.** What are the objectives in bidding of circular projects? **Interaction with other stakeholders:** **10.** How do you interact with the housing association during the tendering process? **11.** How many times do you meet?/ How often do you meet? **12.** How does the housing association communicate its requirements for circular renovation to you? **13.** How do you integrate their requirements in your bidding? **14.** Can you communicate efficiently and effectively during the tendering process? **15.** Do you interact with other stakeholders during the tendering process? **16.** How's your interaction with demolishers and suppliers during the tendering process? **17.** What information do you need from other stakeholders? **18.** What information do you give them? **Use of tools and digital technologies:** **19.** Do you use any digital technologies in tendering? **20.** What digital technologies are you using, for what objectives? **21.** Why did you choose to use this digital technology? **22.** Do your partners (other stakeholders) use any digital technologies in tendering?	Tendering stage	Bid documents, Include expertise in the bidding team, Circular plans, circular materials, Hire demolisher, BIM, LCA, BCI, LCC, MPG, CPR, GPR Through which means: BIM, email, face to face, excel,	

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Appendix C. Questions for contractors

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** What type of contract do you use with housing associations? **2.** Is there anything different in the contract for circular renovation compared to normal renovation? **3.** Are you satisfied with the current type of contract or do you think anything can be improved in the current contract? **4.** What type of contract do you use with demolishers/suppliers/ architects? **5.** Are there anything different in the contracts you made with them for circular renovation?	Contracting stage	Design Build Maintain, Circular Contracting method, Share value, share risks, Collaborative contracting method, LCA, BCI, LCC, MPG, CPR, GPR Joint innovation process	Contractor
Challenges: **6.** What are the challenges to making agreements for circular projects?			
Objectives: **7.** What are the objectives in contracting of circular projects?			
Interaction with other stakeholders: **8.** How's the interaction/communication with housing association/ suppliers when making contracts? **9.** Do you communicate about how to make contracts with them? **10.** Can you communicate efficiently through the current contract? **11.** Do you think anything can be better when making contracts with other stakeholders to communicate your requirements?			
Use of tools and digital technologies: **12.** Do you use any digital technologies in contracting? **13.** What digital technologies are you using, for what objectives? **14.** Why did you choose to use this digital technology? **15.** Do your partners (other stakeholders) use any digital technologies?			

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Appendix C. Questions for contractors

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** Do you design for circular projects before the agreements are made or after? **2.** What do you do to design circular renovation projects? **3.** What makes it different in circular renovation? **4.** How do you decide what circular strategies or materials to adopt?	**Design stage**	Expertise knowledge in material specification, Reuse plan, waste reduction plan, LCA, BCI, LCC, MPG, CPR, GPR Information exchange, material exchange Harvest and reuse of materials	Contractor
Challenges: **5.** What are the challenges in the design stage of circular projects?			
Objectives: **6.** What are the objectives in the design stage of circular projects?			
Interaction with other stakeholders: **7.** How do you interact with other stakeholders to design for circular renovation? **8.** Does the housing association have any requirements about how to do a circular renovation? Does it provide you with any support? **9.** How often do you communicate/work with architects/suppliers/ demolishers when designing for circular renovation? **10.** Can you work/ communicate efficiently? **11.** Anything can be better to communicate with other stakeholders? **12.** What information do you need from other stakeholders? What information do you give them?			
Use of tools and digital technologies: **13.** Do you use any digital technologies in the design stage? **14.** What digital technologies are you using, for what objectives? **15.** Why did you choose to use this digital technology? **16.** Do your partners (other stakeholders) use any digital technologies?			

