Circular business models in construction

-Content and enablers for construction companies

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Mid Seminar

For the Degree of PhD. in Construction Management and Building Technology, which by due of the Technical Faculty Board at Luleå University of Technology will be presented on:

(3rd Feb., Luleå)

Discussant: Adjunct Professor, Christina Claeson-Jonsson, Chalmers University of Technology and Director Research and Development NCC AB
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1. Introduction

1.1 Background

As an industry responsible for shaping the built environment for people, the construction industry has long consumed large amounts of natural resources, generated substantial construction waste, and produced significant carbon emissions, thereby imposing considerable environmental burdens which has negative impacts on sustainable development (Benachio et al. 2020; Giorgi et al. 2022; Lee et al. 2024). A competitive, sustainable construction industry will generate number of benefits in terms of better environment and reservation of natural resources (European Commission, 2020). Sustainability topic has for decades been popular in studies in relation in construction management (Giorgi et al.,2022). To realize a sustainable construction industry, a paradigm towards a more sustainable and resource efficient production method is essential.

Ellen MacArthor Foundation (EMF,2015) highlighted concept of Circular Economy (CE) as a feasible paradigm to realize and achieve a sustainable society in terms of production by leveraging the residual value of materials as much as possible. More specifically in the context of construction, reusing building materials (Nuβholz et al. 2019; Riuttala et al. 2024), recycling construction waste (Hoang et al.,2020), repurposing waste material from other industries (Nayak et al. 2022) , reducing the use of natural fuel (e.g. fossil fuel , diesel and gasoline) and using electricity (Huang et al. 2024) instead of traditional fossil energy have been mentioned as feasible part solutions in previous research. Studies show that such practices are viable to provide environmental value by preserving natural resources as well as reducing carbon emissions (Nußholz et al., 2018; Nuβholz et al. 2019).

However, this transition encounters several challenges, such as the lack of economic incentives (Adam et al. 2017), lack of understanding and knowledge to promote circular principles (Munaro & Tavares, 2023), and lack of support from policies (Munaro & Tavares, 2023). These factors prevent circular practices from being implemented in construction projects smoothly. Li et al. (2025) highlighted that construction companies face external challenges including economic uncertainties, increasing competition and changes from policies. To respond to these challenges, studies highlight that the transition from conventional construction mode to construction with circular practices requires changes in business model (BM) (Mokhlesian & Holmén, 2012; Giorgi et al., 2022). The challenges arising during the construction industry's transition to implement circular practices suitably stem largely from its long-standing adherence to a linear production model- namely, the "take-use-dispose" approach, whereas implementing circular practices in construction requires coordinated improvements in resources, capabilities, information systems and adjustments in external policy (Mokhlesian & Holmén, 2012; Munaro & Tavares, 2023). As Li et al. (2025) mentioned, business model innovation, involving the reorganization of resources and reconfiguration of capabilities, constitutes an effective approach to address challenges connected to circular practices.

Business model is a firm-centered concept articulating the architecture of business logic (Osterwalder et

al. 2005), including value creation and delivery processes, value propositions, and value capture mechanisms (Bocken et al. 2013). This concept helps to visualize business logic and enhance the clarity of communication among stakeholders (Osterwalder et al. 2005). The application of the business model concept by construction companies needs to be further conceptualized and systematized (Abeynayake et al., 2021; Li et al., 2025). The existing gap lies not only in defining the business model concept, but also in understanding the phases through which construction companies can transform towards more circular practices in projects (Abeynayake et al., 2021). Li et al. (2025) summarized the evolution of the business model concept in the construction industry, identifying a *conceptualization* phase and an *application* phase, and highlighting the use of business model as a tool for better integrating *innovations* (innovation phase) into day to day business operations. The phase of conceptualization means defining the business model concept in construction, the application phase means how the construction companies apply the concept as an analytical tool with identification of business model elements and interrelationships between elements. Lastly, the innovation phase involves how construction companies utilize the business model concept to leverage emerging technologies to add value for customers and gain competitive advantages. Such a conceptual evolution of business models within the construction industry offers a structured pathway for examining concepts and mechanisms of circular business model (CBM) in construction. Prior literature reviews have studied the changes needed to enable CBM in construction (Mokhelsian & Holmén, 2012; Giorgi et al. 2022). To embed circular practices into their business operations, construction companies are required to modify their capabilities, value configurations, and partner networks, while simultaneously reconfiguring value propositions, cost structures and capabilities (Mokhlesian & Holmén, 2012). Mokhelsian & Holmén (2012) predominantly focused on which elements of business models require change, rather than on specifying the content of business models themselves (Mokhelsian & Holmén, 2012). Munaro et al. (2021) also strived to study the content of CBM for achieving sustainable buildings, with extracting five clusters of BMs from 89 studies and proposing a framework for achieving sustainable buildings. Although previous studies indicate that business models need to be changed to implement circular practices in projects, the content and operation mechanisms of CBM remain insufficiently understood which in turn makes construction companies reluctant to implement them in practice. The literature consequently highlights the need for a better understanding of circular business models in the construction industry (Munaro et al. 2021).

Therefore, a comprehensive framework is needed to support the understanding of CBMs for construction companies. The framework should clearly articulate the content of value proposition, creation, delivery and capture, in order to support subsequent analysis of interrelationships between business model elements. Li et al. (2025) also examined how business models have been applied as an analytical tool within the construction industry. In general, the application of business model concepts in construction industry encompasses two main types of frameworks: value-oriented framework (Holtström et al. 2024) and strategy-oriented framework (Brege et al. 2014). Both frameworks have proven feasible for analyzing business logic; however, they are applied in different contexts (Li et al. 2025). Regarding value-oriented frameworks, they have been widely applied in case studies within the construction industry. These frameworks focus on how value can be created for clients by optimizing and adjusting the relationships among different business model elements, with particular attention to the processes of value creation (Holtström et al. 2024). Several case studies applied this approach to investigate success factors or determinants for value creation or captur (Riuttala et al. 2024; Holtström et al. 2024). For the strategy-oriented framework, the application mainly focused on relationships between strategy decisions and

effectiveness (Li et al. 2025). For analyzing applications of CBMs for construction companies, the level of implementation of circular practices lies in projects (Holström et al. 2024). Based on this fact, studies are viable to apply value-oriented framework to analyze how internal resources and competencies are organized to create value for clients in projects (Li et al. 2025). The reason could partly stem from the fact that construction industry has a project-based nature (Eriksson, 2013; Hedborg & Addyman, 2024). To form a construction company's implementation, it is important to know mechanisms of how proposed circularity-oriented value is created, delivered and captured in projects. Therefore, value-oriented framework is feasible to use as an analytical tool to study construction projects with circular practices.