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Appendix C. Questions for contractors

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** What do you do at the construction stage of circular renovation? **2.** Compared to traditional renovation, what do you do differently in circular renovation? **3.** How do you procure materials? **4.** What are your requirements for circular renovation?/What factors influence you when you procure materials/services?	Construction stage	Recover demolished materials, estimate required materials, procure for reused materials, Product as service Construction material and waste management Materials flow, information flow,	Contractor
Challenges: **5.** What are the challenges in the construction stage of circular projects?			
Objectives: **6.** What are the objectives in the construction stage of circular projects?			
Interaction with other stakeholders: **7.** What other stakeholders are involved at the realization stage? **8.** How do you interact with them? **9.** How often do you communicate with them at the construction stage? **10.** How efficient are your communications? **11.** Anything could be better when working together or communicating with other stakeholders during the construction stage? **12.** What information do you need from other stakeholders? **13.** What information do you give them?			
Use of tools and digital technologies: **14.** Do you use any digital technologies in the construction stage? **15.** What digital technologies are you using, for what objectives? **16.** Why did you choose to use this digital technology? **17.** Do your partners (other stakeholders) use any digital technologies?			

Appendix D. Questions for suppliers

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** How did you start to get involved in this project? **2.** At which stage did you get involved in this project? **3.** What do you do in this project?/what are your roles?	The planning stage and criteria specification stage	New technical solution for CE, Circular products, Certification for circular materials	Supplier
General practice of circular procurement: **1.** How did you start to get involved in this project? **2.** Did you bid for this project? **3.** What did you do to bid for this project? **4.** What are you doing differently to bid for a circular renovation project compared to normal renovation? **5.** Do you use any digital technologies during the tendering process?	Tendering stage	Provide circular materials, Performance details of circular materials, Provide services instead of products, LCA, BCI, LCC, MPG, CPR, GPR	
Challenges: **6.** What are the challenges to bidding for circular project?			
Objectives: **7.** What are the objectives when bidding for circular projects?			
Interaction with other stakeholders: **8.** How do you interact with the housing association/contractor during the tendering process? **9.** How many times do you meet? How often do you meet? **10.** How does the housing association/contractor communicate its requirements for circular renovation to you? **11.** How do you integrate their requirements in your bidding? **12.** Can you communicate efficiently and effectively during the tendering process? **13.** Do you interact with other stakeholders during the tendering process? **14.** How's your interaction with demolishers during the tendering process? **15.** What information do you need from other stakeholders? **16.** What information do you give them?			
Use of tools and digital technologies: **17.** Do you use any digital technologies in tendering? **18.** What digital technologies are you using, for what objectives? **19.** Why did you choose to use this digital technology? **20.** Do your partners (other stakeholders) use any digital technologies in tendering?			

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Appendix D. Questions for suppliers

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** What type of contract do you use with housing associations/ contractors? **2.** Is there anything different in the contract for circular renovation compared to normal renovation? **3.** Are you satisfied with the current type of contract or do you think anything can be improved in the current contract?	Contracting stage	Design Build Maintain, Circular Contracting method, Share value, share risks, Collaborative contracting method Joint innovation process	Supplier
Challenges: **4.** What are the challenges to making agreements for circular projects?			
Objectives: **5.** What are the objectives in contracting of circular projects?			
General practice of circular procurement: **1.** Are you involved in the design of circular renovation projects? **2.** What makes it different for circular renovation from your perspective? **3.** How do you decide what circular strategies or materials to adopt?	Design stage	Circular materials and products which are easy to repair and disassemble, LCA, BCI, LCC, MPG, CPR, GPR Information flow, materials flow	
Challenges: **4.** What are the challenges to produce and sell circular products?			
Interaction with other stakeholders: **5.** How do you interact with other stakeholders to design for circular renovation? **6.** Does the housing association/contractor have any requirements about how to do circular renovation? Does it provide you with any support? **7.** How do you communicate/work with architects/contractors / demolishers when designing for circular renovation? **8.** Can you work/ communicate efficiently? **9.** Anything can be better to communicate with other stakeholders? **10.** What information do you need from other stakeholders? **11.** What information do you give them?			
Use of tools and digital technologies: **12.** Do you use any digital technologies in the design stage? **13.** What digital technologies are you using, for what objectives? **14.** Why did you choose to use this digital technology? **15.** Do your partners (other stakeholders) use any digital technologies?			

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Appendix D. Questions for suppliers

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** What do you do at the construction stage of circular renovation? **2.** How do you deliver materials/products to contractors? **3.** How do you decide what types of materials/products to produce?	Construction stage	Product as service, Reuse and disassemble of products, Quality certification of materials, Waste prevention measures, Materials delivery process Information flow, Materials flow	Supplier
Challenges: **4.** What are the challenges to produce circular products?			
Interaction with other stakeholders: **5.** How often do you meet/communicate with contractors during the construction stage? **6.** Do you set the requirements for materials/products with contractors together? **7.** Besides the information of materials, do you exchange any other information with contractors? **8.** Do you have contact with other stakeholders during the construction stage? For what purposes? **9.** How efficient are your communications with other stakeholders during the construction stage? **10.** Anything could be better for the communications with other stakeholders? **11.** What information do you need from other stakeholders? **12.** What information do you give them?			
Use of tools and digital technologies: **13.** Do you use any digital technologies in the design stage? **14.** What digital technologies are you using, for what objectives? **15.** Why did you choose to use this digital technology? **16.** Do your partners (other stakeholders) use any digital technologies in tendering?			

Appendix E. Questions for demolishers

Questions	Rational	Options	Target People
General practice of circular procurement: 1. How did you start to get involved in this project? 2. At which stage did you get involved in this project? 3. What do you do in this project?/what are your roles? 4. What do you do differently in circular demolition compared to normal demolition?	The planning stage and criteria specification stage	Circular Demolition, Pre-demolition audits,	Demolisher
General practice of circular procurement: 1. How did you start to get involved in this project? 2. Did you bid for this project? 3. What did you do to bid for this project? 4. What are you doing differently to bid for a circular renovation project compared to normal renovation? 5. Do you use any digital technologies during the tendering process?	Tendering stage	Demolition cost in tender documents LCA, BCI, LCC, MPG, CPR, GPR	
Challenges: 6. What are the challenges to bid for circular demolition?			
Objectives: 7. What are the objectives to bid for circular demolition?			
Interaction with other stakeholders: 8. How do you interact with the housing association/contractor during the tendering process? 9. How many times do you meet? How often do you meet? 10. How does the housing association/contractor communicate its requirements for circular renovation to you? 11. How do you integrate their requirements in your bidding? 12. Can you communicate efficiently and effectively during the tendering process? 13. Do you interact with other stakeholders during the tendering process? 14. What information do you need from other stakeholders? 15. What information do you give them?			
Use of tools and digital technologies: 16. Do you use any digital technologies in bidding? 17. What digital technologies are you using, for what objectives? 18. Why did you choose to use this digital technology?			

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Appendix E. Questions for demolishers

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** What type of contract do you use with housing associations/ contractors? **2.** Is there anything different in the contract for circular renovation compared to normal renovation? **3.** Are you satisfied with the current type of contract or do you think anything can be improved in the current contract?	Contracting stage	Design Build Maintain, Circular Contracting method, Share value, share risks, Collaborative contracting method Joint innovation process	Demolisher
Challenges: **4.** What are the challenges to making agreements for circular demolition?			
Objectives: **5.** What are the objectives in contracting of circular demolition?			
Interaction with other stakeholders: **6.** How's the interaction/communication with housing associations/contractors when making contracts? **7.** Do you communicate about how to make contracts with them? **8.** Can you communicate efficiently through the current contract? **9.** Do you think anything can be better when making contracts with other stakeholders to communicate about your requirements?			
Use of tools and digital technologies: **10.** Do you use any digital technologies in contracting? **11.** What digital technologies are you using, for what objectives? **12.** Why did you choose to use this digital technology?			