Prior studies associated with the mechanisms of CBM in construction projects based on value-oriented framework have not been studied sufficiently (Hart et al. 2019; Giorgi et al. 2022). Mokhelsian and Holmén (2012) emphasized that the relationships between different elements of circular business models in construction project constitute an important area of research. Prior studies focused on determinants of value capture in circular construction projects (Riuttala et al. 2024), indicating how the economic value can be created by reusing e.g. concrete building components, and factors that affecting the potential of value capture. Additionally, some prior research have examined success factors associated with realizing circular construction practices, including reusing building components (Knoth et al. 2022), or the use of timber in building extension and renovation projects (Holtström et al. 2024). These studies illustrate factors that determine the success of creating proposed value. However, the mechanisms of CBM for implementing circular practices in projects need more studies since the practices for realizing circularity in construction projects may not only include reusing building components. For instance, substituting virgin natural resources with renewable resources or energy sources which can help reduce natural resource consumption which is Reduce (Huang et al., 2024),or using waste materials from other industries- such as fly ash- can be used as components of concrete construction materials, regarded as Repurpose, thereby contributing to utilize the remaining value (Nayak et al. 2022). Although these practices all fall within the scope of circular business models, it remains underexplored whether the relationships among business model elements are consistent when different construction practices are adopted. Therefore, investigating the factors that enable circularity to be realized in construction projects under different circular initiatives is significant to study.

1.2 Aim of this study

This mid-seminar report aims to summarize up a two and half years research study with a focus on the content and mechanism of CBM for construction companies, as well as propose and discuss potential future research directions within the context of CBM implementation. To achieve this aim, two sub-studies have been conducted. First a literature review was conducted to articulate content of CBM for construction companies , secondly an exploratory case-study of three construction projects with circular value initiatives have been conducted . Results of these studies advance the understanding of mechanisms of CBM for construction companies and the enablers important for realization of circular initiatives. The report ends with proposing several further research directions based upon the results from the conducted research.

2. Theoretical background

2.1 Business Model concept

When engaging in business activities, an organization employs business model concepts whether explicitly or implicitly (Teece, 2010), which represents the architecture of the business running logic of a business entity. More and more arguments related to business model arise for a common definition as the architecture of value creation, value delivery and value capture mechanisms a company employs (Teece, 2010; Osterwalder & Pigneur, 2010). As argued by Casadesus-Masanell and Ricart (2010), business model could be seen as a realized strategy and tactics are remaining actions at the operational level which decide how much extent the value could be created and captured in the end. Studies often brake down the business model concept into three elements, *Value proposition*, *Value creation and delivery* and *Value capture*, which also remain the characteristics of business model structure valid (Bocken et al. 2014; Munaro et al. 2021). Value proposition provides an overview of products or services from the company for a segment of customers. Value creation and delivery mean how the company organize activities, collaborates with partners, as well as using resources to realize value propositions and deliver to the target customers. Value capture expresses the monetary outcome resulting from the processes of value creation and delivery, hence the revenues obtained from delivering proposed value to customers (Osterwalder et al. 2005; Mokhelsian&Holmén,2012). Concerning the composition of business model, Osterwalder has systematically consolidated business model's elements and proposed the Business Model Canvas (Osterwalder et al. 2005; Osterwalder & Pigneur, 2010). The business model canvas breaks down the concept of a business model into nine detailed building elements, namely; value proposition, key activities, key resources, key partners, customer relationship, customer interfaces, distribution channel, cost structure and revenue streams (Osterwalder & Pigneur, 2010), see *Figure 1*. Based on description above, elements of the business model structure are not independent of one another, the interrelationships form a critical aspect of the business model structure and how it work in real applications (Zhang et al. 2025).