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Appendix E. Questions for demolishers

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** Are you involved in the design of circular renovation projects? **2.** What do you do in the design stage? **3.** What makes it different for circular renovation from your perspective?	Design stage	Demolition plan Information flow, materials flow	Demolisher
Challenges: **4.** What are the challenges in the design stage of circular demolition?			
Objectives: **5.** What are the objectives in design stage of circular demolition?			
Interaction with other stakeholders: **6.** How do you interact with other stakeholders to design for circular renovation? **7.** Does the housing association/contractor have any requirements about how to do circular renovation? Does it provide you with any support? **8.** How do you communicate/work with architects/contractors / demolishers when designing for circular renovation? **9.** Can you work/ communicate efficiently? **10.** Anything can be better to communicate with other stakeholders? **11.** What information do you need from other stakeholders? **12.** What information do you give them?			
Use of tools and digital technologies: **13.** Do you use any digital technologies in design stage? **14.** What digital technologies are you using, for what objectives? **15.** Why did you choose to use this digital technology?			

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Appendix E. Questions for demolishers

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** What do you do at the construction stage of circular renovation? **2.** How do you deliver materials/products to contractors? **3.** How do you demolish and sell reused materials?	Construction stage	deconstruction Information flow, Materials flow	Demolisher
Challenges: **4.** What are the challenges in the construction stage of circular demolition?			
Objectives: **5.** What are the objectives in the construction stage of circular demolition?			
Interaction with other stakeholders: **6.** How often do you meet/communicate with contractors during the construction stage? **7.** Do you set the requirements for materials/products with contractors together? **8.** Besides the information of materials, do you exchange any other information with contractors? **9.** Do you have contact with other stakeholders during the construction stage? For what purposes? **10.** How efficient are your communications with other stakeholders during the construction stage? **11.** Anything could be better for the communications with other stakeholders? **12.** What information do you need from other stakeholders? **13.** What information do you give them?			
Use of tools and digital technologies: **14.** Do you use any digital technologies in the construction stage? **15.** What digital technologies are you using, for what objectives? **16.** Why did you choose to use this digital technology?			

Appendix F. Questions for architects

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** How did you start to get involved in this project? **2.** At which stage did you get involved in this project? **3.** What do you do in this project?/what are your roles? **Challenges:** **4.** What are the challenges to involve early in circular projects? **Objectives:** **5.** What are the objectives to involve early in circular projects? **Interaction with other stakeholders:** **6.** How do you interact with other stakeholders in early market dialogue?	The planning stage and criteria specification stage	Circular design	Architect
General practice of circular procurement: **1.** How did you start to get involved in this project? **2.** Did you bid for this project? **3.** What did you do to bid for this project? **4.** Do you need to have a circular design to bid for this project?/ Or do you design together with clients and contractors after making agreements? **5.** What are you doing differently to bid for a circular renovation project compared to normal renovation? **Challenges:** **6.** What are the challenges in bidding for circular projects? **Objectives:** **7.** What are the objectives when bidding for circular projects? **Interaction with other stakeholders:** **8.** How do you interact with the housing association/contractor during the tendering process? **9.** How many times do you meet? How often do you meet? **10.** How does the housing association/contractor communicate its requirements for circular renovation to you? **11.** How do you integrate their requirements in your bidding? **12.** Can you communicate efficiently and effectively during the tendering process? **13.** Do you interact with other stakeholders during the tendering process? **14.** What information do you need from other stakeholders? **15.** What information do you give them? **Use of tools and digital technologies:** **16.** Do you use any digital technologies in the tendering stage? **17.** What digital technologies are you using, for what objectives? **18.** Why did you choose to use this digital technology?	Tendering stage	Circular design in tender documents LCA, BCI, LCC, MPG, CPR, GPR	Architect

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Appendix F. Questions for architects

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** What type of contract do you use with housing associations/ contractors? **2.** Is there anything different in the contract for circular renovation compared to normal renovation? **3.** Are you satisfied with the current type of contract or do you think anything can be improved in the current contract?	Contracting stage	Design Build Maintain, Circular Contracting method, Share value, share risks, Collaborative contracting method Joint innovation process	Architect
Challenges: **4.** What are the challenges to making agreements for circular demolition?			
Objectives: **5.** What are the objectives in contracting of circular demolition?			
Interaction with other stakeholders: **6.** How's the interaction/communication with housing associations/contractors when making contracts? **7.** Do you communicate about how to make contracts with them? **8.** Can you communicate efficiently through the current contract? **9.** Do you think anything can be better when making contracts with other stakeholders to communicate about your requirements?			
Use of tools and digital technologies: **10.** Do you use any digital technologies in the contracting stage? **11.** What digital technologies are you using, for what objectives? **12.** Why did you choose to use this digital technology?			