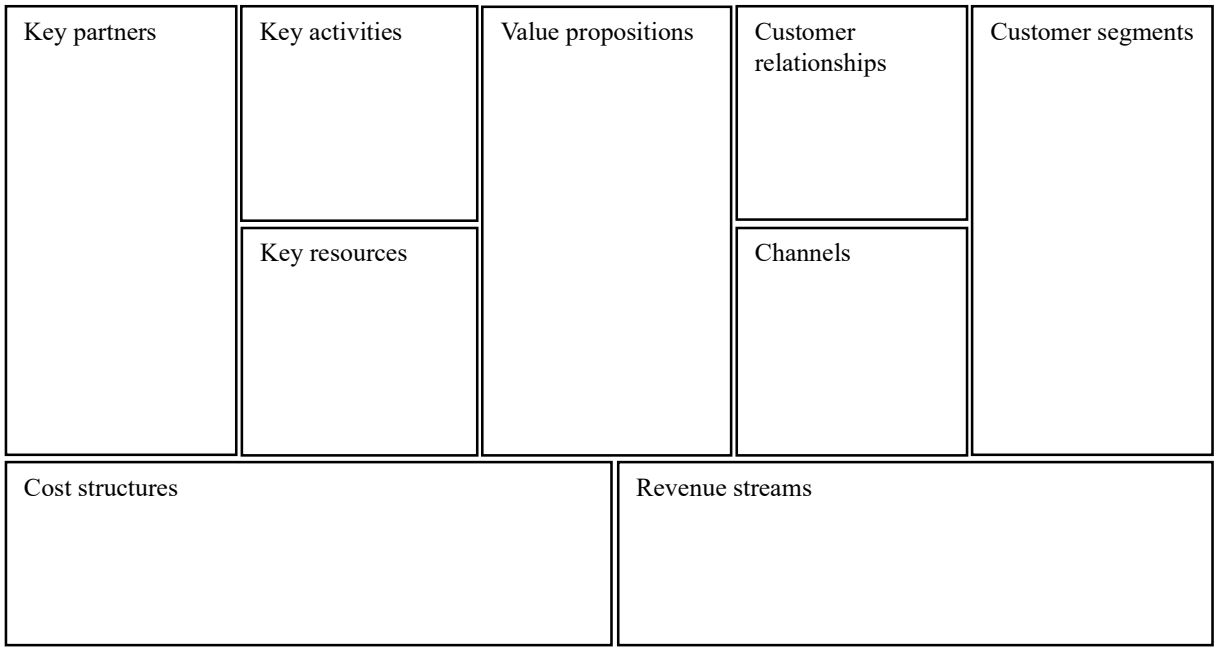

Figure 1. Business Model Canvas (Adapted from Osterwalder & Pigneur, 2010)

2.2 Circular practices in construction

Circular economy has been in the central of the arena in EU for decades (Giorgi et al. 2022), and construction industry is not an exception. Multiple studies have focused on practices that may help construction processes become more resource-efficient and reduce carbon emissions significantly (Condotta & Zatta, 2021; Yi et al.,2026). These practices (e.g. reuse of building elements or materials, recycling construction and demolition waste, electrifying construction machinery to replace the use of fossil energy) embody environmental, economic and social value (Nußholz et al., 2019; Riuttala et al., 2024). Nuβholz et al. (2019) studied a construction company providing three products based on reused materials, finding that reuse of building materials embodies significant potential to be price-competitive with linear production and provide reductions in environmental impacts. Using electric construction machines to replace traditional oil-fired construction machinery has been shown to be a promising way to improve air quality and achieve goals of carbon emission reduction (Yi et al., 2026). By replacing oil-fired electric construction machinery with electric machines, air pollutant and carbon emissions can be reduced by approximately 50% and 42% respectively (Wang et al. 2023). Besides, the consumption of fossil fuel (e.g. diesel) would decrease, which is beneficial for the reservation of natural resources. However, economic benefits generated by electricity of construction machines are insufficient to be understood. More studies are needed to understand if any economic benefits could be generated by the utilization of electric construction machines in construction. Repurposing waste from other industries into valuable construction materials is another typical circular practices within the construction industry, e.g. Nayak et al. (2022)shown that it is possible to use fly ash as a substitute for cement in concrete manufacturing. This practice enables the reduction of cement usage thus could generate environmental and economic benefits (Nayak et al., 2022). The construction industry employs a variety of circular practices, yet they share a key characteristic: each has the potential to create environmental value (e.g. reduction of carbon emissions, reservation of natural resources), while some additionally show the capacity to deliver economic (e.g. decrease the material costs) and social value (e.g. more job

opportunities). These realities underpin the feasibility of realizing value creation through circular practices in the construction industry (Ossie et al. 2023).

However, value is not created or realized automatically through the implementation of circular practices. A variety of factors may affect the value creation process, resulting in potential value leakage. For instance, Riuttala et al. (2024) examined the factors that enable or constrain the capture of economic value in building component reuse. E.g. the cost of treating reusable materials (e.g. cleaning and transporting) should not exceed the cost of virgin materials (e.g. concrete components). However, the price of reusing building components has not been competitive and costs of treating and deconstruction remain high (Munaro & Tavares 2023). Besides economic barriers, informational, institutional, political and technological barriers also hinder the transition towards circular economy in the construction sector and possibly generate value leakage (Munaro & Tavares 2023).

2.3 Circular business models in construction

As circular practices in construction do not automatically guarantee value creation and capture, it is important to examine how value is created and delivered to clients through these practices. The business model concept has been applied to the construction industry since early 2000s, but the application remains fragmented (Li et al. 2025). To incorporate circularity into construction process and add value for the client and society, business model adjustments for circular construction are needed (Mokhelsian & Holmén,2012). To realize the transformation towards circular economy (CE) in construction industry, delivering value created by circular practices to clients is significant. This indicates that merely implementing circular practices (e.g. substituting traditional concrete with fly ash concrete in a project) is far from sufficient to realize circular initiatives smoothly. Various challenges, for instance, the uncompetitive price of recycled materials, fragmented collaboration in supply chain could lead to the value leakage which decrease the motivation of implementation (Munaro & Tavares 2023). Therefore, it is necessary to investigate business models for circular construction in order to clarify how the environmental, economic and social value generated by circular measures can be preserved to the greatest extent (Hart et al. 2019; Giorgi et al. 2022).

When adapting business models for circular construction, modifications made exclusively by the construction company are insufficient. The collaboration model with the client also plays a critical role and warrants careful consideration (Mokhlesian & Holmén, 2012). The literature shows that procurement and contracts limit the use of environmental criteria. For instance, client and construction company confirm the arrangement of contract is "design-build" mode, which means the design work is conducted after procurement process making types off environmental preferences introduced in procurement meaningfulness (Mokhelsian & Holmén, 2012). Besides examining new forms of collaborations with clients, internal changes within the construction company are equally crucial (Mokhlesian & Holmén, 2012), changes in project design and material utilization (e.g. reused building components) necessitate corresponding adjustments in the supply chain as well as knowledge and capabilities in organization. Furthermore, the project-based nature of the construction industry increases the complexity of examining how firm's business models must evolve to support circular construction. As indicated by (Geissdoerfer et al., 2020), adjustments in business models for construction companies should start from the business unit (project) to organization. Insights associated with how to adjust BMs to adapt circular construction

from project level are valuable to provide inspirations for the company to adjust and develop their business models. Holtström et al. (2024) highlighted the importance of selecting appropriate level of analysis in construction business model studies which chose project as the business unit and found that knowledge derived from the project, holistic perspective on planning, involvement of all actors from design to completion are success factors for the timber extension project.

3. Methods

3.1 Research overview

The reserach is jointly funded by SBUF (Svenska Byggbranchens Utvecklings Fond) and Creaternity (an internal funding from Luleå Univeristy of Technology with a specialization on enhancing circularity to build a sustainable industry and society with the help of new technologies and business models). The focus of the research is to enhance our understating of circular practices and provide preliminary recommendations- from the perspective of a construction company on how to adjust their business models to meet increased sustainability and circularity requirements . The research method consists of two main components. The first component is a literature review that examines existing studies on how construction companies may adapt their business models to support circular construction practices, hence support the implementation of CBM. This review summarizes current knowledge in the field and identifies relevant research gaps within the field of CBM.

The second component consists of a case study conducted at a major construction company as the focal firm.. The study examined three of its construction projects that involve different circular initiatives (i.e. reduce, reuse and repurpose). These cases provide data to find enablers for value creation across different circular initiatives. The insights derived from these cases provide valuable implications for construction companies by identifying enablers for the realization of circular initiatives. This knowledge supports construction firms in adopting circular practices more effectively in projects, for example, facilitating smoother collaboration with clients and reducing the risks of project delays and cost overruns.

3.2 Literature review

The literature review has been an effective method to provide a comprehensive view of existing knowledge within the field. In the literature review, a three-step research process was adopted, including searching articles, the selection of data, synthesizing and analyzing. During the data collection process, Scopus was chosen as the database for literature for its broad coverage and multidisciplinary scope (Zhang et al. 2025). A search string was used to help collect literature associated with business models for circularity in construction or discussions associated with part of the business models in construction (e.g. value creation in construction processes). Given this principle, the final search string used in this study was: "Circular*" OR "Sustainable*" AND "Business Model*" AND "Construction*". The asterisk was used to replace letters at the end of certain words. After searching literature by this string, 220 initial articles were identified (by the year of 2024). The next step was to determine whether the result collected should be, or not be, included in the analysis. To ensure the eligibility of the study, four inclusion principles were adopted when examining literature searched from the Scopus. These four principles were:

The literature should be published in English with full text available; the published literature should be included in a peer reviewed journal; the term "construction" in the article means activities associated with building/construction as a context; the article focus or be related to one of elements of business model. After the selection of literature, 53 articles were extracted and read for synthesizing and analysis. Regarding the analysis part, Business Model Canvas was used as a framework to make the summarizing process easier. When reading the article, content related to the elements of business model canvas was extracted and categorized. 34 aspects were extracted in a business model canvas after synthesizing and analysis process.

3.3 Qualitative approach

As proposed by the literature review, the studies need to investigate more interrelationships between different business model elements. Therefore, a study with multiple cases was conducted to explore the mechanisms of how circular practices adopted in projects. To achieve this objective, three different construction projects involving circular initiatives were studied. Through case studies, enablers that promote the realization of circular initiatives, mostly environment-oriented, were extracted to indicate the interrelationship between business model elements. Detailed facts associated with construction project development, procurement, processes were collected as data sources for this study.

Given that the mechanisms through which circular business models operate in the construction industry have not been sufficiently studied, in-depth analysis of specific cases were bound suitable. Therefore, qualitative case studies can reasonably be adopted as an appropriate method for conducting exploratory studies to gain in-depth insights (Eisenhardt, 1989; Yin, 2018). Additionally, even though the concept of business model is generally used at the organizational level (Osterwalder, 2005), the value in construction industry is created in projects. Given this situation, the study takes project as the unit to collect qualitative data and analyze to generate insights associated with enablers for achieving circular initiatives as it will provide detailed and comprehensive information for researchers (Holström et al. 2024). In this study, we collected empirical data from three construction projects in one construction company to reduce the confounding factors, i.e. organizational culture, increasing the focus on enablers for realizing circular initiatives in projects. Regarding the selection of cases, the projects studied were selected in collaboration with the construction company. The chosen projects should include measures aimed at enhancing sustainability performance to create environmental value

With regard to the empirical component of the study, data were collected using semi/structured interviews. In total, 16 semi-structured interviews were conducted across three construction projects. Detailed information about the different projects is provided in **Table 1**. Interviewees represented a range of project roles, including clients, project managers, and project engineers. Detailed information about the interviews is provided in **Table 2**. Depending on the arrangement of projects, different interviewees were involved in different phases of the construction process, such as procurement, project planning, and production. Accordingly, minor variations in interview questions were allowed during the interviews to focus on the specific project phases in which the interviewees were involved. All the interviews were recorded, transcribed, and analyzed using thematic coding to identify key factors associated with the realization of proposed value

Table 1 Detailed information of the projects studied

Project	Characteristics of projects	Type	Duration	Others
P1	A land preparation project in collaboration with a public municipality client for the development of an industrial park. The project demonstrated a strong commitment to environmental sustainability with the electrifications of construction machines.	Infrastructure	Construction time: 2022–2023.	The collaboration form with the client is the partnership. This project is aided by a public administration in finance to explore the use of electric construction machines. This project is BREEAM[1] certified
P2	An infrastructure project to enhance the safety of an old hydro plant with the utilization of new concrete recipe that could reduce the carbon emission from concrete production and minimize cracks that generated during the curing process.	Infrastructure	Construction time[2]: 2021–2024.	The collaboration form with the client is the design-bid-build contract in partnership.
P3	A project focuses on the large-scale reuse of building components to reduce the carbon emission in a significant quantity. The goal of the project is at least 50% of the built in parts that should be from reused materials and components.	Building	Construction time: 2024–2026	The collaboration form with the client here is the design-build contract in partnership. This project is a pilot project for the exploration of large-scale reuse in the focal construction company.

1. BREEAM is a certification providing a comprehensive framework to assess sustainable value and validate performance of various categories of products.
2. The construction time means the time for production. The time for procurement and designing is not included here.