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Appendix F. Questions for architects

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** Do you have a specific design first or do you make agreements with other stakeholders first? **2.** What makes it different for circular renovation from your perspective? **3.** How do you integrate other stakeholders' perspectives in your design?	Design stage	Technical and material plan Information flow, materials flow	Architect
Challenges: **4.** What are the challenges in the design stage?			
Objectives: **5.** What are the objectives in the design stage?			
Interaction with other stakeholders: **6.** How do you interact with other stakeholders to design for circular renovation? **7.** Does the housing association/contractor have any requirements about how to do circular renovation? Does it provide you with any support? **8.** How do you communicate/work with architects/contractors / demolishers when designing for circular renovation? **9.** Can you work/ communicate efficiently? **10.** Anything can be better to communicate with other stakeholders? **11.** What information do you need from other stakeholders? **12.** What information do you give them?			
Use of tools and digital technologies: **13.** Do you use any digital technologies in the design stage? **14.** What digital technologies are you using, for what objectives? **15.** Why did you choose to use this digital technology?			

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Appendix F. Questions for architects

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** What do you do at the construction stage of circular renovation?	Construction stage	Information flow, Materials flow	Architect
Challenges: **2.** What are the challenges in the construction stage of circular demolition?			
Objectives: **3.** What are the objectives in the construction stage of circular demolition?			
Interaction with other stakeholders: **4.** How often do you meet/communicate with contractors during the construction stage? **5.** Do you set the requirements for materials/products with contractors together? **6.** Besides the information of materials, do you exchange any other information with contractors? **7.** How efficient are your communications with other stakeholders during the construction stage? **8.** Anything could be better for communications with other stakeholders? **9.** What information do you need from other stakeholders? **10.** What information do you give them?			
Use of tools and digital technologies: **11.** Do you use any digital technologies in the construction stage? **12.** What digital technologies are you using, for what objectives? **13.** Why did you choose to use this digital technology?			

Appendix G. Questions for Consultants

Questions	Rational	Options	Target People
General practice of circular procurement: 1. How did you start to get involved in this project? 2. What do you do in this project?/ What is your role in this project? 3. Which stages are you involved in this project? 4. How do you help clients choose the appropriate procurement method?/How do you help clients plan for circular projects?	The planning stage and criteria specification stage	Procurement method, project delivery method, Circular strategy and material selection	Consultant
Challenges: 5. What are the challenges to making plans?			
Interaction with other stakeholders: 6. How often do you meet with your client? 7. Through which means do you communicate with your client? 8. What's the efficiency of your communications with the client? 9. What information do you need from other stakeholders? 10. What information do you give them?			
General practice of circular procurement: 1. How do you help clients with their tendering process? 2. How do you advise clients on contractor and supplier selection? 3. What method do you use to select for partners? 4. What factors are important to evaluate contractors? 5. Do you use any digital technologies?	Tendering stage	Bid evaluation, criteria LCA, BCI, LCC, MPG, CPR, GPR	
Challenges: 6. What are the challenges of evaluating bidders?			
Objectives: 7. What are the objectives in tendering?			
Interaction with other stakeholders: 8. How do you interact with the clients? 9. How many times do you meet? How often do you meet? 10. How does the housing association communicate its requirements to you? 11. Can you communicate efficiently and effectively?			
Use of tools and digital technologies: 12. Do you use any digital technologies to support tendering? 13. What digital technologies are you using, for what objectives? 14. Why did you choose to use this digital technology?			
General practice of circular procurement: 1. How do you advise clients about making contracts in circular projects? 2. What type of contracts can be used for circular projects? 3. What are the critical factors in circular contracts?	Contracting stage	Design Build Maintain, Circular Contracting method, Share value, share risks, Collaborative contracting method	
Challenges: 4. What are the challenges of making agreements?			
Objectives: 5. What are the objectives in contracting?			