Table 2 Detailed information for interviewees

Project	The role in project	Interview form	Codes for representing the interviewee
P1	Project manager	On site	R1
	Project engineer	On site	R2
	Tender engineer	On site	R3
	Site manager	On site	R4
	Consultant	Digital	R5
	Consultant	Digital	R6
	Project manager from client	Digital	R7
P2	Project engineer	Digital	R8
	Site manager	Digital	R9
	Technical specialist	Digital	R10
	Project manager from client	Digital	R11
P3	Innovation coordinator	Digital	R12
	Project manager	Digital	R13
	Business manager in project	Digital	R14
	Project manager from client	Digital	R15
	Consultant	Digital	R16

4.Results

4.1 Paper 1

Zhang, B., Larsson, J., & Reim, W. (2025). Circular Business Models for Construction Companies: A Literature Review and Future Research Directions. *Sustainability*, *17*(10), 4688. https://doi.org/10.3390/su17104688.

Status: Published on 20th May 2025

Summary of the paper:

This paper provides an overview of CBM for the construction company based on Osterwalder's business model canvas, shown in the theoretical background *Figure 1*. As the construction industry needs a transition toward sustainability, the circular economy represents a powerful approach to effectively reduce natural resource consumption and carbon emissions, thereby enabling the industry to transform into a more resource-efficient and environmentally friendly sector. However, during the transition process, it has become evident that the adoption of CBM requires deeper investigation. Previous literature indicate that supply chain mismatches, high costs, and insufficient supporting infrastructure pose significant challenges to the actual implementation and wider adoption. Although the number of studies on the implementation of circular practices in construction projects has been increasing, comprehensive research examining the BMs that enable such practices from a BM perspective remains limited. Consequently, conducting a systematic and comprehensive literature review becomes necessary.

The study used the Scopus database as the data source, as Scopus is a relatively comprehensive database that covers a wide range of academic disciplines. The conducted literature review included 53 journal articles, based on the content analysis, categories were identified for each business model element which is called aspects. 34 aspects representing categories under different business model elements in relation to CBM were extracted from literature, see *Figure 2*.

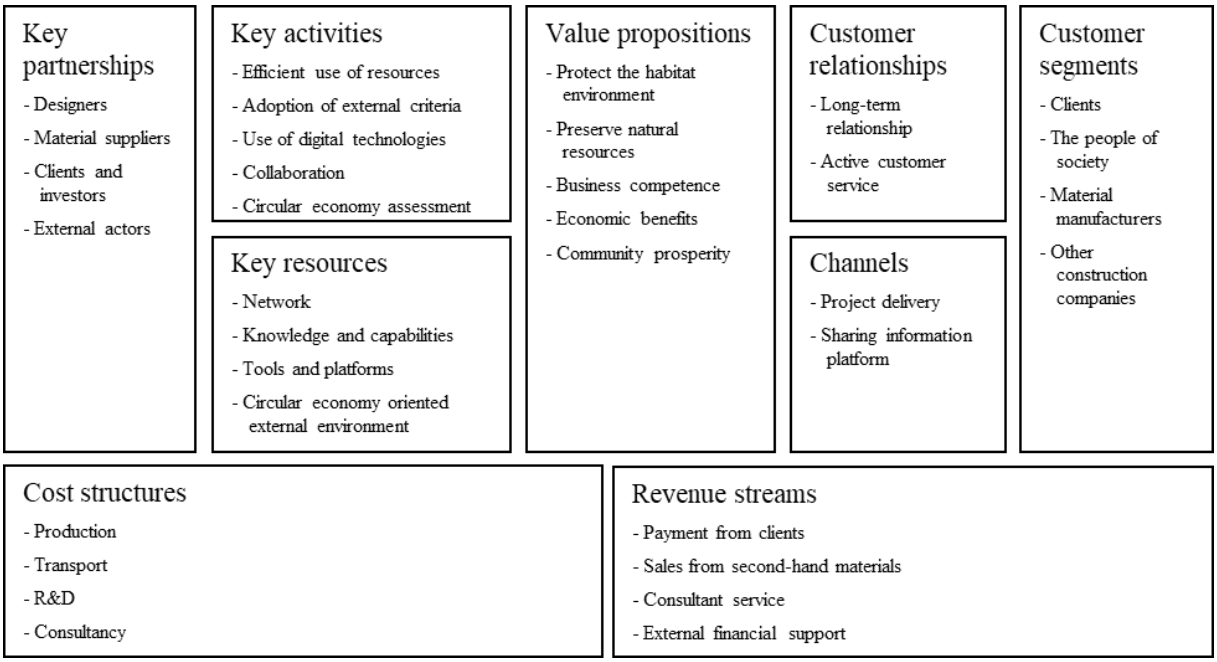

Figure 2 Circular business model for the construction industry

Based on the results of the literature review, in terms of *value propositions*, construction projects delivered by contractors through the implementation of CBMs can provide clients with environmental value, enhanced business competitiveness and economic value. With regard to realizing these value propositions, particularly environmental value, the *key activities* and practices involve improving the efficiency of resource use. These include recycling and reusing construction materials or building components, reducing the consumption of virgin natural resources by substituting them with renewable resources, and collaborating with other industries to utilize industrial by-products as inputs for construction materials. Such practices enable waste from other industries to regain value, reduce environmental impacts and maximize the utilization of exiting materials. These activities represent key manifestations of the circular economy within construction projects. To enable their effective implementation, other supporting activities are also essential. For example, the use of external criteria provides practitioners with clear guidance for project implementation, while the application of digital technologies facilities real-time access to material information, supports overall-planning, and enhances coordination among different actors within the supply chain. In addition, the evaluation of circular practices constitutes a critical activity, as it helps prevent situations in which the environmental burdens generated by circular construction exceed those of conventional construction projects. These key activities also require the involvement of appropriate personnel and *key resources*, and they have direct implications for project costs. On the other hand, research on the relationship between construction companies and their clients in circular construction projects remain limited. In particular, there is a lack of understanding of how clients interpret the concept of circularity and how such interpretations are translated into contractual arrangements. This aspect is nevertheless critical for construction companies when implementing circular practices in projects, as a clearer understanding of client expectations can help contractors better meet client requirements, build trust, and increase the likelihood of securing similar projects in the future, thereby contributing positively to generate revenue.

Additionally, this paper highlighted the need for more knowledge in relation to the relationship between

different elements of business model to make the business model more likely to be used as a system (Zhang et al. 2025). The interactions among different elements of circular business models are also implicitly reflected in the content of these elements. Beyond the composition of individual business model elements, the interactions between elements constitute a critical component of the mechanisms through which business models operate. In this study, particular emphasis is placed on the interrelationships among key business model elements. These include the alignment of value propositions among different key partners along the value chain, as well as the relationship between the key activities required to realize value propositions and the associated cost structure. Circular practices also enable construction companies to assume new roles, such as sellers and service providers of reused building components, thereby attracting new customer segments. The impact of such business expansion on revenue generation represents an important area of investigation and may create economic incentives for construction companies. In addition, the development of digital technologies, such as material information platforms and digital markets for reuseable materials, constitutes a critical infrastructural element that can facilitate and simplify the implementation of circular construction.

This paper concludes the content of circular business models from a more general perspective, providing a broad view for both construction companies and policy makers about what has been learned and included in relation to contents of CBM for construction companies. However, more studies are needed to take the individual company as a starting point, to investigate business model that meet requirements from clients for the objective of further innovation. The business model innovation includes different dimensions and levels, especially for project-based enterprise (i.e. business unit, organizational level, ecosystem). To acknowledge the interplay between client's requirements and construction companies business models, taking a company as a starting point to observe enablers and challenges when conducting circular initiatives and trying to see the connections between projects (business units) and organization would be reasonable ways to study CBM adjustment and implementation towards circularity in the construction industry.

Author contribution:

Bowen Zhang is the first author of this article and was primarily responsible for developing and generating research ideas, data collection (including selection of keywords for the searching string, inclusion of targeted articles), data analysis and discussion, manuscript drafting, manuscript revision and submission.

Johan Larsson was primarily responsible for conceptualization, funding acquisition, project administration, data analysis, supervision, writing – review and editing, final approval of the submitted version

Wiebke Reim was primarily responsible for the conceptualization of this paper, data analysis, supervision, writing- review and editing, final approval of the submitted version.

4.2 Paper 2 (Working)

Zhang, B., Larsson, J. & Reim, W. . Enablers for realizing circular initiatives in construction projects: Insights from a multiple case study. *Journal of cleaner production* (plan to submit in February 2026)

Status: Paper is under development

Summary of the paper:
The transition towards circularity in the construction industry encounters challenges including the unalignment of current business models and client requirements to enhance the extent of circularity in construction projects. For instance, the lack of economic incentives, conflicts of incentives between actors in the supply chain, hinder the transition and make construction companies reluctant to adopt circular practices in projects. To overcome these challenges, previous studies have focused on enablers or success factors that contribute to the adoption of circular practices in projects, e.g. promoting the involvement of manufacturers, and acknowledging the need of suitable communication and documentation between the construction company and the client. However, these studies have mostly focused on one circular initiative (e.g. reuse of building components, or sustainable wood extension) which lack a holistic perspective for a combination of circular initiatives. Usually, a large sized construction company has several projects with different circular initiatives. To address these issues, this study aims to explore the factors that enable the realization of different circular initiatives, thereby shedding light on part of the underlying mechanisms of circular business models, especially the relationship between value proposition and value creation (key activities, key partners and key resources). Therefore, this study conducted a multiple case study including 16 semi-structured interviews with practitioners (i.e. clients, consultants, engineers in the construction company) to investigate enablers that contribute to the realization of circular initiatives in three projects from different construction contexts. The identified enablers are presented in **Table 3**.

The study finds that the value created in project is mostly shown as the environmental value and stems from the working method proposed (i.e. *reusing* building materials, *reducing* the use of natural resources by using electric construction machines, and *repurposing* fly ash to substitute cement in concrete). Despite differences in technical focus and implementation pathways, the analysis reveals that circular initiatives which are reduce, repurpose and reuse share a set of mutual enablers at the project level. To realize these initiatives, firstly, the *collaboration with client* to get economic feasibility and smoother process emerge as an enabler across all initiatives. In all initiatives, client and contractor move beyond traditional cost-driven contract and adopt more collaborative arrangements, which help to accommodate uncertainty, allow cost flexibility to ensure that circular initiatives can be realized under suitable and acceptable cost conditions. Secondly, an enabler among all initiatives was the use *of early-stage planning and organizational capabilities*. The capability to translate circular ambitions into technically feasible, contractually acceptable solutions is a crucial enabler. Thirdly, all initiatives need *careful planning at the early stage* due to uncertainties of implementing circular practices in construction projects. To realize circular initiatives require decisions to be made earlier and demands tighter integration between design, procurement, construction planning and cost estimation. Early planning and involvement of various stakeholders allow uncertainty to be managed proactively. Also, the construction company would have a view that different working methods may lead to different levels of challenges. Based on the experience of these three circular initiatives, the

study found that when the circular initiative (i.e. using fly ash concrete in the infrastructure project) needs less action for adjustment to realize the value of material properties, the easier it will be viable in terms of time and costs.

The findings may increase the construction company's knowledge about how to adjust their business model to meet clients' circularity-oriented requirements. Sometimes, the requirement from the client is fuzzy in terms of specific working method. Under this situation, it leaves the construction company room to select appropriate methods to realize the environmental value when also ensuring the viability of economy. Also, paying attention to developing capabilities to get specific resources and partnerships in an immature circular construction market could decrease the cost of construction projects and help to establish competitive advantages for bidding processes.

Authorship:
Bowen Zhang is the first author and corresponding author for this article. He works for and be responsible for the generation of article's ideas, data collection and analysis, manuscript drafting, and manuscript revision and submission.