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Appendix G. Questions for Consultants

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** Do you advise about the design of circular projects? **2.** How do you advise about the circular materials and strategies to use? Which means do you use to evaluate the circularity of different materials and strategies?	**Design stage**		Consultant
Challenges: **3.** What are the challenges?			
Objectives: **4.** What are the objectives?			
Interaction with other stakeholders: **5.** How do you interact with other stakeholders to design for circular renovation? **6.** Does the housing association/contractor have any requirements about how to do circular renovation? **7.** How do you communicate with other stakeholders? **8.** Can you communicate efficiently? **9.** Anything can be better to communicate with other stakeholders?			
General practice of circular procurement: **1.** Do you advise at the construction stage? **2.** Do you use any digital technologies?	**Construction stage**		

Appendix H. Questions for digital firms

Questions	Rational	Options	Target People
General practice of circular procurement: **1.** How did you start to get involved in this project? **2.** What do you do in this project?/ What is your role in this project? **3.** Which stages are you involved in this project? **4.** What digital tools do you use for what purposes? **5.** How did you make agreements with the client on this project? **6.** Did you bid for this project or with other means?		BIM, AI, Material Passport, Material Bank, Digital Platform BIM, email, excel, in person,	Digital firms
Challenges: **7.** What are the challenges?			
Objectives: **8.** What are the objectives?			
Interaction with other stakeholders: **9.** How often do you meet with your client? **10.** Through which means do you communicate with your client? **11.** What's the efficiency of your communications with the client? **12.** What information do you need from your clients to help them? **13.** How do you analyze the information you obtained? **14.** What information can you provide them to help them?			

Related to Chapter 4

Appendix I contains information about the real-case scenario of Dutch social housing renovation used in the Q methodology workshop for participants to ground their responses to possible situations of this scenario.

Appendix I. Real-case scenario. Source: https://www.eigenhaard.nl/projecten/rivierenhuis/

Case name	Rivierenhuis
Case description	The Rivierenhuis is located in Amsterdam South; it is a building from 1964 comprising 320 homes and 34 units for renovation. The homes have been improved and made more energy-efficient, and the building itself has been modernized.
Scale of the building	306 independent two-room apartments of approx. 40 m^2 and 14 non-independent residential units at the head of the building.
Circular strategies adopted	Bio-based (home-separating) interior walls, circular HR++ glass and the refurbishment of existing elevators and sanitary facilities
Stakeholders involved	Housing association, contractor, consultant, architect, supplier, demolisher,…

Curriculum vitae

Di Wu

Di Wu is an interdisciplinary research and development professional and PhD researcher at Delft University of Technology (TU Delft), specializing in circular economy, procurement and supply chain management, sustainable built-environment transitions, digital transformation, and social housing management. Her work bridges academic research, industry practice, and policy, with a particular focus on translating complex sustainability challenges and analytical findings into actionable strategies, implementation frameworks, decision-support approaches, and organizational transformation recommendations.

Since November 2021, Di has been conducting her PhD research in the Department of Management in the Built Environment at TU Delft, focusing on circular procurement and supply chain management in Dutch social housing. Her research examines how circular economy principles can be translated from theoretical guidance into operational procurement practices by addressing technological, organizational, regulatory, institutional, and stakeholder dimensions.

Her research combines qualitative and quantitative approaches, including case studies, interviews, surveys, Q methodology, desk research, and data analysis. She has particular experience in participatory research, co-design, stakeholder engagement, workshop facilitation, and comparative analysis, allowing practitioners and other stakeholders to actively contribute to research and knowledge development.