Johan Larsson is primarily responsible for conceptualization of this paper, the acquisition of funding project administration, data collection, data analysis, supervision, writing review and editing

Wiebke Reim is primarily responsible for conceptualization of this paper, the acquisition of funding, data analysis, supervision, writing review and editing.

Table 3 Enablers for realizing circular initiatives in projects

Initial codes	Final codes	Circular initiatives
The adoption of a partnership-based contractual arrangement	Collaborative Governance with client	Reduce
Electrification readiness as tendering criterion and organizational capabilities for realizing using electrified machines.	Organizational capabilities and resources mobilization	
Internal access to electrified machinery		
Internal collaboration with consulting engineers under conditions where the client offered relatively low fee for project planning		
Digital tools enable earthwork balance optimization	Technical and Operational planning readiness for project	
Coordinating large and small electric equipment		
Early clarification of responsibilities for electrification infrastructure		
Access to energy storage through energy provider collaboration	External key partnership and support	
Additional funding for implementing electrified construction equipment which alleviates cost pressure		
Use of BREEAM to clarify vague client requirements		
Partnering procurement to allow cost flexibility for the utilization of new concrete recipe	Collaborative Governance and early stakeholder alignment	Repurpose
Early collaboration with client and supplier for repurposing fly ash in concrete to construct dam		
Mutual trust built between construction company and client enables efficient collaboration		
In-house expertise on fly ash concrete performance for feasibility assessment at the early stage	Organizational capabilities and early-stage feasibility assessment	
Capability and experience for realizing sustainability in project with suitable cost to win the tender		

Low heat generation enables mass concrete casting process for the dam Cost reduction potential of fly ash as an industrial by product to enable lower cost of projects Properties of concrete recipe with low heat generation reduces rework risk and cooling needs with saving cost.	Material performance-driven technical and economic feasibility.	
Accessibility of local source of reusable building components Regulatory adaptation for reused components	Contextual and external institutional conditions for reuse feasibility	Reuse
Team adaptability to time-constrained material sourcing Early alignment of building design with reusable material availability	Organizational adaptability and design planning integration	
Shared understanding of reuse complexity with client which enables cost flexibility Accurate cost estimation for reusing building components in early planning Cost savings from client owned storage facilities for storing components	Collaboration with client and economic feasibility	

4.3 Working paper 3

Zhang B., Wisse E.S., Enhancing contractor's readiness to reuse building materials in projects – a case study in Sweden. Plan to submit and present the work at 42nd ARCOM Conference 2026, Loughborough University.

Status: Paper is under development, abstract submitted on 15th Jan. 2026

Abstract:
To meet stricter climate goals, contractors need to integrate reused materials into project delivery. While pilot projects demonstrate that reuse is technically feasible, project-level insights do not fully translate to organizational learnings. Examining a Swedish residential pilot project, this paper draws on 12 semi-structured interviews with clients, contractors and consultants to identify key learning domains that emerge when contractors aim to operationalize reuse. The findings show that contractors need to a) navigate an immature reuse market, including unpredictable material availability and pricing logics, and unclear quality assurance procedures; b) coordinate and integrate reuse-specific design and execution, as design adjustments are required and logistical challenges arise, disrupting established processes; and c) address collaboration and procurement limitations, as partnering during pilot projects enables experimentation but weakens economic competitiveness. Together, these suggest that contractors will need to translate project-level insights into organizational capabilities to move beyond the pilot setting. This paper contributes by providing insights into collaboration mechanisms as well as success factors during project planning and execution, thus advancing the understanding of how building component reuse can suitably be achieved in projects.

Keywords: reuse, pilot project, organizational readiness, circular procurement, partnering.

Authorship:
Bowen Zhang is the first author and corresponding author for this conference paper. He is primarily responsible for developing the idea, organizing project meetings, data collection, data analysis, drafting and revising manuscript.

Sean Eille Wisse is responsible for developing ideas, data collection, data analysis, drafting and revising manuscripts.

5. Concluding remarks

By combining the findings from the literature review with the completed qualitative study, several recurring factors that are critical for enabling circular construction at the project level can be identified. One such factor is the use of external criteria, such as BREEAM, which plays an important role in guiding projects to achieve sustainability objectives within a reasonable cost range. In addition, sustainability- or circularity-oriented goals tend to increase project complexity, for example in material logistics and in sourcing suitable reusable materials within specific time constraints. Under these conditions, key resources, particularly project- and firm-level skills, knowledge, and capabilities, emerge as crucial factors in enabling realization of circular initiatives in construction projects.

At the same time, the analyzed cases consistently show a tendency toward increased initial project costs when implementing circular practices (e.g. reusing building components) which is in line with previous literature (Riuttala et al. 2024). For instance, environmentally friendly concrete is generally more expensive, and reused building components require inspection and processing to ensure usability, which increases production and R&D costs. Nevertheless, the findings also indicate that economic value creation remains possible. For example, environmentally friendly concrete can be easier to handle during large-scale casting processes and may reduce the risk of rework, thereby improve productivity and lowering overall costs. Moreover, fly ash, used as a substitute material, is an industrial waste product whose price has the potential to decrease. In projects involving the reuse of building components, the exploratory and demonstrative nature of the projects means that standards for reuse have not yet been fully established. Once such standards are developed, the costs associated with repeated inspections are expected to decline. Therefore, although trade-offs between environmental and economic value are currently observed, there is clear potential for achieving both environmental and economic value simultaneously in the future.

Synthesizing the findings from the case studies with insights from literature review reveals that, although prior research highlights the potential for generating economic value through the implementation of circular practices in construction projects (Guerra & Leite, 2021), the three studied projects were primarily driven by environmental value creation. Economic considerations were largely framed in terms of cost acceptability, rather than as opportunities to actively capture through the reuse of components based on their residual value. As a result, the anticipated economic value generation was not realized in practice. This can be attributed to a combination of external and internal factors. Externally, immature market conditions- such as the lack of well-developed digital marketplaces and supporting infrastructure, limiting contractors' ability to effectively plan and implement circular practices in projects. These external challenges are consistent with the findings of (Christensen et al., 2022; Yu et al., 2022), highlighting the current immaturity of industry practices. Internally, contractor related capabilities, including cost forecasting and control, as well as insufficient knowledge regarding the implementation of circular practices further constrain the realization of economic value.

Also, the results of the case studies reveal that all three projects exhibit several common enablers for realizing circular initiatives, including *collaboration with client to get economic feasibility*, *organizational capabilities* and *careful planning at the early stage*. The need for changes in *organizational capabilities* is consistent with the findings reported in the literature review by (Mokhelsian & Holmén, 2012), reflecting the

requirements for companies to possess access to scare resources and knowledge related to the implementation of circular practices, which in turn enhances project feasibility. Early planning also emerges as a critical enabler, a finding that aligns with (Holtström et al. 2024) on building extension with timber, which emphasizes the importance of involving project participants early in the process to achieve more effective planning. Additionally, the analysis shows that although the implementation of circular practices generally leads to increased costs under current conditions, the cost impact tends to be lower when changes are primarily introduced at the material level without substantially altering existing work processes. In such cases, projects appear to be less affected by knowledge limitations and immature market conditions.

The study finds that while there are common enablers across circular construction projects, there are still significant differences between projects in terms of how environmental value is realized. This highlights the need for construction companies to account for project-specific characteristics when implementing circular practices and to make choices accordingly.

6.Future directions

This report primarily aims to clarify the content of circular business models for construction companies and to explore the mechanisms of circular business models at the project level through case- based analysis, with a particular focus on the enablers for the realization of circular initiatives. However, achieving the broader goal of enabling construction companies to independently and systematically implement circular business models and thereby facilitate the wider implementation of circular practices in projects requires more further investigations. Accordingly, this report outlines several feasible directions for further research.

First proposition

Further research is needed on the mechanisms through which circular business models operate at the project level. In the case studies analyzed in this research, the projects are pilot projects. This implies that the relationship between the client and the construction contractor is largely collaborative, with the shared objective of generating knowledge through project implementation. Under such conditions, clients are not primarily cost-driven in their procurement decisions, and contractors are not solely profit-oriented in their bidding strategies, although cost control remains an important consideration.

However, this situation represents a special case. If circular construction is to be implemented as a daily business practice, the relationship between value creation and value capture becomes critical. For instance, when construction contractors' understanding of client requirements is misaligned, this can result in cost overruns and delays in project delivery. From the contractor's perspective, two aspects are particularly important: first, the ability to control costs; and second, the ability to understand clients' requirements related to circularity or sustainability and to meet these requirements while maintaining cost efficiency. Only under these conditions can contractors secure payments from clients and ultimately realize economic value capture. For instance, how different forms of value, especially economic value are negotiated, protected and realized in project-based settings.

Therefore, future research should investigate more circular initiatives (e.g. reuse of building components or materials), the key determinants that influence value capture in circular construction projects.

In particular, future research could investigate which client requirements are perceived as non-negotiable and which can be subject to collaboration and compromise in the implementation of circular practices. Such an understanding would help clarify how contractors prioritize and manage client expectations while exploring opportunities for economic value capture in projects with circular practices.

Second proposition

Although the construction industry is fundamentally project-based, it also operates at an organizational level, that is, the level of the company. When implementing business models, companies follow market-oriented strategies and employ tactical actions to maximize value creation and value capture (Reim, 2018). From this perspective, future research should focus on developing implementation frameworks for circular business models at the organizational level within construction companies.

From a organizational level perspective, a key research question concerns how circular business models can be implemented in practice beyond individual projects. This represents a shift from studying the mechanisms of circular business models in the construction projects toward examining their application in organizational contexts. For example, when a construction company, or a specific business unit within the company, implements a circular business model, what types of risks may arise? To what extent the implementation of CBMs affects existing organizational processes or BM remains an important yet underexplored issue. This aspect has been discussed by (Geissdoerfer et al., 2020) in their work on circular business model innovation; however, it has received limited attention in the construction industry, particularly from an organizational perspective.

Furthermore, to ensure the effective realization of value creation and value capture mechanisms, it is necessary to understand which tactical actions construction companies need to adopt, what organizational capabilities are required, and how such capabilities can be developed over time. Addressing these questions would elevate research on circular business models from project-level mechanism exploration to organizational level implementation. Also, construction companies often operate through different business units that are responsible for distinct project types, such as infrastructure, and building projects. To enhance the feasibility of the research, future studies will focus on a single project type. While research on the implementation of circular practices in building projects is relatively well established compared to infrastructure projects (Ossio et al., 2023), the role of construction in supporting industrial transition remains underexplored.

Industrial transformation has been recognized as having a positive impact on reducing carbon emissions and fostering more sustainable developments. Construction projects that serve industrial transformation-such as factories and manufacturing facilities constitute a critical enabler of this transition. However, these types of projects have received limited attention in the literature. Consequently, investigating how construction companies implement CBMs in response to demands of industrial transition represents a promising and relevant direction for future research.

Third proposition

When implementing circular business models at the organizational level or circular construction practices at the project level, technologies that enable business model experimentation under conditions of limited cost and controlled risk may be of value to construction companies. Digital technologies, specifically agent-based simulation, have been shown to play an important role in business model experimentation (Lange et al., 2021). However, within the construction industry, the application of agent-based simulation for modeling and testing circular business models remains limited.

In circular construction projects, factors such as material flows and coordination among project participants significantly influence project outcomes. An important question for future research may be how and to what extent agent-based simulation can help construction companies improve the predictability of outcomes before implementing circular business models in practice. Such simulations may need to know who "agents" are (e.g. contractor, clients, consultants and suppliers), how many agents we have in a context (numbers) and their relationships, as well as external conditions (e.g. project processes, material flows, cost of materials, capacities for storge) which can support risk control, strategic decision-making, and even bidding processes. Investigating the applicability and limitations of agent-based simulation in this context represents a promising research direction for advancing the implementation of circular business models for construction companies.

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