Alongside her research, Di has substantial project coordination and stakeholder-management experience. She has coordinated cross-functional sustainability projects and engaged with more than 30 organizations, involving researchers, practitioners, policymakers, housing organizations, construction companies, contractors, suppliers, consultants, developers, and digital companies. Her responsibilities also include research development, funding applications and proposal development, knowledge dissemination, workshops, seminars, and stakeholder outreach.

Di has actively disseminated her research through international academic conferences and professional research networks. Her conference contributions include the Association of Researchers in Construction Management (ARCOM) Conference in the UK in 2025; the European Network for Housing Research (ENHR) Conference in the Netherlands in 2024; the ARCOM Conference in 2023; and the Amsterdam Institute for Advanced Metropolitan Solutions' Reinventing the City scientific conference.

Di also contributes to education at TU Delft. As an instructor for the master's-level course Information Management in the Built Environment, she has delivered lectures and interactive sessions using digital tools, serious games, and case studies. She has also mentored master's graduation students, supporting them with research design, data analysis, academic writing, project planning, and stakeholder engagement. At TU Delft's Circular Built Environment (CBE) Hub, she designed and coordinated a circular procurement simulation game, which provided a participatory environment for examining stakeholder decision-making and collaboration in procurement.

Before beginning her doctoral research, she completed a master's degree in Architecture, Building and Planning at Eindhoven University of Technology and a bachelor's degree in Architecture and Urban Planning at Beijing University of Technology in China. She also gained practical experience through architecture and project design internships in China, contributing to sustainable design, urban planning projects, stakeholder communication, project planning, and technical documentation.

Her broader societal engagement includes organizing social and cultural events at TU Delft and volunteering in the Netherlands and Beijing.

Publications

Wu, D., Wang, T., Chan, W.P., Gruis, V., (2026), "Integration of Circular Economy in the Procurement Process of Dutch Social Housing: Practices, Challenges, and Development." Smart and Sustainable Built Environment. https://doi.org/10.1108/SASBE-07-2025-0398

Wu, D., Wang, T., Chan, W.P., Gruis, V., (2026), "Multi-Stakeholder Perspectives and Collaboration on Circular Procurement of Dutch Social Housing Renovation." Under review at Business Strategy and the Environment

Wu,D.,Wang, T., Chan,W.P., Gruis, V., (2024), "Holistic Analysis of Circular Procurement in the Built Environment: An Integrated Supply Chain Perspective." Working paper

Wu, D.,Wang, T., Chan,W.P., Gruis, V., (2026), "Examine the gaps between theories and practices of circular procurement in Dutch social housing." Working paper

TOC

26#21

Circular procurement in social rented housing

Experience from and perspectives for Dutch housing associations

Di Wu

Procurement transformation plays a crucial role in accelerating the circular economy transition by creating circular demand and translating circular ambitions into concrete practices. Although circular procurement has received growing attention in recent years, a holistic understanding and investigation that goes beyond incorporating circular economy requirements into existing procurement functions remains underdeveloped. Against this background, this thesis investigates how procurement can be transformed to facilitate the circular economy transition. The built environment, particularly the Dutch social housing sector, provides the empirical context. As a project-based industry, construction faces distinctive procurement challenges arising from fragmented and temporary supply chains, project-specific management, and complex production processes. To address the research aims from both theoretical and empirical perspectives, this thesis adopts a mixed-method research design, combining a systematic literature review, case studies, interviews, focus groups, Q methodology, and desk research. The findings suggest that circular procurement should be understood as an integrated management approach. This approach should align environmental goals, economic incentives, organizational capabilities, and societal expectations by coordinating supply chain management, stakeholder interactions, procurement decision-making, and value creation. Meanwhile, the system-level transformation also needs to be aligned with the complexities in operational practices of procurement. This thesis contributes theoretically to the literature on circular procurement, supply chain management, the built environment, stakeholder collaboration, and Dutch social housing. It also provides practical insights for organizations and supply chain actors within and beyond the built environment seeking to transform their procurement to facilitate the circular economy transition.

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